Agenda
Public Works and Parks Committee Regular Meeting
June 1, 2026 | 5:30 PM

Public Works Wastewater Treatment Plant
26729 98th Dr. NW
Stanwood, WA 98292

This meeting will be conducted in person at the City of Stanwood Public Works Wastewater Treatment Plant, 26729 98th Dr. NW, Stanwood, WA 98292
https://www.stanwoodwa.org.

1. **Call to Order**
2. **New Business**
   a. General Sewer Plan
3. **Committee Comments**
4. **Staff Comments**
5. **Adjourn**

City of Stanwood
Public Works and Parks
Committee Staff Report

Item Number:	2.a.
Date:	June 1, 2026
Subject:	General Sewer Plan
Contact Person:	Alan Lytton, City Engineer
Attachments:	1. 2026 - GSP Agency Review_2026-01-30 (1)

ISSUE

The updated General Sewer Plan for the Stanwood provides a long-range strategy for maintaining and expanding the City's sewer collection and wastewater treatment system through 2044. The plan evaluates existing infrastructure, projected growth, regulatory requirements, system deficiencies, and financial impacts associated with future improvements.

The City's sewer utility currently includes:

- approximately 34 miles of gravity sewer main,
- 8 lift stations
- The sewer system currently serves approximately 2,347 sewer connections with an average annual wastewater flow of approximately 0.58 MGD (million gallons per day).
- The City's WWTP currently operates under a National Pollutant Discharge Elimination System (NPDES) permit with a maximum monthly average flow capacity of 1.5 MGD.
- Current projections indicate the City will reach approximately:
    - 85% of permitted treatment capacity by 2035, and
    - 107% of permitted capacity by 2044.

Infiltration and Inflow (I/I)

The report identifies infiltration and inflow (I/I) as an ongoing issue during major rain events.

During a February 2020 storm event, the system experienced flows equivalent to 289 gallons per capita per day, exceeding the EPA guideline threshold of 275 gpcd for inflow.

Dry weather infiltration rates, however, remained below EPA concern thresholds.

The Capital Improvement Plan includes an inflow and infiltration study to further evaluate and reduce wet weather impacts.

The General Sewer Plan concludes that the City's sewer utility is currently functioning adequately but will require substantial long-term investment to accommodate projected growth, maintain regulatory compliance, address aging infrastructure, and expand wastewater treatment capacity before existing facilities exceed permitted limits.

FINAL JANUARY 2026

City of Stanwood

GENERAL SEWER PLAN

PREPARED BY RH2 ENGINEERING

Zach Schrempp, PE, Project Manager

City of Stanwood
General Sewer Plan

FINAL
JANUARY 2026

Mayor
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City Council
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Earl Cowan
Darren Robb
Robert 'Chili' Hicks
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Andreena Bergman
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CERTIFICATION

This General Sewer Plan for the City of Stanwood was prepared under the direction of the following professional engineers registered in the State of Washington.

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Dan Mahlum, PE

01/30/2026

Zachary W. Schrempp

Zach Schrempp, PE

01/30/2026

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Appendix I – Stanwood Wastewater Treatment Plant Nitrogen Optimization Plan
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E | EXECUTIVE SUMMARY

PURPOSE OF THE PLAN

The City of Stanwood's (City) sewer system is a major infrastructure, most of which is invisible to the customers it serves. The sewer system requires qualified staff to operate and maintain an ongoing capital improvement program to replace old components to meet the requirements mandated by federal and state laws. The primary purpose of the City's General Sewer Plan is to identify and schedule sewer system improvements that correct existing deficiencies and ensure a safe and reliable sewer system for current and future customers.

SUMMARY OF KEY ELEMENTS

Sewer Service Area, Land Use, and Population

The City limit boundary encompasses approximately 2.9 square miles. The City's planned sewer service area is the same as the City's Urban Growth Area (UGA) boundary, which encompasses 3.5 square miles. Approximately 60 percent of the lands within the current City limits are designated for residential use, approximately 6 percent are designated for mixed use, approximately 4 percent are designated for commercial use, approximately 12 percent are designated for industrial use, and approximately 15 percent are designated for public facilities. The remaining land within the City limits is non-designated right-of-way or other City properties located outside the City's UGA. **Table ES-1** presents the land uses within the City limits and UGA boundary. The City's 2020 population was 7,705 and is expected to grow to 13,180 in 2044.

Table ES-1

Land Use – City Limits and Unincorporated UGA

Land Use Type	City Limits	Unincorporated UGA
Residential[1]	59.5%	65.2%
Mixed Use	5.9%	0.0%
Commercial[2]	3.8%	0.7%
Industrial[3]	11.8%	31.1%
Public Facility[4]	14.7%	0.1%
Non-Designated[5]	4.3%	3.0%
Total	**100%**	**100%**

1. Residential land use includes all residential land use types and traditional neighborhood land use.
2. Commercial land use includes general commercial and neighborhood business land uses.
3. Industrial land use includes both planned and general industrial land uses.
4. Public facility land use includes public facility, as well as parks and open space land use types.
5. Non-designated land uses include non-designated rights-of-way and City water facility property located outside of the UGA boundary.

Existing Facilities and Discharge Regulations

The sewer system is made up of a wastewater treatment plant (WWTP), 8 lift stations, approximately 34 miles of sewer piping, and approximately 1 mile of force main. A summary of the sewer system characteristics is provided in **Table ES-2**. **Chapter 2** describes the City's gravity collection and conveyance system, lift station, and general WWTP characteristics.

Table ES-2

2020 Sewer System Summary

Description	Data
Population (City, 2020)	7,705
Sewer Planning Area (acres)	2,218
Total Connections	2,347
Number of Persons per Household	2.72
Average Gallons per Capita per Day	52
Average Annual Flow (MGD)	0.58
Maximum Month Average Flow (MGD)	0.85
Maximum Day Flow (MGD)	2.18
Number of Lift Stations	8
Total Length of Sewer Force Main (miles)	1.2
Total Length of Sewer Gravity Main (miles)	34.2

Gravity Sewer Collection Piping

The City's existing sewer service area is comprised of five major drainage basins. More than 34 miles of sewer piping ranging in size from 6 to 30 inches serves the sewer system customers. As shown in **Table ES-3**, most of the sewer pipe (approximately 77 percent) within the sewer service area is 8-inch-diameter pipe.

Table ES-3

Gravity Sewer Piping Inventory – Diameter

Diameter (Inches)	Length (Feet)	Length (Miles)	% of Total
6	2,578	0.5	1.4%
8	138,432	26.2	76.7%
10	5,000	0.9	2.8%
12	12,240	2.3	6.8%
14	3,669	0.7	2.0%
15	13,728	2.6	7.6%
18	1,155	0.2	0.6%
20	272	0.1	0.2%
24	185	0.0	0.1%
27	3,191	0.6	1.8%
30	123	0.0	0.1%
Total	**180,573**	**34.2**	**100%**

Lift Stations

The City currently owns, operates, and maintains eight wastewater lift stations. The characteristics of each lift station are presented in **Table ES-4**.

Table ES-4

Lift Station Characteristics

	Lift Station						Pumps			
Lift Station	Year Constructed	Force Main Dia. (in)	Force Main Length (ft)	No. of Pumps	Configuration	Manufacturer	hp	TDH (ft)	Design Capacity (gpm)	Firm Capacity (gpm)
Main	1999	16	628	4	Wet well/Dry well	ITT-Flygt	20	50	1,120 1,120 1,120 1,120	3,700
Pioneer Hills	1999	6	1,673	2	Self-priming	Gorman-Rupp	20	72	500 500	470
Copper Station	2005	6	1,598	2	Submersible	Wemco	20	137	300 300	300
Cedarhome	1997	6	1,378	2	Self-priming	Gorman-Rupp	20	76	345 345	333
Mineral Point	2018	4	798	2	Submersible	ITT-Flygt	4	42	170 170	170
Lindstrom Development	2007 [1]	4	388	2	Self-priming	Gorman-Rupp	7.5	45	160 160	198
Taylor's Landing	2001	4	247	2	Self-priming	Gorman-Rupp	7.5	52	150 150	150
Creekside	2021	4	406	2	Submersible	Wilo	3	35	125	125

1 = City took ownership of lift station in 2007.

gpm = gallons per minute

Wastewater Treatment and Disposal Facilities

The City's original WWTP was constructed in 1963. In 1973, the plant was upgraded to include an effluent chlorination system and a propeller flow meter. In the mid-1970s, the four primary lagoons were decommissioned due to the decreased biochemical oxygen demand (BOD) loads from the industrial source, Twin City Foods.

The City upgraded the WWTP in 1996 to include the conversion of an existing 1.25-acre lagoon into a complete-mix aerated lagoon with five 15 horsepower floating, high-speed surface aerators, installation of an effluent baffle for the 35-acre facultative lagoon, modifications to the chlorination building, and the addition of chlorine contact tank drain pumps. In addition, the wastewater flow from the headworks was redirected from the 35-acre facultative lagoon to the 1.25-acre complete-mix lagoon. In 2004, the plant was upgraded from a capacity of 0.25 million gallons per day (MGD) to a 1.5 MGD capacity. These upgrades included construction of the headworks, oxidation ditches, secondary clarifiers, an ultraviolet disinfection system, a scum system, a plant water system, a yard pump station, sludge stabilization ponds, and decant pump stations. In 2013, the WWTP was upgraded with a sodium hypochlorite injection system that feeds into the washdown water line and injects into the return activated sludge piping.

NPDES Regulations

The City has a National Pollutant Discharge Elimination System (NPDES) waste discharge permit issued by the Washington State Department of Ecology (Ecology). The permit includes effluent limits for treated water discharged to the City's Old Stillaguamish River outfall. In addition, the permit includes facility flow and loading design criteria for the WWTP as shown in **Table ES-5**.

Table ES-5

WWTP Permitted Flow and Loading Design Criteria

Parameter	Design Quantity
Maximum Month Design Flow (MMDF)	1.5 MGD
BOD_5 Influent Loading for Maximum Month	4,100 ppd
TSS Influent Loading for Maximum Month	4,100 ppd

BOD_5 = 5-day Biochemical Oxygen Demand

ppd = pounds per day

TSS = total suspended solids

Existing Wastewater Characteristics and Flows

Flow and load values in a sewer system are used to determine the size of gravity collection piping, lift station facilities, and force main piping, and the size and type of treatment facilities needed. This information also is used to develop the sewer service provider's NPDES Permit, which is required by Ecology. **Chapter 4** presents the historical and projected WWTP flow and loading rates.

The total influent flow to the WWTP is made up of untreated flow primarily from residential customers but also includes flow from several commercial, industrial, public facility, and other connections. The historical average annual flow (AAF), maximum month average flow (MMF),

maximum day flow (MDF), and peak hour flow (PHF) (including infiltration and inflow) are summarized in **Table ES-6**.

Table ES-6

Historical WWTP Influent Flow Summary

Year	AAF (MGD)	MMF (MGD)	MDF (MGD)	PHF (MGD)	Percent of NPDES Permit Max. Month Limit[1]	Peaking Factors		
						MMF/AAF	MDF/AAF	PHF/AAF
2016	0.55	0.76	1.38	--	51%	1.37	2.50	--
2017	0.56	0.78	1.15	--	52%	1.40	2.06	--
2018	0.58	0.93	1.90	--	62%	1.60	3.26	--
2019	0.52	0.64	1.03	2.02	43%	1.22	1.96	3.86
2020	0.58	0.85	2.18	2.30	57%	1.47	3.77	3.98
2021	0.60	0.95	1.67	2.28	63%	1.58	2.77	3.79
2022	0.59	0.80	1.54	--	53%	1.35	2.60	--
2016 to 2022 Average	**0.57**	**0.82**	**1.55**	**2.20**	**--**	**1.43**	**2.70**	**3.88**
2016 to 2022 Max.	**0.60**	**0.95**	**2.18**	**2.30**	**--**	**1.60**	**3.77**	**3.98**

1 = The City's WWTP is permitted for a maximum month average influent flow of 1.5 MGD.

Table ES-7 summarizes the historical 5-day biochemical oxygen demand (BOD_5).

Table ES-7

Historical WWTP Influent BOD_5 Loading Summary

Year	Sewer System Population	Sewer System Employment	Average Annual BOD_5 (mg/L)	Average Annual BOD_5 (ppd)	Max. Month BOD_5 (mg/L)	Max. Month BOD_5 (ppd)	Percent of NPDES Permit Max. Month Limit[1]	BOD_5 Max. Month Average/Average Annual Peaking Factor
2016	6,635	3,760	292	1,310	389	1,569	38%	1.20
2017	6,785	3,811	284	1,276	365	1,549	38%	1.21
2018	6,835	3,863	357	1,641	461	2,209	54%	1.35
2019	7,020	3,916	368	1,608	434	2,022	49%	1.26
2020	7,540	3,970	326	1,559	428	1,914	47%	1.23
2021	7,734	4,068	358	1,704	462	2,306	56%	1.35
2022	7,927	4,162	442	2,050	598	2,301	56%	1.12
2016 to 2022 Average	**--**	**--**	**347**	**1,592**	**448**	**1,981**	**--**	**1.25**
2016 to 2022 Max.	**--**	**--**	**442**	**2,050**	**598**	**2,306**	**--**	**1.35**

1 = The City's WWTP is permitted for a maximum month BOD_5 influent loading of 4,100 ppd.

mg/L = milligrams per liter

Infiltration and Inflow

A sanitary sewer system must be able to carry the domestic wastewater generated by utility customers and the extraneous infiltration and inflow (I/I) that is a part of every sewer collection system. In May 1985, the U.S. Environmental Protection Agency (EPA) published a brochure titled *Infiltration/Inflow, I/I Analysis and Project Certification* that developed guidelines to help determine what amount of I/I is considered "excessive" and what amount can be cost-effectively removed.

Inflow is considered to be non-excessive if the average daily flow during periods of heavy rainfall or spring thaw does not exceed 275 gallons per capita day (gpcd). The peak recorded flow rate in

recent years of record per the City's Discharge Monitoring Reports (DMRs) was 2.18 MGD, which occurred on February 6, 2020. The City experienced a 6-day period of rain that resulted in more than 1.55 inches of rainfall. When divided by the number of residential customers in 2020, this peak inflow event equates to a flow rate of 289 gpcd, which is above the EPA maximum of 275 gpcd.

Infiltration is considered to be non-excessive if the average daily flow during periods of dry weather does not exceed 120 gpcd. The peak dry weather flow period in recent years of record for the City was the 7-day period from December 23 to December 29, 2020. This period was preceded by 4 days of rain and yielded an average flow rate of 0.70 MGD. When divided by the 2020 residential population, this equates to 93 gpcd, which is less than the EPA threshold of 120 gpcd.

Peaking Factors

Projected flows are used to analyze how well the existing sewer system will perform in the future and determine improvements required to maintain or improve system function. Peaking factors are needed to establish projected flow scenarios for the sewer system, which are then applied to future flow rates. **Table ES-8** shows the existing flow rates and peaking factors as measured at the City's WWTP from 2016 to 2022.

Table ES-8

Summary of Peaking Factors Utilized for Sewer System Flow and Loading Projections

Flow	
MMF/AAF	1.60
MDF/AAF	3.77
PHF/AAF	4.00
BOD_5	
Max. Month Average/Average Annual	1.35
TSS	
Max. Month Average/Average Annual	1.57

Projected Wastewater Flow

Table ES-9 presents the existing and projected flow rates for the WWTP. The City's current NPDES Permit allows a maximum monthly average influent flow of 1.5 MGD at the WWTP. As shown in **Table ES-9**, the flow capacity of the WWTP will be exceeded within the 20-year planning period. At 85-percent capacity, WWTP upgrade planning will need to begin. The City's Capital Improvement Plan (CIP) includes the planning, engineering, and construction of the wastewater treatment plant upgrades.

Table ES-9

Projected Sewer System Average Annual, Maximum Month, and Peak Hour Flow Rates

	Year	Sewer Service Area Residential Population	Sewer Service Area Employment Population	AAF (MGD)	MMF (MGD)	PHF (MGD)	Percent of NPDES Permit Max. Month Limit
Existing	**2020**	**7,540**	**3,970**	**0.58**	**0.85**	**2.30**	**57%**
	2021	7,734	4,068	0.60	0.95	2.28	63%
	2022	7,927	4,162	0.59	0.80	--	53%
Projected	2023	8,119	4,252	0.59	0.94	2.34	62%
	2024	8,311	4,340	0.60	0.96	2.40	64%
	2025	8,505	4,428	0.62	0.99	2.47	66%
	2026	8,702	4,515	0.63	1.01	2.53	67%
	2027	8,901	4,604	0.65	1.04	2.60	69%
	2028	9,104	4,695	0.67	1.06	2.66	71%
	2029	9,312	4,788	0.68	1.09	2.73	73%
	2030	9,524	4,883	0.70	1.12	2.80	75%
	2031	9,741	4,982	0.72	1.15	2.87	77%
	2032	9,963	5,084	0.74	1.18	2.95	78%
	2033	10,191	5,191	0.76	1.21	3.02	80%
	2034 (+10 Years)	**10,426**	**5,302**	**0.77**	**1.24**	**3.10**	**83%**
	2035	10,666	5,418	0.79	1.27	3.18	85%
	2036	10,914	5,540	0.82	1.30	3.26	87%
	2037	11,168	5,668	0.84	1.34	3.35	89%
	2038	11,430	5,802	0.86	1.37	3.43	91%
	2039	11,700	5,944	0.88	1.41	3.53	94%
	2040	11,978	6,093	0.90	1.45	3.62	96%
	2041	12,264	6,250	0.93	1.49	3.72	99%
	2042	12,560	6,417	0.95	1.53	3.82	102%
	2043	12,865	6,593	0.98	1.57	3.92	105%
	2044 (+20 Years)	**13,180**	**6,780**	**1.01**	**1.61**	**4.03**	**107%**
	2074 (Est. Buildout)	**30,498**	**24,950**	**2.76**	**4.42**	**11.1**	**294%**

Projected Wastewater Quality

Projected BOD_5 and TSS loadings are presented in **Tables ES-10** and **ES-11**. As shown in the tables, 85 percent of the loading capacity at the WWTP for BOD_5 and TSS will be exceeded within the 20-year planning period. The City's CIP includes the planning, engineering, and construction of the WWTP upgrades.

Table ES-10

Projected Wastewater Treatment Plant BOD_5 Loadings

	Year	Sewer Service Area Residential Population	Sewer Service Area Employment Population	Annual Average BOD_5 (ppd)	Maximum Month BOD_5 (ppd)	Percent of NPDES Permit Max. Month Limit
Existing	**2020**	**7,540**	**3,970**	**1,559**	**1,914**	**47%**
	2021	7,734	4,068	1,704	2,306	56%
	2022	7,927	4,162	2,050	2,301	56%
Projected	2023	8,119	4,252	1,753	2,372	58%
	2024	8,311	4,340	1,794	2,428	59%
	2025	8,505	4,428	1,836	2,484	61%
	2026	8,702	4,515	1,878	2,541	62%
	2027	8,901	4,604	1,920	2,599	63%
	2028	9,104	4,695	1,964	2,657	65%
	2029	9,312	4,788	2,008	2,717	66%
	2030	9,524	4,883	2,053	2,778	68%
	2031	9,741	4,982	2,100	2,841	69%
	2032	9,963	5,084	2,147	2,905	71%
	2033	10,191	5,191	2,196	2,972	72%
	2034 (+10 Years)	**10,426**	**5,302**	**2,246**	**3,039**	**74%**
	2035	10,666	5,418	2,298	3,109	76%
	2036	10,914	5,540	2,351	3,181	78%
	2037	11,168	5,668	2,406	3,255	79%
	2038	11,430	5,802	2,462	3,332	81%
	2039	11,700	5,944	2,520	3,410	83%
	2040	11,978	6,093	2,580	3,492	85%
	2041	12,264	6,250	2,642	3,576	87%
	2042	12,560	6,417	2,706	3,662	89%
	2043	12,865	6,593	2,773	3,752	92%
	2044 (+20 Years)	**13,180**	**6,780**	**2,841**	**3,845**	**94%**
	2074 (Est. Buildout)	**30,498**	**24,950**	**6,850**	**9,269**	**226%**

Table ES-11

Projected Wastewater Treatment Plant TSS Loadings

	Year	Sewer Service Area Residential Population	Sewer Service Area Employment Population	Annual Average TSS (ppd)	Maximum Month TSS (ppd)	Percent of NPDES Permit Max. Month Limit
Existing	**2020**	**7,540**	**3,970**	**1,562**	**2,725**	**66%**
	2021	7,734	4,068	1,339	2,099	51%
	2022	7,927	4,162	1,407	1,914	47%
Projected	2023	8,119	4,252	1,447	2,268	55%
	2024	8,311	4,340	1,489	2,333	57%
	2025	8,505	4,428	1,530	2,398	58%
	2026	8,702	4,515	1,572	2,463	60%
	2027	8,901	4,604	1,614	2,530	62%
	2028	9,104	4,695	1,658	2,598	63%
	2029	9,312	4,788	1,702	2,667	65%
	2030	9,524	4,883	1,747	2,738	67%
	2031	9,741	4,982	1,794	2,811	69%
	2032	9,963	5,084	1,841	2,886	70%
	2033	10,191	5,191	1,890	2,962	72%
	2034 (+10 Years)	**10,426**	**5,302**	**1,940**	**3,041**	**74%**
	2035	10,666	5,418	1,992	3,122	76%
	2036	10,914	5,540	2,045	3,205	78%
	2037	11,168	5,668	2,100	3,291	80%
	2038	11,430	5,802	2,156	3,379	82%
	2039	11,700	5,944	2,214	3,470	85%
	2040	11,978	6,093	2,274	3,564	87%
	2041	12,264	6,250	2,336	3,661	89%
	2042	12,560	6,417	2,401	3,762	92%
	2043	12,865	6,593	2,467	3,866	94%
	2044 (+20 Years)	**13,180**	**6,780**	**2,536**	**3,973**	**97%**
	2074 (Est. Buildout)	**30,498**	**24,950**	**6,544**	**10,256**	**250%**

Operation and Maintenance

Chapter 9 addresses the operation and maintenance (O&M) staff for the City's WWTP and collection system. The current staff includes management personnel, supervisory personnel, operators, technicians, and office personnel engaged in the activities necessary for the continuous safe operation and maintenance of a sewer system and sewer utility. Currently, there are five full-time employees for the WWTP and collection system.

Summary of Improvements

A general description of improvements and an overview of the deficiencies they will resolve are presented in **Chapter 10**. The CIP numbers for sewer main improvements have an "SM" prefix (example: SM1). The CIP numbers for lift station projects have an "LS" prefix (example: LS1). The CIP numbers for miscellaneous collection system projects have an "M" prefix (example: M1). The CIP numbers for the WWTP improvements have an "F" prefix (example: F1).

Some cost estimates for collection system improvement projects were provided by the City. For other projects, the costs for the proposed improvements were estimated based on costs of similar, recently constructed sewer projects in the City and around the Puget Sound area and are presented in 2024 dollars.

Project costs for the proposed improvements to the WWTP were estimated based on a breakdown of the civil, structural, mechanical, and electrical tasks anticipated for each project (except CIP F1 and CIP F7). The cost estimates were made in 2024 dollars. Cost estimates for civil tasks were considered only for CIP F9 and CIP F10 and were estimated based on unit costs from recent projects in the region, scaled to the volumes and areas associated with the site work for these projects. Cost estimates for structural tasks were developed based on unit prices from recent projects, the approximate volumes of concrete to be removed and/or added, and the approximate areas of new buildings and metal structures. Cost estimates for mechanical tasks were developed based on recent budget proposals for proposed equipment, and approximations of the costs associated with demolition of previous equipment and ancillary work to integrate the new equipment. Cost estimates for electrical tasks were based on the costs of similar, recent projects in the region and the types and amounts of electrical upgrades to accommodate the proposed equipment associated with each project.

Because the cost estimates shown in **Table ES-12** are presented in 2024 dollars, it is recommended that future costs be adjusted to account for the effects of inflation and changing construction market conditions at the actual time of project implementation.

Table ES-12

Proposed Capital Improvements Plan Implementation Schedule

CIP No.	Description	Estimated Total Project Cost (2024 $)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035-2044
	Sewer Main Improvements												
SM1	72nd Ave Sewer Main Replacement	$ 1,925,000	$1,925K										
SM2	Twin City Mile Project - 271st Camano Street to 94th Main Replacement	$ 1,900,000	$200K	$850K	$850K								
SM3	Cedarhome Dr Sewer Main Replacement	$ 1,285,000	$1,285K										
SM4	68th Sewer Main Replacement	$ 1,000,000	$1,000K										
SM5	SR 532 and Pioneer Highway Sewer Crossing	$ 800,000	$800K										
SM6	99th/272nd Pl Main Replacement	$ 775,000				$110K	$665K						
SM7	274th Sewer Main Replacement	$ 700,000	$700K										
SM8	Pioneer Highway and SR532 Sewer Main	$ 600,000	$600K										
SM9	Cedarhome Collection System	$ 275,000	$275K										
SM10	272nd St/76th Dr Main Replacement	$ 150,000	$150K										
SM11	Pioneer Highway (Taylor's Landing Vicinity) Gravity Main Replacement - Future	$ 900,000							$450K	$450K			
SM12	70th Avenue NW (South of 278th Street NW) Gravity Main Replacement	$ 300,000									$150K	$150K	
SM13	Sewer Drainage Basin 1 Pipe Replacement Program	$ 1,400,000							$100K	$100K	$100K	$100K	$1,000K
	Lift Station Improvements												
LS1	Pioneer Hills Lift Station Upgrades	$ 350,000	$350K										
LS2	Decommission Church Creek Lift Station	$ 80,000	$40K	$40K									
LS3	Taylor's Landing Lift Station Upgrades	$ 200,000							$200K				
LS4	Copper Lift Station Upgrades	$ 100,000							$100K				
LS5	Decommission Cedarhome Lift Station	$ 80,000							$80K				
	Miscellaneous Collection System Improvements												
M1	General Sewer Plan Update	$ 450,000								$150K	$150K	$150K	
M2	Sewer Rate Study	$ 45,000					$45K						
M3	Sewer Project Inventory	$ 225,000	$225K										
M4	GIS Equipment and Setup (Sewer)	$ 200,000	$100K	$100K									
M5	Inflow and Infiltration Study	$ 125,000				$125K							
	Wastewater Treatment Plant Improvements												
F1	Miscellaneous Improvements	$ 1,400,000							$100K	$100K	$100K	$100K	$1,000K
F2	Headworks Screen Replacement	$ 1,365,000			$228K	$1,137K							
F3	Existing Secondary Clarifier Nos. 1 and 2 Improvements	$ 2,332,000					$390K	$1,942K					
F4	UV System Replacement and Expansion	$ 907,000					$182K	$725K					
F5	Generator Replacement	$ 1,211,000					$202K	$1,009K					
F6	Telemetry Improvements	$ 104,000			$104K								
F7	Biosolids Removal and Utilization	$ 3,400,000	$1,400K					$2,000K					
F8	Grit Removal Unit and Classifier Installation	$ 2,044,000			$409K	$1,635K							
F9	Solids Handling System Upgrades	$ 13,067,000	$1,100K	$1,597K	$6,597K	$8,770K	$8,770K						
F10	Activated Sludge Process - Capacity and Nutrient Enhancements	$ 13,767,000											
Total Estimated Cost of Improvements		**$ 53,462,000**	**$10,150K**	**$2,587K**	**$8,188K**	**$11,777K**	**$10,254K**	**$5,676K**	**$1,030K**	**$800K**	**$500K**	**$500K**	**$2,000K**

Financial Summary

The objective of the financial analysis is to identify the total cost of providing sewer service and provide a financial program that allows the sewer utility to remain financially viable during the execution of its short-term and long-term CIP. Comparative statements of the sewer fund resources and uses for the previous 6 years are summarized in **Table ES-13**.

Table ES-13

Summary of Historical Fund Resources and Uses Arising from Cash Transactions

	2018	2019	2020	2021	2022	2023
Beginning Cash and Investments						
Beginning Cash and Investments	$ -	$ -	$ 5,338,431	$ 5,171,833	$ 8,119,856	$ 7,417,547
Reserved	476,990	484,225	-	-	-	-
Unreserved	4,133,842	4,836,993	-	-	-	-
Net Adjustments	28,627	2,453	-	-	-	-
Revenues						
Taxes	$ -	$ -	$ -	$ -	$ -	$ -
Licenses and Permits	-	-	-	-	-	-
Intergovernmental Revenues	100	-	-	-	-	57,392
Charges for Goods and Services	2,131,724	2,214,435	2,348,538	2,689,165	3,017,303	3,198,837
Fines and Penalties	13,215	11,420	2,522	16	19,169	15,772
Miscellaneous Revenues	401,203	456,443	452,790	436,548	185,047	259,002
Total Operating Revenues:	$ 2,546,242	$ 2,682,298	$ 2,803,850	$ 3,125,729	$ 3,221,519	$ 3,531,003
Expenditures						
General Government	$ -	$ -	$ -	$ -	$ -	$ -
Public Safety	-	-	-	-	-	-
Utilities	1,043,980	1,042,969	1,196,533	1,330,856	1,562,096	1,855,384
Transportation	-	-	-	-	-	-
Natural and Economic Environment	-	-	-	-	-	-
Social Services	-	-	-	-	-	-
Culture and Recreation	-	-	-	-	-	-
Total Operating Expenses:	$ 1,043,980	$ 1,042,969	$ 1,196,533	$ 1,330,856	$ 1,562,096	$ 1,855,384
Excess (Deficiency) Revenues over Expenditures:	**$ 1,502,262**	**$ 1,639,329**	**$ 1,607,317**	**$ 1,794,873**	**$ 1,659,423**	**$ 1,675,619**
Other Increases in Fund Resources						
Debt Proceeds	$ -	$ -	$ -	$ 4,569,635	$ -	$ -
Transfers-In	3,077	-	-	-	163,135	-
Special or Extraordinary Items	-	-	-	-	-	-
Other Resources	80,000	33,140	-	-	47,338	32,842
Total Other Increases in Fund Resources	$ 83,077	$ 33,140	$ -	$ 4,569,635	$ 210,473	$ 32,842
Other Decreases in Fund Resources						
Capital Expenditures	$ 326,818	$ 1,079,028	$ 944,435	$ 2,572,481	$ 1,752,860	$ 1,288,074
Debt Service	576,762	576,227	575,692	844,004	819,346	856,982
Transfers-Out	-	-	221,000	-	-	-
Special or Extraordinary Items	-	-	-	-	-	-
Other Uses	-	2,453	32,786	-	-	45,463
Total Other Decreases in Fund Resources	$ 903,580	$ 1,657,708	$ 1,773,913	$ 3,416,485	$ 2,572,206	$ 2,190,519
Increase (Decrease) in Cash and Investments:	**$ 681,759**	**$ 14,761**	**$ (166,596)**	**$ 2,948,023**	**$ (702,310)**	**$ (482,058)**
Ending Cash and Investments						
Nonspendable	$ -	$ -	$ -	$ -	$ -	$ -
Restricted	-	-	500,035	-	45,463	32,842
Committed	-	-	-	-	-	-
Assigned	-	-	4,671,798	8,119,856	7,372,084	6,902,646
Unassigned	-	-	-	-	-	-
Reserved	484,225	492,711	-	-	-	-
Unreserved	4,836,993	4,845,720	-	-	-	-
Total Ending Cash and Investment	**$ 5,321,218**	**$ 5,338,431**	**$ 5,171,833**	**$ 8,119,856**	**$ 7,417,547**	**$ 6,935,488**

Preliminary

Table ES-13 shows the following findings and trends.

- The City's sewer charges for services increased steadily from about $2.1 million in 2018 to $3.2 million in 2023. The average annual compounding increase was 8.46 percent per year.

Operating expenditures increased by approximately $0.8 million over the 6 years, for an average annual compounding increase of 12.19 percent. Total revenues were approximately two times the operating expenses, allowing net income (revenues minus expenditures) to grow from $1.5 million in 2018 to $1.7 million in 2023.

- The O&M Coverage Ratio (total operating revenue divided by total operating expenses) began in 2018 at 244 percent and fell to 190 percent by 2023. However, a ratio equal to or greater than 100 percent shows that operating revenue will successfully cover operating expenses.
- Net Operating Income as a percentage of Operating Revenue in 2018 was 59 percent and decreased to 47 percent by 2023.
- The Debt Service Coverage Ratio, calculated by dividing cash operating income (revenue less expenses before depreciation) by annual revenue bond expenses, for all outstanding debt ended 2018 at 2.60, decreasing to 1.96 by 2023 as the City took on more debt. The fact that this ratio has sustained levels higher than the target of 1.25 indicates a stable capacity for new debt.

To properly evaluate future capital funding needs, the CIP was escalated by 5 percent annually to the year of planned spending. The CIP identifies $60.9 million in escalated project costs over the 10-year planning period from 2025 to 2034. The 20-year period through 2044 includes $63.3 million of total escalated project costs. A summary is shown in **Table ES-14**.

Table ES-14

Budget and 10-Year and 20-Year CIPs

Year	2024 $	Escalated $
2025	$ 10,280,000	$ 10,787,500
2026	2,720,900	2,986,068
2027	8,325,917	9,616,551
2028	11,919,055	14,457,072
2029	10,400,316	13,233,307
2030	5,826,706	7,757,088
2031	1,085,227	1,463,830
2032	709,884	972,484
2033	414,680	552,512
2034	419,621	576,844
Total	**$ 52,102,304**	**$ 62,403,256**
2035-2044	3,152,844	4,410,642
Total	**$ 55,255,149**	**$ 66,813,898**

Table ES-15 summarizes the annual revenue requirements for the 10-year planning period based on the forecast of revenues, expenditures, fund balances, and fiscal policies.

Table ES-15

Budget Year and 10-Year Financial Forecast

Revenue Requirement	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenues										
Rate Revenues Under Existing Rates	$ 3,691,481	$ 4,006,886	$ 4,183,877	$ 4,411,939	$ 4,635,085	$ 4,716,067	$ 4,829,776	$ 4,946,226	$ 5,065,485	$ 5,187,619
Non-Rate Revenues	54,948	91,948	51,124	53,959	56,744	58,286	59,947	61,809	63,635	65,521
Total Revenues	**$ 3,746,429**	**$ 4,098,833**	**$ 4,235,002**	**$ 4,465,897**	**$ 4,691,829**	**$ 4,774,353**	**$ 4,889,722**	**$ 5,008,035**	**$ 5,129,120**	**$ 5,253,139**
Expenses										
Cash Operating Expenses	$ 2,741,619	$ 2,800,858	$ 2,923,604	$ 3,037,397	$ 3,140,462	$ 3,246,799	$ 3,375,116	$ 3,496,749	$ 3,623,252	$ 3,754,840
Existing Debt Service	370,681	356,666	239,580	241,230	239,800	240,900	241,670	151,360	150,728	150,013
New Debt Service	205,189	423,258	423,258	1,591,134	1,686,694	1,931,062	2,442,837	2,442,837	2,442,837	2,442,837
Total Expenses	**$ 3,317,489**	**$ 3,580,781**	**$ 3,586,441**	**$ 4,869,761**	**$ 5,066,956**	**$ 5,418,760**	**$ 6,059,623**	**$ 6,090,946**	**$ 6,216,817**	**$ 6,347,690**
Net Surplus (Deficiency)	**$ 428,940**	**$ 518,052**	**$ 648,560**	**$ (403,864)**	**$ (375,127)**	**$ (644,408)**	**$ (1,169,901)**	**$ (1,082,910)**	**$ (1,087,697)**	**$ (1,094,550)**
Annual Rate Adjustment	**0.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**	**3.00%**	**3.00%**	**3.00%**	**3.00%**
Cumulative Annual Rate Adjustment	**0.00%**	**6.00%**	**12.36%**	**19.10%**	**26.25%**	**33.82%**	**37.84%**	**41.97%**	**46.23%**	**50.62%**
Rate Revenues After Rate Increase	$ 3,691,481	$ 4,227,264	$ 4,678,830	$ 5,229,903	$ 5,824,085	$ 6,281,391	$ 6,641,071	$ 7,005,230	$ 7,389,357	$ 7,794,547
Additional Taxes from Rate Increase	-	4,791	10,760	17,783	25,849	34,030	39,378	44,763	50,521	56,675
Net Cash Flow After Rate Increase	**$ 428,940**	**$ 733,640**	**$ 1,132,753**	**$ 396,318**	**$ 788,025**	**$ 886,887**	**$ 602,017**	**$ 931,330**	**$ 1,185,654**	**$ 1,455,703**
Coverage After Rate Increases	7.50	4.31	5.40	1.97	2.05	1.55	1.59	1.75	1.87	1.99

The existing sewer rate structure consists of a monthly fixed charge and a commodity charge per hundred cubic feet (ccf) billed to customers on a bi-monthly basis. The City's existing sewer rate structure is shown in **Table ES-16**.

Table ES-16

Existing Schedule of Rates

Base Charge (per acc. per month)	2025
Residential	
Individually Metered	$ 62.51
Master Metered (per unit)	62.51
Commercial	
Light Commercial	$ 62.51
Heavy Commercial	71.05
General Industrial	79.61
Commodity Charge (per ccf)	**2025**
Residential	
Individually Metered	$ 8.73
Master Metered	8.73
Commercial	
Light Commercial	$ 8.73
Heavy Commercial	10.16
General Industrial	11.58

Notes *:*

1. A 50% reduction applies to inactive customers

2. Nursing homes / child care accounts are billed per unit

3. Commodity charge applies to all usage above 6ccf per month

The financial forecast indicates the need for annual rate adjustments to satisfy the forecasted financial obligations. Sewer rates with a forecast increase for the 10-year planning period are shown in **Table ES-17**.

Table ES-17

Proposed Schedule of Rates

Base Charge (per acc. per month)	Existing	2026	2027	2028	2029	2030	2031	2032	2033	2034
Residential										
Individually Metered	$ 62.51	$ 66.26	$ 70.24	$ 74.45	$ 78.92	$ 83.66	$ 86.17	$ 88.76	$ 91.42	$ 94.16
Master Metered (per unit)	62.51	66.26	70.24	74.45	78.92	83.66	86.17	88.76	91.42	94.16
Commercial										
Light Commercial	$ 62.51	$ 66.26	$ 70.24	$ 74.45	$ 78.92	$ 83.66	$ 86.17	$ 88.76	$ 91.42	$ 94.16
Heavy Commercial	71.05	75.31	79.83	84.62	89.70	95.08	97.93	100.87	103.90	107.02
General Industrial	79.61	84.39	89.45	94.82	100.51	106.54	109.74	113.03	116.42	119.91
Commodity Charge (per ccf)	**Existing**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Residential										
Individually Metered	$ 8.73	$ 9.25	$ 9.81	$ 10.40	$ 11.02	$ 11.68	$ 12.03	$ 12.39	$ 12.76	$ 13.14
Master Metered	8.73	9.25	9.81	10.40	11.02	11.68	12.03	12.39	12.76	13.14
Commercial										
Light Commercial	$ 8.73	$ 9.25	$ 9.81	$ 10.40	$ 11.02	$ 11.68	$ 12.03	$ 12.39	$ 12.76	$ 13.14
Heavy Commercial	10.16	10.77	11.42	12.11	12.84	13.61	14.02	14.44	14.87	15.32
General Industrial	11.58	12.27	13.01	13.79	14.62	15.50	15.97	16.45	16.94	17.45

Notes *:*

1. A 50% reduction applies to inactive customers

2. Nursing homes / child care accounts are billed per unit

3. Commodity charge applies to all usage above 6ccf per month

1 | INTRODUCTION

SEWER SYSTEM OWNERSHIP AND MANAGEMENT

The City of Stanwood (City) is a municipal corporation that owns and operates a public sewer system within its corporate boundaries. Sewage collection, treatment, and disposal are provided through a conventional gravity collection system and a treatment facility, including ultraviolet disinfection, sludge stabilization ponds, and river discharge. Operation and management of the sewer system is provided by the Wastewater Division of the City's Public Works Department.

OVERVIEW OF EXISTING SYSTEM

The City limits encompass approximately 2.9 square miles, while the planned sewer service area is the same as the City's Urban Growth Area boundary, which encompasses 3.5 square miles. The City experienced an increase in growth from a population of 6,073 in 2009 to a population of 6,340 in 2013 (1.1 percent per year). The City has experienced a slightly increased rate of growth in population since 2013 to a 2020 population of 7,705 (2.8 percent per year), which is the base year for this General Sewer Plan (GSP). As of December 2020, the City provided service to approximately 2,347 customer connections within the City's sewer service area. The City's sewer system is comprised of a wastewater treatment plant, 8 lift stations, approximately 1 mile of force main, and approximately 34 miles of gravity sewer mains. A summary of sewer system data is provided in **Table 1-1**.

Table 1-1

2020 Sewer System Data

Description	Data
Population (City, 2020)	7,705
Sewer Planning Area (acres)	2,218
Total Connections	2,347
Number of Persons per Household	2.72
Average Gallons per Capita per Day	52
Average Annual Flow (MGD)	0.58
Maximum Month Average Flow (MGD)	0.85
Maximum Day Flow (MGD)	2.18
Number of Lift Stations	8
Total Length of Sewer Force Main (miles)	1.2
Total Length of Sewer Gravity Main (miles)	34.2

MGD = million gallons per day

AUTHORIZATION AND PURPOSE

In October 2021, the City authorized RH2 Engineering, Inc., to prepare a General Sewer Plan in accordance with Washington Administrative Code (WAC) 173-240-050. The previous GSP was prepared for the City in 2015. The purpose of this updated GSP is as follows:

- To update the City's GSP for consistency with the future population and employment growth projections from the City's Community Development Department.
- To evaluate existing sewer flow and loading data and project future flows and loadings.
- To analyze the existing sewer collection system to determine if it meets minimum requirements mandated by the Washington State Department of Ecology and the City's own policies and design criteria.
- To determine the overall reliability and vulnerability of the existing wastewater lift stations.
- To identify sewer collection system improvements that will resolve existing system deficiencies and accommodate future needs.
- To evaluate the existing treatment plant to determine if the facility meets the City's National Pollutant Discharge Elimination System (NPDES) Permit requirements.
- To identify treatment plant improvements that will resolve existing system deficiencies and accommodate future wastewater treatment needs.
- To prepare a schedule of improvements that meets the goals of the City's financial program.

RELATED PLANS AND STUDIES

As part of preparing this GSP, several plans and studies were examined, including the following:

- City of Stanwood *General Sewer Plan* (June 2015).
- City of Stanwood *Comprehensive Plan* (June 2015).

PROJECTS COMPLETED SINCE THE 2015 GSP

The City has undergone several projects since the previous GSP was prepared in 2015 and has implemented many of the recommended projects in the 2015 GSP, including the Main Lift Station rehabilitation and force main upgrades, and Pioneer Highway interceptor upgrades. **Table 1-2** provides a list of the projects that have been completed since the City's previous GSP.

Table 1-2

Projects Completed Since 2015

Project Description
272nd Street NW and 76th Drive NW Gravity Main Replacement (Partial)
Church Creek Collection System Construction
Cedarhome Collection System Construction
Main Lift Station (Lift Station 4) Force Main Upgrades
Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies
Upper Pioneer Highway Interceptor Existing Deficiencies
Pioneer Highway Interceptor Existing Deficiencies
Lower Pioneer Highway Interceptor Existing Deficiencies (Partial)
72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies (Partial)
Main Lift Station (Lift Station 4) Alternatives Analysis
Main Lift Station (Lift Station 4) Rehabilitation
Church Creek Loop NW Gravity Main Replacement
78th/Cecilia Way Sewer Replacement (2023)
79th Drive Sewer Replacement (2023)
Mineral Point Lift Station (2018)
Creekside Lift Station (2022)
I/I Study (2018)
Biosolids Removal (2017)

SUMMARY OF GSP CONTENTS

A brief summary of the content of the chapters in this GSP is as follows:

- **Chapter 1** introduces the reader to the City's sewer system, the objectives of the GSP, and the GSP's organization.
- **Chapter 2** presents the sewer service area, describes the existing sewer system, and presents discharge and disposal regulations.
- **Chapter 3** presents related plans, land use, and population characteristics.
- **Chapter 4** identifies existing wastewater flow and loading rates and projects future flow and loading rates.
- **Chapter 5** presents the City's operational policies and design criteria.
- **Chapter 6** discusses the sewer system analyses and existing system deficiencies.
- **Chapter 7** evaluates the wastewater treatment plant based on capacity and existing condition.
- **Chapter 8** presents the recommended wastewater treatment plant improvements.
- **Chapter 9** discusses the City's operations and maintenance program.
- **Chapter 10** presents the proposed sewer system improvements, their estimated costs, and an implementation schedule.

- **Chapter 11** summarizes the financial status of the sewer utility and presents a plan for funding the sewer improvements.

LIST OF ABBREVIATIONS

The abbreviations listed in **Table 1-3** are used throughout this GSP.

Table 1-3

Abbreviations

Abbreviations	Description
A	Amperes
AAF	average annual flow
AC	asbestos cement
AKART	all known, available, and reasonable methods of prevention, control, and treatment
BLR	Snohomish County Buildable Lands Report
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
BPS	Booster Pump Station
ccf	charge per hundred cubic feet
CI	cast iron
CIP	Capital Improvement Plan
City	City of Stanwood
CWA	Clean Water Act
County	Snohomish County
DI	ductile iron
DMR	Discharge Monitoring Report
DO	dissolved oxygen
DSL	distribution system leakage
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERU	Equivalent Residential Unit
fps	feet per second
FSM	Frankenberger Stahl & Maschinenbau
FTE	full-time employee
GMA	Growth Management Act
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
G.O.	General Obligation
GSP	General Sewer Plan
HDPE	high-density polyethylene
HMI	human machine interface
hp	horsepower

Table 1-3

Abbreviations (continued)

Abbreviations	Description
HVAC	heating, ventilation, and air conditioning
I/I	infiltration and inflow
IMLR	internal mixed liquor recycle
L&I	Labor and Industries
lf	linear feet
LFC	local facilities charge
MCE	meter capacity equivalent
MDF	maximum day flow
MG	million gallons
MGD	million gallons per day
mg/L	milligrams per liter
MLS	Main Lift Station
MLSS	mixed liquor suspended solids
MMF	maximum month flow
NMF	No Meat Factory
NOP	Nitrogen Optimization Plan
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
OFM	Office of Financial Management
ORP	oxidation-reduction potential
PAOs	phosphorous accumulating organisms
PHF	peak hour flow
PIF	Plant Investment Fee
ppd	pounds per day
PSNGP	Puget Sound Nutrient General Permit
PUD	Public Utility District
PVC	polyvinyl chloride
PWTF	Public Works Trust Fund
RAS	return activated sludge
RCW	Revised Code of Washington
RH2	RH2 Engineering, Inc.
SCADA	supervisory control and data acquisition
SEALUO	Stanwood Economic Analysis of Land Use Options Memorandum
SR	State Route
SRT	solids retention time
TDH	total dynamic head
TIN	Total Inorganic Nitrogen
TS	total solids
TSS	total suspended solids
UGA	Urban Growth Area
ULID/LID	Utility Local Improvement District
UV	ultraviolet
VFD	variable frequency drive
WAC	Washington Administrative Code
WAS	waste activated sludge
WSP	Water System Plan
WWTP	wastewater treatment plant
WWTPO	Wastewater Treatment Plant Operator
WUE	Water Use Efficiency
YPS	Yard Pump Station

2 | SEWER SYSTEM DESCRIPTION AND DISCHARGE REGULATIONS

INTRODUCTION

This chapter describes the City of Stanwood's (City) sewer service area, wastewater collection and treatment system, lift stations, and discharge and disposal regulations and permits. Included in this chapter is a brief overview of the City's topography, geology, and climate to provide a better understanding of the physical characteristics of the service area. A brief description of the City's water system facilities also is presented.

The results of the evaluation and analyses of the existing sewer collection system are presented in **Chapter 6**. An evaluation of the existing treatment facilities is presented in **Chapter 7**. Improvements to address treatment facility deficiencies are presented in **Chapter 8**.

SEWER SERVICE AREA

History

The City was incorporated in 1903. The City's initial sewer collection system was constructed mostly of asbestos cement pipe in 1963 to serve the downtown Stanwood area, former east Stanwood, and the City's eastern hill. Most of the downtown area sewer system still remains and is in use today. The system was expanded to serve new developments on the eastern hill, including lift stations and sewer extensions that were largely constructed of polyvinyl chloride (PVC) pipe. The properties currently served by the City's sewer system are generally a blending of single-family neighborhoods and small businesses. The western portion of the City includes a mix of single-family, multi-family, and commercial development. **Figure 2-1** is a map of the existing sewer system, and **Figure 2-2** is a map of the existing sewer service area.

The City's primary wastewater treatment plant (WWTP) was completed in 1963. The original plant consisted of a headworks with grit channel, comminutor, bypass bar screen, and Parshall flume; four 1.25-acre anaerobic primary lagoons, a 35-acre facultative lagoon, and an outfall to the Stillaguamish River. In 1973, the WWTP was upgraded with the addition of effluent chlorination facilities and a propeller-type flow meter. The City constructed a new WWTP in 2004 to increase the system's total capacity to 1.5 million gallons per day (MGD). This expansion included construction of the headworks, oxidation ditches, and secondary clarifiers, an ultraviolet disinfection system, and a scum system. In addition, two existing wastewater treatment lagoons were converted to sludge stabilization ponds. In 2013, the plant was upgraded with a sodium hypochlorite injection system that feeds into the washdown water line and injects into the return activated sludge (RAS) piping. For more information on the WWTP and facility upgrades, refer to **Chapter 7**.

Geography, Geology, and Topography

The topography of the area served by the City varies greatly in elevation. The lowest areas served are located along the Stillaguamish River just above mean sea level. The highest areas served are located at an elevation of approximately 270 feet.

The City is located within the Puget Lowland, a broad tectonic basin bounded by the Cascade Mountains to the east and the Olympic Mountains to the west. The present landscape has been shaped by an active tectonic margin, continental glaciations, and modern river drainages. Continental glaciers have advanced and retreated within the Puget Lowland multiple times during the Quaternary period, resulting in a thick sequence of unconsolidated glacial and interglacial sediments overlying bedrock. The last glacial advance into the Puget Lowland, known as the Vashon, ended roughly 12,000 years ago.

Post-glacial streams, such as the Stillaguamish River, have reworked older glacial deposits. The City's downtown area is located on a broad, low lying alluvial delta of the Stillaguamish River. Upgradient, the Stillaguamish River occupies an alluvial valley between the glaciated uplands of the East Stanwood Plateau to the north and the Tulalip Plateau to the south. Depth to bedrock in the City's vicinity ranges from approximately 1,200 feet under downtown Stanwood to about 300 feet under the East Stanwood Plateau.

The City's sewer system area includes downtown areas along the Stillaguamish River, where the surficial geology is mapped as river alluvium and estuary deposits, generally consisting of soft or loose silt, clay, and sand with some peat and organic material, and has shallow groundwater.

In the upland areas of the East Stanwood Plateau, the sediment was often deposited during the Vashon glaciation. These sediments can be Vashon recessional outwash, Vashon glacial till, and Vashon advance outwash. The glacial till and advance outwash deposits can be hard and were consolidated by being overridden by the glacier, while the recessional outwash deposits can be loose and less consolidated.

The United States Geological Survey identifies several active faults near the City, including the Devils Mountain Fault Zone, approximately 8 miles north of the City, and the Utsalady Point Fault, which is mapped 3 miles northwest of downtown Stanwood and may extend under the City and along the Stillaguamish River Valley.

The tectonic setting of the City results in significant seismic activity. During an earthquake, unconsolidated sediments are susceptible to shaking and liquefaction when saturated. The Washington State Department of Natural Resources identifies the following liquefaction susceptibility and Seismic Site Classes (based on the National Earthquake Hazards Reduction Program) for the geologic units in the City's vicinity: alluvium deposits have a moderate to high liquefaction susceptibility and are Class D to E; glaciomarine deposits on the East Stanwood Plateau have a low to moderate liquefaction susceptibility and are Class D; recessional outwash has a low liquefaction susceptibility and is Class C to D; and glacial till and pre-Vashon undifferentiated sediments have a very low liquefaction susceptibility and are Class C and Class C to D, respectively. Landslides are not mapped within the City's sewer service area; however, there is a risk of shallow landslides on steep slopes along the edges of the glaciated uplands.

Climate

The climate in the City is typical of Snohomish County. The nearby weather station at the Arlington Municipal Airport reports an average summer temperature of 61 degrees Fahrenheit, with an average daily maximum temperature of 74 degrees Fahrenheit. The average winter temperature reported is 39 degrees Fahrenheit, with an average daily minimum temperature of 34 degrees Fahrenheit.

The National Oceanic and Atmospheric Administration's Stanwood 0.7 N Station records show precipitation occurring most often during the months of October to April, with the heaviest rains generally occurring during the month of November. The average total annual precipitation for the City is approximately 31 inches. Similar precipitation patterns are observed at the Arlington Municipal Airport station as well.

Water Bodies

The Stillaguamish River is located along the southwestern edge of the City and is the largest surface water body in the City. This water body serves as the outfall for the treated effluent from the wastewater treatment plant. Church Creek is located on the eastern side of the City and flows southwest to meet the Stillaguamish River. Additional water bodies include Irvine Slough, Douglas Creek, and Douglas Slough, as shown in **Figure 2-1**.

City Limits and Sewer Service Area Boundary

The City is located in northern Snohomish County, Washington. The City limits and sewer service area boundary encompass an area of approximately 2.9 square miles, as shown in **Figures 2-1** and **2-2**. The existing sewer collection system extends just north of 288th Street NW, south to the Burlington Northern Railroad, east to 64th Avenue NW, and west to the Skagit Slough as shown in **Figures 2-1** and **2-2**.

The City's existing sewer service area is comprised of five major sewer drainage basins and eight subbasins, as shown in **Figure 2-3**.

The northern, southeastern, and southwestern portions of the Urban Growth Area (UGA) are not currently served by the City's existing sewer system. The sewer service area shown on **Figure 2-1** is based on the City's UGA that was established through close partnership with the Snohomish County Planning Department to satisfy Washington State Growth Management Act guidelines.

EXISTING SEWER FACILITIES

The City owns, operates, and maintains the wastewater system, which includes the collection system, sewage lift stations, the WWTP, and an effluent outfall.

Gravity Sewer Collection Piping

The City has approximately 34 miles of sewer piping, including collection sewers and interceptors. Approximately 77 percent of the system is 8-inch-diameter gravity main, totaling approximately 26 miles. **Table 2-1** summarizes the pipe by diameter. **Figure 2-1** illustrates pipe size and location.

Table 2-1

Gravity Sewer Piping Inventory – Diameter

Diameter (Inches)	Length (Feet)	Length (Miles)	% of Total
6	2,578	0.5	1.4%
8	138,432	26.2	76.7%
10	5,000	0.9	2.8%
12	12,240	2.3	6.8%
14	3,669	0.7	2.0%
15	13,728	2.6	7.6%
18	1,155	0.2	0.6%
20	272	0.1	0.2%
24	185	0.0	0.1%
27	3,191	0.6	1.8%
30	123	0.0	0.1%
Total	**180,573**	**34.2**	**100%**

The predominant material used in the system, accounting for approximately 81 percent of gravity piping, is PVC.

Approximately 65 percent of the gravity sewer's installation year is unknown. Assumptions of pipe ages based upon materials were made to determine the general age of the collection system piping. Asbestos cement (AC) was the primary material used when the sewer system was constructed in 1963. An installation year of 1963 was assumed for AC pipe where the actual year is unknown. Cast iron (CI) and concrete pipe use was generally phased out by the end of the 1970s; accordingly, the total length of CI and concrete pipe where the installation year is unknown was divided by 17 years to determine an approximate length of pipe installed per year from 1963 to 1980 to appropriately allocate assumed installation years. Ductile iron (DI) and high-density polyethylene (HDPE) use rose in popularity in the 1980s, and these materials are still used in present day, although largely for deep sewer pipe construction. Use of PVC pipe also rose in popularity in the 1980s, and PVC is the typical gravity sewer pipe material used in the present day. The total length of DI, HDPE, and PVC pipe where the installation year is unknown was divided by 44 years to determine the approximate length of pipe installed per year from 1980 to 2024 to appropriately allocate assumed installation years. **Table 2-2** summarizes the pipe by material, and **Table 2-3** summarizes the pipe by installation years (both known and assumed).

Table 2-2

Gravity Sewer Piping Inventory – Material

Material	Length (Feet)	Length (Miles)	% of Total
Asbestos Cement	19,467	3.7	10.8%
Cast Iron	390	0.1	0.2%
Concrete	12,306	2.3	6.8%
Ductile Iron	23	0.0	0.0%
HDPE	561	0.1	0.3%
PVC	145,657	27.6	80.7%
Steel	1,873	0.4	1.0%
Unknown	296	0.1	0.2%
Total	**180,573**	**34.2**	**100%**

Table 2-3

Gravity Sewer Piping Inventory – Installation Year

Installation Year	Total Length (ft)	Total Length (mi)	% of Entire System	Total Assumed Length (ft)	Total Assumed Length (mi)	% of Entire System
1960s	19,467	3.7	10.8%	24,517	4.6	13.6%
1970s	0	0.0	0.0%	7,215	1.4	4.0%
1980s	0	0.0	0.0%	23,825	4.5	13.2%
1990s	0	0.0	0.0%	23,825	4.5	13.2%
2000s	714	0.1	0.4%	24,539	4.6	13.6%
2010s	27,415	5.2	15.2%	51,240	9.7	28.4%
2020s	15,588	3.0	8.6%	25,117	4.8	13.9%
Unknown	117,389	22.2	65.0%	296	0.1	0.2%
Total	**180,573**	**34.2**	**100.0%**	**180,573**	**34.2**	**100.0%**

Lift Stations

The City currently owns, operates, and maintains 8 wastewater lift stations and approximately 6,082 feet of force main throughout the system. The operation of the pumps in the lift stations is dictated by the water level in the wet wells. None of the City's lift stations have a bypass to Waters of the State. The characteristics of each lift station are summarized in **Table 2-4**, and a description of each lift station follows. The firm capacities presented in **Table 2-4** are the capacities of each lift station with the largest pump out of service. The capacity of each lift station currently meets the design criteria presented in **Chapter 5**.

Table 2-4

Lift Station Characteristics

Lift Station	Lift Station						Pumps			
	Year Constructed	Force Main Dia. (in)	Force Main Length (ft)	No. of Pumps	Configuration	Manufacturer	hp	TDH (ft)	Design Capacity (gpm)	Firm Capacity (gpm)
Main	1999	16	628	4	Wet well/Dry well	ITT-Flygt	20	50	1,120 1,120 1,120 1,120	3,700
Pioneer Hills	1999	6	1,673	2	Self-priming	Gorman-Rupp	20	72	500 500	470
Copper Station	2005	6	1,598	2	Submersible	Wemco	20	137	300 300	300
Cedarhome	1997	6	1,378	2	Self-priming	Gorman-Rupp	20	76	345 345	333
Mineral Point	2018	4	798	2	Submersible	ITT-Flygt	4	42	170 170	170
Lindstrom Development	2007 [1]	4	388	2	Self-priming	Gorman-Rupp	7.5	45	160 160	198
Taylor's Landing	2001	4	247	2	Self-priming	Gorman-Rupp	7.5	52	150 150	150
Creekside	2021	4	406	2	Submersible	Wilo	3	35	125	125

1 = City took ownership of lift station in 2007.

Main Lift Station

The Main Lift Station, located at the intersection of 270th Street NW and 94th Drive NW, transports all of the wastewater from the City's collection system to the WWTP. The wet well/dry well type lift station is located towards the western end of the collection system. Improvements in 2020 fitted the lift station with 4 pumps that are controlled by variable frequency drives, each with a design capacity of 1,120 gallons per minute (gpm) at 50 feet of total dynamic head (TDH), for a firm capacity of 3,700 gpm. The station upgrades included a new 16-inch HDPE force main in a 24-inch HDPE casing. An engine generator for standby power also was added in 2012. The water level in the wet well is measured by a radar level sensor; the City plans to install floats in the future for redundancy.

Pioneer Hills Lift Station

The Pioneer Hills Lift Station is located along Pioneer Highway and was constructed in 1999 to serve the Pioneer Hills development. The lift station receives all flow from Basin 2A (**Figure 2-3**). The self-priming lift station has 2 pumps, each with a design capacity of 500 gpm at 72 feet of TDH. The firm capacity of the Pioneer Hills Lift Station is 470 gpm. This station has a 6-inch force main and an engine-driven pump for backup power. The water level in the wet well is measured by a transducer, and the lift station also has floats for backup.

Copper Station Lift Station

The Copper Station Lift Station is located along Copper Way NW, north of 288th Street NW, and was constructed in 2005 to serve the Copper Station housing development at the northern end of the collection system. The lift station receives all flow from Basin 3A (**Figure 2-3**). The submersible lift station has 2 pumps, each with a design capacity of 300 gpm at 137 feet of TDH. The firm capacity of this lift station is 300 gpm. This station has a 6-inch force main and an engine generator onsite

for standby power. The water level in the wet well is measured by a transducer, and the lift station also has floats for backup.

Cedarhome Lift Station

Cedarhome Lift Station, located at the intersection of 276th Street NW and 72nd Avenue NW, was constructed in 1997 and serves several developments in the area. It is a self-priming lift station with 2 pumps, each with a design capacity of 345 gpm at 76 feet of TDH. The firm capacity of this lift station is 333 gpm. This station has a 6-inch force main and an engine-driven pump for backup power. The City conducted pump testing on the installed pumps in 2008 as part of a previous General Sewer Plan. The water level in the wet well is measured by a bubbler.

Recently, a gravity sewer was constructed to bypass the Cedarhome Lift Station and convey the tributary flow to 72nd Avenue NW. This bypass became active in June 2025, and the Cedarhome Lift Station has since been decommissioned. The bypass redirects a significant amount of wastewater flow from the northeast portion of the City, previously tributary to Basin 4, to Basin 5. **Figures 2-1** and **2-3** reflect the basin areas prior to activation of the bypass.

Mineral Point Lift Station

The Mineral Point Lift Station is located at the south end of 65th Lane NW and was constructed in 2018 to serve the Mineral Point housing development (Basin 4A shown on **Figure 2-3**). The lift station discharges to Basin 4, which is anticipated to be partially re-routed in 2024 when the Cedarhome Lift Station is decommissioned, as discussed previously. The submersible lift station has 2 pumps, each with a design capacity of 170 gpm at 42 feet of TDH, with a station firm capacity of 170 gpm. This station has a 4-inch force main. The water level in the wet well is measured by a transducer, and the lift station also has floats for backup.

Lindstrom Development Lift Station

Lindstrom Development Lift Station is located east of 72nd Avenue NW and serves part of the commercial area south of State Route 532 (Basin 5A shown on **Figure 2-3**). Formerly privately owned, the City took ownership of the lift station in 2007. The self-priming lift station has 2 pumps, each with a design capacity of 160 gpm at 45 feet of TDH. The firm capacity of the Lindstrom Development Lift Station is 198 gpm. This station has a 4-inch force main and an engine generator onsite for standby power. The water level in the wet well is measured by a transducer, and the lift station also has floats for backup.

Taylor's Landing Lift Station

Taylor's Landing Lift Station, located at the end of 260th Street NW south of the Pioneer Highway, was constructed in 2001 to serve a small housing development in the area (Basin 5B shown on **Figure 2-3**). The self-priming lift station has 2 pumps, each with a design capacity of 150 gpm at 52 feet of TDH. The firm capacity of this lift station is 150 gpm. This station has a 4-inch force main and standby power is provided via a portable engine generator. The water level in the wet well is measured by a bubbler.

Creekside Lift Station

Creekside Lift Station, located east of 72nd Avenue NW, was constructed in 2021 to serve the Creekside Apartment Homes (Basin 5C shown on **Figure 2-3**). The submersible lift station has 2 pumps, each with a design capacity of 125 gpm at 35 feet of TDH and a firm capacity of 125 gpm. This station has a 4-inch force main.

Church Creek Lift Station (Decommissioned 2022)

Church Creek Lift Station, which was located north of Church Creek Park on Church Creek Loop NW and served the Church Creek Estates development, was decommissioned in 2022. A gravity bypass was constructed to convey the wastewater that previously flowed to this lift station to the gravity sewer in 72nd Avenue NW.

Wastewater Treatment and Disposal Facilities

Existing System

The City's original wastewater treatment plant was constructed in 1963. In 1973, the plant was upgraded to include an effluent chlorination system and a propeller flow meter. In the mid-1970s, the four primary lagoons were decommissioned due to the decreased biochemical oxygen demand (BOD) loads from the industrial source, Twin City Foods. In 1991 and 1992, the dikes around the treatment plant were raised to a nominal elevation of 11.0 feet due to the flooding during the end of 1990.

The City upgraded the WWTP in 1996 to include the conversion of an existing 1.25-acre lagoon into a complete-mix aerated lagoon with five 15 horsepower (hp) floating, high-speed surface aerators, installation of an effluent baffle for the 35-acre facultative lagoon, modifications to the chlorination building, and the addition of chlorine contact tank drain pumps. In addition, the wastewater flow from the headworks was redirected from the 35-acre facultative lagoon to the 1.25-acre complete-mix lagoon. In 2004, the plant was upgraded from 0.25 MGD to 1.5 MGD capacity. These upgrades included construction of the headworks, oxidation ditches, secondary clarifiers, an ultraviolet disinfection system, a scum system, a plant water system, a yard pump station, sludge stabilization ponds, and decant pump stations. The effluent was discharged through an outfall into the Stillaguamish River. For more information on the treatment facility upgrades, refer to the City's *Wastewater Facilities Plan* by Tetra Tech/KCM, Inc., dated May 2000. In 2013, the WWTP was upgraded with a sodium hypochlorite injection system that feeds into the washdown water line and injects into the RAS piping.

For more information on the treatment plant and facility upgrades, refer to **Chapter 7**.

DISCHARGE AND DISPOSAL REGULATIONS AND PERMITS

WWTP NPDES Permit and Regulations

Wastewater flow and loading into the City's WWTP and treated plant effluent water discharged to the Old Stillaguamish River are regulated through the City's National Pollutant Discharge Elimination System (NPDES) Permit.

The federal Clean Water Act (CWA, 1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States: "The objective of the CWA is the restoration and maintenance of the chemical, physical, and biological integrity of the country's water." The CWA grants individual authority to each state to define the water quality standards (within the limits set by the water quality goals) within its jurisdiction and enforce them. Water quality standards for surface waters in Washington State have been established (Chapter 173-201A Washington Administrative Code (WAC)) and are enforced by the Washington State Department of Ecology (Ecology) (Chapter 90.48 Revised Code of Washington (RCW)). The purpose of the water quality standards is to provide "public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife." Each surface water in the state is identified as fresh water or marine water and designated for one or more uses, which then determines the specific water quality standards that apply to that water.

The state also has established a permit program for implementation of the NPDES Permit Program created by the CWA. The program requires a discharge permit for any point source, such as a domestic wastewater treatment plant, and discharge of pollutants to surface waters of the state for the purpose of maintaining water quality standards. Each permit is renewed on roughly a 5-year cycle. The permit and accompanying fact sheet include information on discharge limits, monitoring schedules, and general and special conditions that apply to the applicable point source.

The City's current NPDES Permit (Permit No. WA0020290) has an effective date of November 1, 2016, and expired on October 31, 2021. Permit renewal is currently in progress; however, the permit may not be issued by the expiration date. In accordance with RCW 34.05.422(3) and WAC 173-220-180(5), if the new permit is not issued and effective by the current permit's expiration date, then the current permit and its terms and conditions are administratively extended and remain in effect and enforceable until Ecology issues a new permit. Copies of the permit and accompanying fact sheet are included as **Appendix A**.

Facility Design Criteria

The permitted facility flow and loading design criteria for the City's WWTP are included in **Table 2-5**.

Table 2-5

WWTP Permitted Flow and Loading Design Criteria

Parameter	Design Quantity
Maximum Month Design Flow (MMDF)	1.5 MGD
BOD_5 Influent Loading for Maximum Month	4,100 ppd
TSS Influent Loading for Maximum Month	4,100 ppd

BOD_5 = 5-day Biochemical Oxygen Demand

ppd = pounds per day

TSS = total suspended solids

The NPDES Permit also stipulates that if the flow or waste load reaches 85 percent of any of the design criteria for 3 consecutive months, or if the facility would reach design capacity in 5 years, the City must submit a plan and schedule to maintain capacity to Ecology.

Effluent Limits

Treated plant effluent water is discharged to the Old Stillaguamish River through a piped outfall, which is designated as Outfall No. 001 in the NPDES Permit. The effluent limits for Outfall No. 001 are summarized in **Table 2-6**.

Table 2-6

NPDES Permit Effluent Limits

Parameter	Average Monthly	Average Weekly
BOD_5	30 mg/L 376 ppd 85% removal of influent BOD_5	45 mg/L 563 ppd
TSS	30 mg/L 376 ppd 85% removal of influent TSS	45 mg/L 563 ppd
Parameter	**Minimum**	**Maximum**
pH	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric Mean**	**Weekly Geometric Mean**
Fecal Coliform Bacteria	200/100 mL	400/100 mL

mg/L = milligrams per liter

mL = milliliters

Future City NPDES Permit Effluent Limits (Outfall No. 001) Changes

Ecology can change water quality standards or NPDES Permit effluent limits (the latter for the purpose of maintaining water quality standards). Known future changes to water quality standards and NPDES Permit effluent limits that are applicable to Outfall No. 001 at the WWTP are summarized in this section.

Bacterial Indicator Effluent Limits

The receiving water of the Old Stillaguamish River at Outfall No. 001 is designated for Primary Contact Recreational Use (WAC 173-201A-612, Table 612). To protect water contact recreation in marine water, such as the receiving water, bacterial indicator criteria (standards) are defined in WAC 173-201A-210(3)(b). Ecology is considering modifications to future permits to include monitoring and limits for the bacterial indicator enterococci.

The City's NPDES Permit has a fecal coliform bacteria effluent limit for Outfall No. 001. An enterococci bacteria effluent limit for Outfall No. 001 will be considered when the permit is renewed. As Ecology continues its review, the current fecal coliform bacteria effluent limit will remain in effect and likely continue when the permit is renewed.

Chapter 7 of this General Sewer Plan (GSP) evaluates the existing processes of the City's WWTP and describes the WWTP's existing ultraviolet (UV) disinfection system. **Chapter 7** also discusses a future Engineering Report that will provide further details about recommended WWTP improvements. The new enterococci bacteria effluent limits may impact the design and configuration of the UV disinfection system and will be evaluated during the development of the Engineering Report.

Other NPDES Permit Changes

Per Ecology, the renewed permit may require an industrial user survey for per- and polyfluoroalkyl substances (PFAS) source control, enterococci, and fecal coliform effluent monitoring.

Other Regulations and Required Permits

WWTP Puget Sound Nutrient General Permit

Section 303(d) of the CWA establishes a process to identify and clean up surface waters that do not meet the applicable water quality standards. Every few years, Ecology performs a water quality assessment using collected data to determine whether water quality of the surface waters meets the standards. Based on the assessment, each surface water is placed into one of five categories that describes the status of the water quality and ranges from meeting the standards (Category 1) to impaired (i.e. polluted) and requiring a water improvement project (Category 5). Surface waters placed into Category 5 are listed on the state's 303(d) list of polluted waters, which is named after the referenced section of the CWA.

At certain times of the year, dissolved oxygen levels in a large number of locations throughout Puget Sound do not meet the applicable water quality standards, and in many other locations show evidence of not meeting the standards in the future. The surface waters within Puget Sound that are not meeting the dissolved oxygen standards are listed on the state's 303(d) list. Ecology initiated the Puget Sound Nutrient Reduction Project (Project) in the spring of 2017 to address the problem of human sources of nutrients contributing to the low and decreasing dissolved oxygen levels throughout Puget Sound. As a result of modeling, Ecology believes discharges of nutrients to Puget Sound from domestic wastewater treatment plants are significantly contributing to the

problem. The goal of the Project is to develop a nutrient source reduction strategy, which includes reducing nutrient levels discharged from domestic wastewater treatment plants.

Ecology has been utilizing a model of Puget Sound to understand the problem and simulate potential improvements. Ecology has identified nitrogen as the limiting nutrient, with inorganic nitrogen, consisting of nitrate-nitrite and ammonia, as the "biologically available" form. Ecology is performing additional modeling for optimization scenarios; however, results from completed modeling are being used to determine effluent nitrogen permit limits for domestic wastewater treatment plants with outfalls to Puget Sound (identified as marine sources), which includes the City's WWTP. Individual NPDES permits for the same treatment plants will continue independently of, but in conjunction with, the general permit and may be modified as necessary to include facility-specific nutrient-related requirements.

In January 2021, Ecology released a preliminary draft of the Puget Sound Nutrient General Permit (PSNGP) for public comment. The public comment period ended on March 15, 2021, and Ecology proceeded with developing a formal version, which became effective January 1, 2022, and expires December 31, 2026.

At the time this GSP was initially drafted, the City was covered under the original PSNGP effective January 1, 2022. The PSNGP was later invalidated in February 2025, with a target date for reissuance in early 2026. Therefore, references to the PSNGP throughout this GSP are specifically to the original PSNGP. A draft of the updated PSNGP was issued for comment in the summer of 2025, and numerous comments were received. Based on the feedback, Ecology will not be reissuing the PSNGP as of January 2026 and will instead propose requirements through individual WWTP permits. The original PSNGP language is still referenced throughout this GSP, and the City understands future permit limits and requirements will need to be evaluated in the Engineering Report to determine impacts to recommended improvements.

Copies of the original PSNGP and accompanying fact sheet are included as **Appendix A**. The following descriptions summarize the original PSNGP, including anticipated permit limits specific to the City's WWTP.

Notice of Intent

The City has filed a Notice of Intent for coverage under the PSNGP and will submit Discharge Monitoring Reports (DMRs) as required by the permit and as discussed as follows.

Nitrogen Optimization Requirements

The City must submit an annual Nitrogen Optimization Plan (NOP) to Ecology no later than March 31, 2026, as defined in the PSNGP. Optimization refers to short-term actions (low cost controls and process changes) focused on improving existing performance. Optimization processes do not include large scale capital investments. The City must begin optimization immediately upon coverage under the PSNGP.

The NOP must include the following components.

1. Treatment Process Performance Assessment

   Assess the nitrogen removal potential of the current treatment process and have the ability to evaluate optimization strategies prior to implementation.

   a. Evaluation. Develop a treatment process assessment method for the purposes of evaluating optimization approaches during the permit term. This will include an evaluation of current (pre-optimization) process performance to determine the empirical Total Inorganic Nitrogen (TIN) removal rate for the WWTP. The assessment must include an evaluation of possible optimization strategies at the WWTP prior to and after implementation. Determine the optimization goal for the WWTP and develop a list of optimization strategies capable of achieving the optimization goal for the WWTP. Update this list as necessary to continuously maintain a selection of strategies for achieving each optimization goal identified. Any optimization strategy may be excluded from the initial selection if it is found to exceed a reasonable implementation cost or timeframe. Documentation must be provided that includes an explanation of the rationale and financial criteria used for the exclusion determination.

   b. Initial Selection. Identify the optimization strategy selected for implementation. Document the expected percentage of TIN removal (or the expected reduction in effluent load) for the optimization strategy prior to implementation.

2. Optimization Implementation

   The City must document implementation of the selected optimization strategy, which includes the following:

   a. Strategy Implementation. Describe how the selected strategy was implemented during the reporting period, initial implementation costs, length of time to implement (including start date), anticipated and unanticipated challenges, and impacts to the overall treatment performance due to optimization process changes.

   b. Load Evaluation. The City must review effluent data collected during the reporting period to determine whether TIN loads are increasing. This includes using all accredited monitoring data to determine the WWTP's annual average TIN concentration and load for each year during the reporting period. The City also must determine the WWTP's TIN removal rate at the end of each year and compare it with the pre-optimization rate previously identified.

   c. Strategy Assessment. The City must quantify the results of the implemented strategy and compare them to the expected percentage of TIN removal previously identified. If the TIN loading increased, apply adaptive management, and re-evaluate the optimization strategies and the resulting performance to identify the reason. From this, select a new optimization strategy or revise the implementation for better performance. Document any updates to the implementation schedule and overall plan.

3. Influent Nitrogen Reduction Measures/Source Control

   The City must investigate opportunities to reduce influent TIN loads from septage handling practices, commercial, dense residential, and industrial sources and submit documentation with the annual NOP, including the following:

a. Review non-residential sources of nitrogen and identify any possible pretreatment opportunities.

b. Identify strategies for reducing TIN from new multi-family/dense residential developments and commercial buildings.

AKART Analysis

Under the PSNGP, all permittees classified as Small Loaders must prepare and submit an approvable all known, available, and reasonable treatment (AKART) analysis to Ecology for the purposes of evaluating reasonable treatment alternatives capable of reducing TIN. Permittees that maintain an annual TIN average of less than 10 mg/L and do not document an increase in load through their DMRs are excluded from this requirement and do not have to submit this analysis.

Monitoring Requirements

The PSNGP will create additional monitoring requirements for the City. These requirements do not replace any requirements stipulated in the City's NPDES Permit. The City will need to comply with both permits separately. Recorded monitoring data should be submitted monthly on the electronic DMR form provided by Ecology within the Water Quality Permitting Portal. The City may use the monitoring locations identified in the NPDES Permit to collect samples for the PSNGP but must still prepare two separate monthly DMR submittals (one for each permit). Samples must be representative of the flow and characteristics of the discharge, and sampling is not required outside of normal working hours or during unsafe conditions. For each sample taken, the City must record the sample date and time, location, method of sampling, and individual who performed the sampling. The City must use appropriate flow measurement and methods consistent with accepted scientific practices, including proper installation, calibration, and maintenance of all measurement devices. A summary of the anticipated monitoring requirements under the PSNGP and a comparison to the City's NPDES Permit can be found in **Tables 2-7** and **2-8**.

Table 2-7

Comparison of City NPDES Permit and PSNGP Monitoring Requirements for WWTP Influent

Parameter	Units and Specification	Minimum Sampling Frequency (NPDES)	Minimum Sampling Frequency (PSNGP)	Sample Type
Flow	MGD	Continuous	-	Metered/Recorded
BOD_5	mg/L	2/week	-	24-Hour Composite
BOD_5	ppd	2/week	-	Calculated
TSS	mg/L	2/week	-	24-Hour Composite
TSS	ppd	2/week	-	Calculated
$CBOD_5$	mg/L	-	2/month	24-Hour Composite
Total Ammonia	mg/L as N	-	2/month	24-Hour Composite
Nitrate plus Nitrite	mg/L as N	-	1/month	24-Hour Composite
Total Kjeldahl Nitrogen	mg/L as N	-	1/month	24-Hour Composite

N = Nitrogen

$CBOD_5$ = carbonaceous BOD_5

Note: Table is a summary of the original PSNGP prior to the February 2025 invalidation and is for information only.

Table 2-8

Comparison of City NPDES Permit and PSNGP Monitoring Requirements for WWTP Effluent

Parameter	Units and Specification	Minimum Sampling Frequency (NPDES)	Minimum Sampling Frequency (PSNGP)	Sample Type
Flow	MGD	Continuous	2/month	Metered/Recorded
BOD_5	mg/L	2/week	-	24-Hour Composite
BOD_5	ppd	2/week	-	Calculated
BOD_5	% removal	1/month	-	Calculated
TSS	mg/L	2/week	-	24-Hour Composite
TSS	ppd	2/week	-	Calculated
TSS	% removal	1/month	-	Calculated
Fecal Coliform	#/100 ml	2/week	-	Grab
pH	Standard Units	1/day	-	Grab
$CBOD_5$	mg/L	-	2/month	24-Hour Composite
Total Organic Carbon	mg/L	-	1/quarter	24-Hour Composite
Total Ammonia	mg/L as N	1/quarter	2/month	24-Hour Composite
Nitrate plus Nitrite Nitrogen	mg/L as N	1/quarter	2/month	24-Hour Composite
Total Kjeldahl Nitrogen	mg/L as N	1/quarter	1/month	24-Hour Composite
TIN	mg/L as N	-	2/month	Calculated
TIN	ppd	-	2/month	Calculated
Average Monthly TIN	lbs	-	1/month	Calculated
Annual TIN, year to date	lbs	-	1/month	Calculated

Note: Table is a summary of the original PSNGP prior to the February 2025 invalidation and is for information only.

The City must submit monthly monitoring data using Ecology's WQWebDMR program by the 15th day of the following month. Any pollutant monitoring data collected more frequently than the permit stipulates must be used in calculations and submitted in the DMR.

After 12 months of monitoring, the City may request a reduction in sampling frequency from Ecology if it can demonstrate that the distribution of concentrations can be accurately represented with a lower sampling frequency.

Additional Requirements

The City must retain records of monitoring information or documentation pertaining to permit requirements for a minimum of 5 years following termination of permit coverage. If the City is unable to comply with the conditions of the permit, it must notify Ecology within 24 hours and submit a written report to Ecology via the WQWebPortal within 5 days describing the noncompliance event and duration, and how steps will be taken to correct it. The City must keep the following documentation onsite or within reasonable access to the site: Permit Coverage Letter, PSNGP, DMRs, and attachments to the NOP.

WWTP General Permit for Biosolids Management

Ecology issued an updated General Permit for Biosolids Management on January 2, 2025, that was effective on February 1, 2025. This General Permit was issued as part of the state biosolids program (Chapter 173-308 WAC) and covers facilities that qualify as a Treatment Works Treating Domestic Sewage. The City's WWTP has been covered under this General Permit and has been producing stabilized Class B biosolids.

Aquatic Life Toxics Criteria Regulation

On August 15, 2024, Ecology adopted updates to water quality standards (Chapter 173-201A WAC). This included updates to limits for several toxic constituents, including PFAS and 6PPD-quinone, to protect aquatic life in both marine and fresh waters. These new updates are currently under review by the U.S. Environmental Protection Agency (EPA). At the time this GSP was drafted, no specific limits have been assigned to the City's WWTP. The City may need to issue an amendment to this GSP once the EPA approves and finalizes these updates.

Telemetry and Supervisory Control

Successful operation of any municipal sewer system requires gathering and using accurate sewer system information. A telemetry and supervisory control and data acquisition (SCADA) system gathers information and can efficiently control a system by automatically optimizing facility operations. The system also provides instant alarm notification to operations personnel in the event of equipment failure, operation problem, flood, fire, or other emergency situations. Data from the SCADA system is continuously collected on the wastewater treatment plant human machine interface (HMI) computer system. Operators can view real time or historical information on the HMI. The HMI computer also automatically creates WWTP reports required by Washington State.

The City's SCADA system was upgraded in 2020. Upgrades included new programmable logic controllers, 3G/4G cellular routers/modems, and other upgrades at the WWTP, Pioneer Hills Lift Station, Copper Station Lift Station, Cedarhome Lift Station, Mineral Point (router/modem only), Lindstrom Development Lift Station, Taylor's Landing Lift Station, and Church Creek Lift Station.

ADJACENT SEWER SYSTEMS

There are no other nearby municipal sewer systems. Wastewater treatment facilities within a 20-mile radius of the City's wastewater treatment plant are shown on **Figure 2-4**. The Schenk Meat Packing Plant is a private industrial wastewater generator that is located in the northeast portion of the City and has its own lagoon and effluent disposal system.

CITY OF STANWOOD WATER SYSTEM

This section provides a brief description of the City's existing water system and the current operation of the facilities. The water service area and system facilities are shown on **Figure 2-5**.

Pressure Zones

The City serves customers within an elevation range from approximately sea level, near the shores of Skagit Bay and the Stillaguamish River, to approximately 270 feet near the Knittle and Cedarhome Reservoirs. The wide range of elevations requires that the water pressure be increased or reduced to maintain pressures that are safe and sufficient to meet the system's flow requirements. This is achieved in the City's system by dividing the water system into seven distinct pressure zones, as shown in **Figure 2-5**. The pressures in the 125, 297, and 365 Pressure Zones are regulated by reservoir levels. The four smaller pressure zones are supplied by pressure reducing stations with water from the higher pressure zones. The pressure reducing stations decrease the pressure of water that is supplied to services located below the ridge that overlooks Pioneer Highway.

Supply Facilities

Introduction

All water supply to the City's water system currently is provided by groundwater wells on the East Stanwood Plateau. Bryant Well No. 1, located near State Route 532 and 268th Street NW, is the City's largest single source of supply. Bryant Well No. 2 was taken offline in 2020 due to a decline in capacity and currently is used as a monitoring well because of its close proximity to Bryant Well No. 1. A replacement well, Bryant Well No. 3, was drilled in 2013 and connected to the water system in 2015. The Cedarhome Well was installed in 2008 to replace the Sill Well, which has been offline since 1985 and is disconnected from the water system. The City's oldest source of supply, the Hatt Slough Springs, is located south of the City limits on the south side of Hatt Slough and currently is offline due to a November 2011 landslide restricting access to the site. The Hatt Slough Springs are currently considered an emergency source of supply. The Fure Well was decommissioned in 2020.

Water Treatment

The City transitioned to system-wide chlorination in 2008. The Cedarhome Well and Bryant Well Nos. 1 and 3 are chlorinated. The Hatt Slough Springs were chlorinated as a precautionary measure when in use, although harmful bacteria have never been detected. Historically, the water quality at

all sources has been excellent, aside from slightly higher than allowable manganese and arsenic levels at Bryant Well No. 1 prior to the completion of the Bryant Well Field Treatment Facility.

The Bryant Well Field Treatment Facility currently treats Bryant Well Nos. 1 and 3 for arsenic, manganese, and hydrogen sulfide using an oxidation and filtration process. Two chemicals are initially added to the raw water: sodium hypochlorite and ferric chloride. A low strength 0.8-percent sodium hypochlorite solution is created onsite using water, salt, and a chemical reactor. The ferric chloride is added to assist with arsenic removal and is purchased in 55-gallon drums. All chemicals are injected into the raw water through metering pumps. In addition to feeding chemicals, an aeration system adds dissolved oxygen from the ambient air to the raw water to reduce hydrogen sulfide concentrations. After chemical addition, the raw water is filtered through a pressure vessel containing anthracite and greensand media to remove manganese, iron, and arsenic compounds. A contact loop is provided after filtration to ensure that chlorine fully reacts with ammonia and reaches breakpoint before the treated water reaches the first customer downstream of the plant.

The Cedarhome Well is equipped with a sodium hypochlorite on-site generation system and a contact loop similar to the Bryant Well Field Treatment Facility. No other chemicals are added to this source.

Drinking water is often fluoridated to assist in the prevention of tooth decay. The City has chosen not to fluoridate its water at this time.

Water Conservation

The City has a Water Use Efficiency (WUE) Program that meets the requirements of Chapter 246-290 WAC. New goals have been proposed based on the demand analysis and projections presented in the City's updated *Water System Plan* WSP. It is anticipated that the proposed goals will be adopted along with the WSP at a regularly scheduled City Council meeting. Prior to adoption of the goals, a public notice will be posted at least 2 weeks before a City Council meeting public forum for presenting and considering public comments.

The proposed goals and objectives of the City's WUE Program consist of:

- Reduce the 4-year rolling average demand per equivalent residential unit (ERU) to 155 gallons per day by 2030; and
- Maintain a distribution system leakage (DSL) 3-year rolling average at 10 percent or less.

The City will achieve these goals and objectives through the implementation of the WUE Program. Reducing DSL is a supply side goal that can be achieved through measures that will mainly be carried out by the City's Water Department or in coordination with other City departments. Reducing the demand per ERU is a demand side goal that can be achieved through carrying out measures that affect customers' water use.

Pump Station Facilities

The City's water system has a total of two booster pump stations. The Cedarhome and Knittle Booster Pump Stations (BPS) are utilized to fill the 365 Zone Cedarhome Reservoir.

The Cedarhome BPS was originally constructed in 1973 and replaced in 2006 with a larger capacity facility. The new above-grade Cedarhome BPS is located on the northwest corner of 68th Avenue NW and 282nd Place NW. Three identical, horizontal split case centrifugal pumps powered by 20 hp motors provide the primary supply from the 297 Zone to the 365 Zone Cedarhome Reservoir. Currently, only two of the three pumps can be used due to motor wiring issues. The City is working to resolve this.

The Knittle BPS, which was constructed in 1998 for the Bay View Lane development, is located north of 276th Street NW on the Knittle Reservoir site. The above-grade pump station and adjacent Knittle and Cedarhome Reservoirs are located on property that is owned by the City. The pump station has four end-suction centrifugal pumps that are used to pump water from the Knittle Reservoirs to the 365 Zone Cedarhome Reservoir, primarily as a backup to the Cedarhome BPS. The primary pump is rated at 15 gpm and is powered by a 3 hp motor. The two lag pumps are rated at 85 gpm and are powered by 5 hp motors. The fourth pump, which can provide fire flow to the 365 Zone, is rated at 1,175 gpm and is powered by a 50 hp motor. The pump station has an on-site engine generator set for backup power supply that automatically turns on in the event of a power outage.

Storage Facilities

The City's water system has two storage facilities that supply the 125 Zone, two that supply the 297 Zone, and one that supplies the 365 Zone.

Two 200,000-gallon Bailey Reservoirs are located on 81st Drive NW and supply the City's 125 Zone. The 45-foot-diameter, 17.5-foot-tall concrete tanks were constructed in 1989 and replaced the original wood reservoirs. Each tank provides approximately 11,897 gallons of storage per foot height.

The 1.5 million gallon (MG) and 1.0 MG Knittle Reservoirs are steel tanks located north of 276th Street NW and Stauffer Road on a dirt road and provide water storage for the 297 Zone. The 1.5 MG Reservoir (constructed in 2019) is 75 feet in diameter, 47 feet tall, and provides approximately 33,048 gallons of storage per foot height. The 1.0 MG reservoir (constructed in 1997) is 61 feet in diameter, 47 feet tall, and provides approximately 21,862 gallons of storage per foot height.

The 550,000-gallon Cedarhome Reservoir is located on the same site as the Knittle Reservoirs, north of 276th Street NW and Stauffer Road. The reservoir was constructed in 2009. The composite elevated tank, which consists of a concrete base and an elevated steel tank, has a low water level of 329.5 feet and an overflow elevation of 365 feet. Above an elevation of 339 feet, the reservoir has a uniform diameter of 53.3 feet and provides approximately 16,710 gallons of storage per foot height to the 365 Zone. The storage area below 339 feet is conical and provides a varying volume of water storage capacity per foot height.

Distribution and Transmission System

The City's retail service area contains more than 73 miles of water main ranging in size from less than 1 inch to 42 inches. Most of the water main (approximately 39 percent) within the retail

service area is 8-inch diameter, and approximately 75 percent of the water main is 8-inch diameter or smaller.

Water System Interties

Water system interties are physical connections between two adjacent water systems. Interties normally are separated by a closed isolation valve or control valve. Emergency supply interties provide water from one system to another during emergency situations only. An emergency situation may occur when a water system loses its main source of supply or a major transmission main, or during firefighting situations, and is unable to provide a sufficient quantity of water to its customers. Normal supply interties provide water from one system to another during non-emergency situations and typically supply water at all times.

The City's water system currently has no interties. However, the *North Snohomish County Coordinated Water System Plan* discusses possible interties to connect the City with the Arlington and Tatoosh water systems. Other interties that the City may consider include the City of Everett, Snohomish County Public Utility District (PUD) No. 1, and PUD No. 1 of Skagit County.

3 | LAND USE AND POPULATION

INTRODUCTION

The City of Stanwood's (City) *Comprehensive Plan* was originally prepared in 1995, readopted in 2004 after the first required Growth Management Act (GMA) update, and was last updated in December 2024. The plan was developed to meet the requirements of the State of Washington GMA. The GMA requires, among other things, consistency between land use and utility plans and their implementation. This chapter demonstrates the compatibility of the City's General Sewer Plan (GSP) with other plans, identifies the designated land uses within the existing and future sewer service area, and presents population and employment projections for the City's sewer system.

COMPATIBILITY WITH OTHER PLANS

Introduction

To ensure that the GSP is consistent with the land use policies that guide it and other related plans, the following planning documents were examined.

- State of Washington Growth Management Act
- *City of Stanwood Comprehensive Plan 2015-2035*
    - *Stanwood Economic Analysis of Land Use Options Memorandum*
- *Snohomish County Comprehensive Plan*
    - *2021 Snohomish County Buildable Lands Report*

Growth Management Act

The State of Washington GMA of 1990 (and its multiple amendments) defined four goals relevant to this GSP:

1. Growth should be in urban areas;
2. There should be consistency between land use and utility plans and their implementation;
3. There should be concurrency of growth with public facilities and services; and
4. Critical areas should be designated and protected.

Urban Growth Area

The GMA requires that Snohomish County (County) and the City cooperate in designating an Urban Growth Area (UGA) adjacent to the City's existing corporate limits where most future urban growth and development will be directed. The county-wide UGA is defined in the County's *Comprehensive Plan* and encompasses the area where this urban growth and development is projected to occur over the 20-year planning period. The current UGA boundary is shown in **Figure 3-1**.

Consistency

The GMA requires planning consistency from two perspectives. First, it requires consistency of plans among jurisdictions. This means that plans and policies of the City and County must be consistent per the Revised Code of Washington (RCW) 36.70A.100. Second, the GMA requires the implementation of the plan be consistent with the comprehensive plans (RCW 36.70A.120).

Concurrency

Concurrency means that adequate public facilities and services are provided at the time growth occurs. For example, growth should not occur where schools, roads, and other public facilities are overloaded. To achieve this objective, the GMA directs growth to areas already served or readily served by public facilities and services (RCW 36.70A.110). It also requires that when public facilities and services cannot be maintained at an acceptable level of service, new development should be prohibited (RCW 36.70A.110).

Critical Areas

The GMA requires that critical areas be designated and protected. Critical areas include fish and wildlife habitat, flood zones, aquifer recharge areas, streams, creeks, rivers, lakes, wetlands and other surface water, and geologic hazard areas, such as steep slopes and liquefaction zones. The City has adopted development regulations identifying and protecting critical areas as required. The State Environmental Policy Act checklist in **Appendix B** addresses other environmental concerns.

City of Stanwood Comprehensive Plan

The City's current *Comprehensive Plan 2015-2035*, adopted in 2015, is undergoing an update concurrently with this update of the City's GSP. The Land Use Element of the City's *Comprehensive Plan* is the City's vision of how growth and development should occur over a 20-year horizon. While the Land Use Element goals and policies set forth general standards for locating land uses, the Future Land Use Map, which has been reproduced and is shown in **Figure 3-1**, indicates geographically where certain types of uses may be appropriate. The Future Land Use Map is a blueprint for development of an area, whereas the zoning map and zoning code are the regulatory means for implementing it.

The Land Use Element considers the general location of land uses, as well as the appropriate intensity and density of land uses given the current development trends. The utilities, transportation, and capital facilities elements ensure that new development will be adequately serviced without compromising adopted levels of service, similar to the principle of concurrency as defined in the GMA. The City's GSP was reviewed and taken into consideration during the development of, and subsequent revisions to, the Capital Facilities Element of the *Comprehensive Plan*.

Stanwood Economic Analysis of Land Use Options Memo

Prepared by FCS GROUP and dated September 8, 2022, the *Stanwood Economic Analysis of Land Use Options Memorandum* (SEALUO) identifies and evaluates alternative land use options that the

City should consider as it prepares a new *Comprehensive Plan* and development code. The land use alternatives were evaluated in terms of housing and employment capacity, impacts on the City's general fund, and the potential value of new private investment. The primary goal of the SEALUO is to establish what land use changes are necessary for the City to accommodate for its future growth within the UGA as projected by the County. The final version of the future land use the City will utilize for its comprehensive planning was provided by FCS GROUP and is shown in **Figure 3-1**. As can be seen later in this GSP, the additional housing and employment capacity created as a result of future rezoning was utilized to develop sewer system population and employment projections.

Snohomish County Comprehensive Plan

The County adopted the *Snohomish County Comprehensive Plan* on June 28, 1995. The plan took effect on July 10, 1995. Since this time, the plan has been amended several times to incorporate UGA changes, capital facility plan changes, and land use changes. The plan consists of the following five sections.

- General Policy Plan
- Future Land Use Map
- Transportation Element
- Capital Facilities Plan
- Parks and Recreation Comprehensive Plan

The County's *Comprehensive Plan* guides development in rural, unincorporated Snohomish County and designates land use in the unincorporated UGA. Similar to the City's *Comprehensive Plan*, the land use element of the County's plan is:

> ...comprised of interrelated land use goals which form the basis of the County's land use strategy and:
>
> - provide for a supply and distribution of land use types to accommodate the majority of county population and employment growth within urban growth areas;
> - reduce land consuming urban development patterns and provide structure for urban development within neighborhoods or urban centers;
> - reduce development pressures and patterns of sprawl within rural areas;
> - conserve agricultural, forest and mineral resource lands of long-term commercial significance; and
> - preserve and protect open space, scenic and cultural resources.

2021 Snohomish County Buildable Lands Report

The *Snohomish County Buildable Lands Report* (BLR), adopted September 8, 2021, by the Snohomish County Council, was developed in consultation with the cities of Snohomish County. The BLR is a requirement under the GMA that compares planned and actual urban densities to

determine if original comprehensive planning assumptions were accurate and if the cities in the County are capable of accommodating for their projected growth. For the development of the BLR, the County and associated cities conducted a review and evaluation of achieved urban densities, remaining anticipated growth, and the adequacy of the urban area land supply to accommodate the remaining projected residential and employment growth through 2035. The SEALUO utilizes population and employment capacity estimates from the BLR and 2044 targets from Snohomish County Ordinance No. 22-003 (adopted growth forecast, February 23, 2022).

LAND USE

The City limits currently encompass an area of approximately 1,871 acres or 2.9 square miles. The City's UGA encompasses an additional 347 acres outside of the current City limits for a total area of 3.5 square miles. The City's Future Land Use Map, shown in **Figure 3-1**, guides development within the City and its UGA. Land use outside the UGA is designated by the County, as shown in **Figure 3-1**.

Approximately 60 percent of the area within the current City limits is designated for residential use, as indicated in **Table 3-1**. Approximately 6 percent is designated for mixed use, approximately 4 percent is designated for commercial use, approximately 12 percent is designated for industrial use, and approximately 15 percent is designated for public facilities. The remaining land area within the City limits is non-designated right-of-way or other City properties located outside the City's UGA boundary.

Within the City's unincorporated UGA, approximately 65 percent is designated for residential use as shown in **Table 3-1**. Less than 1 percent is designated for commercial use, approximately 31 percent is designated for industrial use, and less than 1 percent is designated to public facilities. The remaining land area within the unincorporated UGA is allocated to non-designated right-of-way.

Table 3-1

Land Use – City Limits and Unincorporated UGA

Land Use Type	City Limits	Unincorporated UGA
Residential[1]	59.5%	65.2%
Mixed Use	5.9%	0.0%
Commercial[2]	3.8%	0.7%
Industrial[3]	11.8%	31.1%
Public Facility[4]	14.7%	0.1%
Non-Designated[5]	4.3%	3.0%
Total	**100%**	**100%**

1. Residential land use includes all residential land use types and traditional neighborhood land use.
2. Commercial land use includes general commercial and neighborhood business land uses.
3. Industrial land use includes both planned and general industrial land uses.
4. Public facility land use includes public facility, as well as parks and open space land use types.
5. Non-designated land uses include non-designated rights-of-way and City water facility property located outside of the UGA boundary.

POPULATION

Household Trends

The City is primarily a residential community comprised largely of single-family residences. In 2020, the Office of Financial Management (OFM) estimated that 2,175 housing units in the City, or 73 percent, were single-family residential, approximately 800 housing units, or 27 percent, were multi-family residential, and approximately 4 housing units, or 1 percent, were “mobile homes and specials.”

OFM data from the 2020 Census indicates an average household size for the City of 2.72 persons per household, and an average household size for Snohomish County of 2.68 persons per household. The BLR utilizes average household sizes of 3.00 persons per household for single-family detached units, 2.65 persons per household for townhouse units, 2.00 persons per household for multi-family units, and 1.20 persons per household for senior apartments.

Existing and Future City Population

The County has experienced rapid population growth and extensive physical developments in recent years. The population of the County increased approximately 12 percent from 2014 to 2020 based on OFM estimates. The population of the City increased approximately 18 percent

during the same period. **Table 3-2** illustrates the historical population growth since 2010, with years 1990, 1995, 2000, and 2005 included for reference.

Table 3-2

Historical Population Trends within City Limits

Year	Population
1990	1,961
1995	2,910
2000	3,923
2005	4,580
2010	6,231
2011	6,220
2012	6,300
2013	6,340
2014	6,530
2015	6,585
2016	6,635
2017	6,785
2018	6,835
2019	7,020
2020	7,705

NOTE: The historical population represents the population within the City limits. The sources of the historical population numbers are the OFM postcensal estimates.

City and UGA Population and Employment Capacity

Exhibit 7 of the SEALUO utilizes a 2020 base City population of 7,705 people, a 2020 base UGA population of 142 people, a 2019 base City employment of 3,865 jobs, and a 2019 base UGA employment of 192 jobs. Exhibit 7 also shows the existing City and UGA population and employment capacity per the BLR: 11,664 people and 4,822 jobs in the City, and 870 people and 1,482 jobs in the UGA. Year 2044 capacity targets from the BLR also are presented in Exhibit 7, identifying an employment capacity shortfall within the current City municipal boundary. This information is shown in **Table 3-3**.

Table 3-3

City and UGA Population and Employment Capacity

Population				
Area	**2020 Population**	**2021 Capacity[1]**	**2044 Target[2]**	**Capacity with Land Use Alternatives[3]**
City of Stanwood	7,705	11,664	10,963	12,310
Unincorporated Stanwood	142	870	432	870
Total	**7,847**	**12,534**	**11,395**	**13,180**
Employment				
Area	**2019 Employment**	**2021 Capacity[1]**	**2044 Target[2]**	**Capacity with Land Use Alternatives[3]**
City of Stanwood	3,865	4,822	5,073	5,298
Unincorporated Stanwood	192	1,482	726	1,482
Total	**4,057**	**6,304**	**5,799**	**6,780**

1 = Capacity estimates are based on the 2021 BLR.

2 = 2044 targets are from Snohomish County Ordinance No. 22-003, adopted growth forecast, February 23, 2022.

3 = Includes net change in capacity under SEALUO Alternatives 1 and 2.

The City has selected Alternatives 1 and 2 from the SEALUO to increase the City's population and employment capacity beyond the capacities reported in the BLR to achieve the BLR's 2044 targets. Per SEALUO Exhibit 21, Alternative 1 is projected to result in a net increase in City employment capacity of 513 jobs. Alternative 2 is projected to result in a net decrease in City employment capacity of 37 jobs, and a net increase in City population capacity of 254 dwellings. Based on the description of Alternative 2 in the SEALUO, the increase in dwellings was converted to population by multiplying the total number of households by the estimated average townhome household size of 2.65 people and townhome occupancy rate of 96 percent from the BLR, which results in an additional 646 people.

With the implementation of these alternatives, the 2044 City population capacity is expected to increase to approximately 12,310 people, and the 2044 City employment capacity is expected to increase to approximately 5,298 jobs, as shown in **Table 3-3**.

Existing and Projected Sewer System Population

The actual number of people currently served by the City's wastewater system is different than the population of the City limits and unincorporated UGA. The sewer system currently serves the majority of the existing City population shown in **Table 3-3** and a portion of the unincorporated UGA population.

The 2020 water system connections without wastewater service were identified by the City. It was assumed that there currently are no sewer connections without water service. The estimated population associated with the connections that have water service and no wastewater service was determined in two steps. First, the total number of single-family residential connections (101) was multiplied by the estimated average single-family detached unit household size of 3.0 people and the occupancy rate of 96 percent from the BLR, resulting in a total of 291 people. Second, the population associated with other connections was estimated. This included a mobile home (assumed two residents) adjacent to the Cedarhome Baptist Church and the Soundview Retirement

Home (five reported residents), neither of which are served by the City's sewer system. Of the estimated total population of 298 people, 172 are located within the City limits and 126 are located within the UGA. To determine the existing population served by the sewer system, these totals were subtracted from the City and unincorporated UGA population served by the water system, as shown in Table 3-4 of the City's *Water System Plan* (WSP). The existing (2020) total population served by the sewer system is approximately 7,540 people, as shown in **Table 3-4**.

Table 3-4

Sewer System Population

Year	City Population Served	Unincorporated UGA Population Served	Total Sewer System Population Served
2020	7,533	7	7,540
2021	7,689	45	7,734
2022	7,848	79	7,927
2023	8,010	109	8,119
2024	8,176	135	8,311
2025	8,345	160	8,505
2026	8,517	184	8,702
2027	8,693	208	8,901
2028	8,873	231	9,104
2029	9,056	255	9,312
2030	9,244	280	9,524
2031	9,435	306	9,741
2032	9,630	333	9,963
2033	9,829	362	10,191
2034 (+10 Years)	**10,032**	**393**	**10,426**
2035	10,240	427	10,666
2036	10,451	462	10,914
2037	10,667	501	11,168
2038	10,888	542	11,430
2039	11,113	587	11,700
2040	11,343	635	11,978
2041	11,577	687	12,264
2042	11,817	743	12,560
2043	12,061	804	12,865
2044 (+20 Years)	**12,310**	**870**	**13,180**
2074 (Est. Buildout)	**22,112**	**8,386**	**30,498**

The City has chosen to plan for sufficient sewer system capacity to supply the projected 2044 City and UGA population capacity reported in **Table 3-3**. A uniform growth rate was applied to the City and UGA population served between existing (2020) and 2044. As shown in **Table 3-4**, the sewer system is expected to provide service to a total of approximately 13,180 people in 2044.

For long-range planning purposes, a 50-year (2074) estimated buildout sewer system population was calculated by extrapolating the 2044 population into the future using the 2020 to 2044 City

and UGA projected growth rates. This results in a projected 2074 sewer system population of approximately 30,498 people. This estimated "buildout" population will be taken into consideration for facility capacity and collection system sizing, as the useful life of these sewer system elements is often far longer than a typical 20-year planning horizon. However, it is important to note that the accuracy of this population projection is very low and not directly based on the City's *Comprehensive Plan*; the City Planning Department does not have an operating definition or estimate of a true "buildout" population.

Existing and Projected Sewer System Employment

Similar to residential population, the existing employment currently served by the sewer system differs from the total employment within the City limits and UGA shown in **Table 3-3**.

As with the calculation of existing sewer system population, the existing sewer system employment was calculated by removing the estimated employment associated with the City's water connections that do not have sewer service from the estimated existing water system employment from WSP Table 3-5. All non-sewered water connections with associated employment are located in the UGA outside the City limits. The employment associated with these connections (approximately 139 jobs) was estimated based on the type of facility, inquiries to the facilities themselves on their number of employees, and other publicly available information. As shown in **Table 3-5**, the estimated existing (2020) sewer system employment is approximately 3,970 jobs.

Table 3-5

Sewer System Employment

Year	City Employment Served	Unincorporated UGA Employment Served	Total Sewer System Employment Served
2019	3,865	--	--
2020	3,914	56	3,970
2021	3,964	105	4,068
2022	4,014	148	4,162
2023	4,065	187	4,252
2024	4,117	223	4,340
2025	4,169	259	4,428
2026	4,222	294	4,515
2027	4,275	329	4,604
2028	4,330	365	4,695
2029	4,385	403	4,788
2030	4,440	443	4,883
2031	4,497	485	4,982
2032	4,554	531	5,084
2033	4,612	579	5,191
2034 (+10 Years)	**4,670**	**632**	**5,302**
2035	4,729	689	5,418
2036	4,789	751	5,540
2037	4,850	818	5,668
2038	4,912	891	5,802
2039	4,974	970	5,944
2040	5,037	1,056	6,093
2041	5,101	1,149	6,250
2042	5,166	1,251	6,417
2043	5,232	1,361	6,593
2044 (+20 Years)	**5,298**	**1,482**	**6,780**
2074 (Est. Buildout)	**7,735**	**17,215**	**24,950**

The City has chosen to plan for sufficient sewer system capacity to supply the projected 2044 City and UGA employment capacity reported in **Table 3-3**. A uniform growth rate was applied to the City and UGA employment served between existing (2020) and 2044. As shown in **Table 3-4**, the sewer system is expected to provide service to a total of approximately 6,780 jobs in 2044.

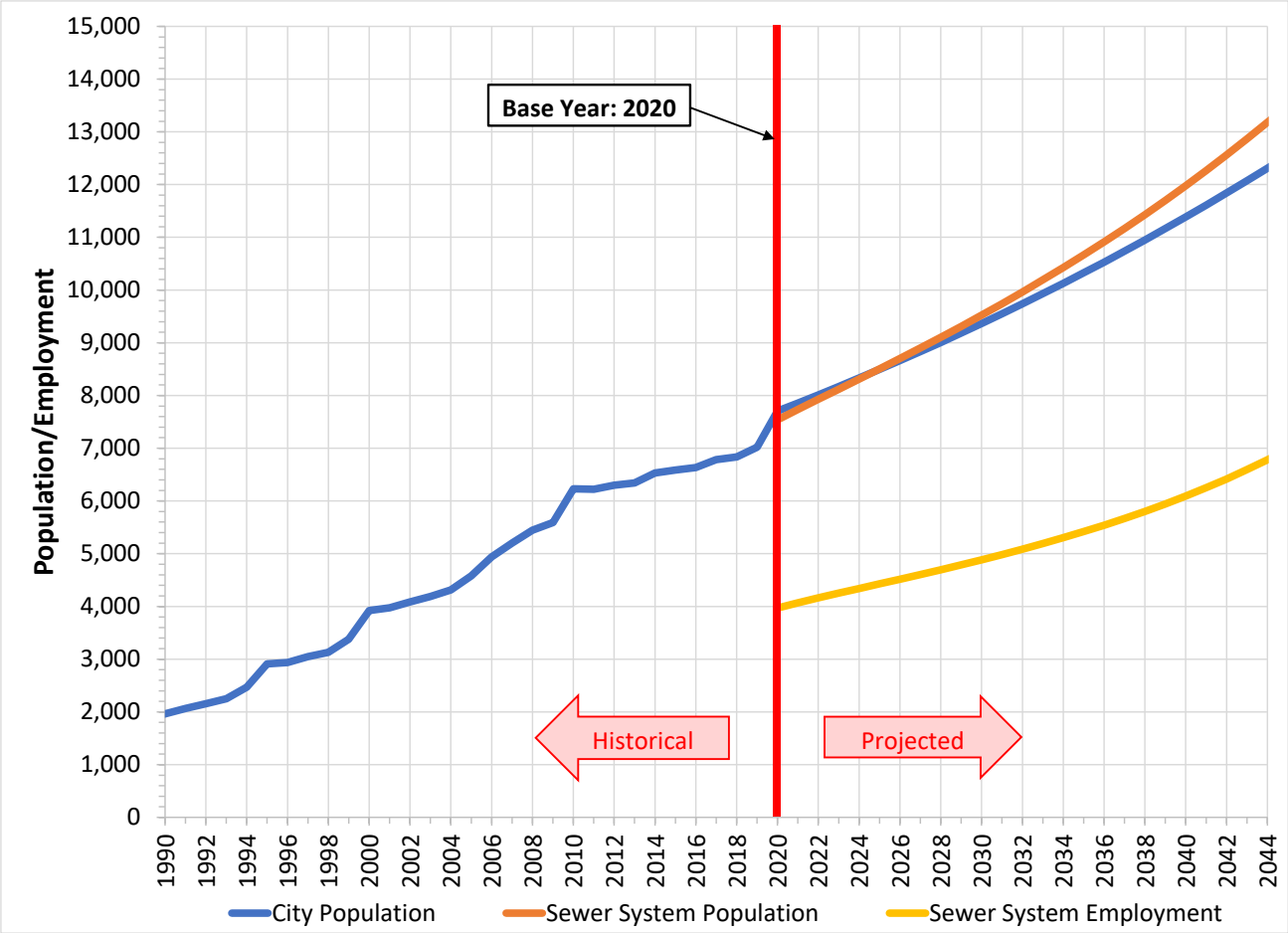
For long-range planning purposes, a 50-year (2074) estimated buildout sewer system employment was calculated by extrapolating the 2044 employment into the future using the 2020 to 2044 City and UGA projected employment growth rates. This results in a projected 2074 sewer system employment of approximately 24,950 people. This estimated “buildout” employment will be taken into consideration for facility capacity and collection system sizing, as the useful life of these sewer system elements is often far longer than a typical 20-year planning horizon. However, it is important to note that the accuracy of this employment projection is very low and not directly

based on the City's *Comprehensive Plan*; the City Planning Department does not have an operating definition or estimate of true "buildout" employment.

Chart 3-1 shows the historical and projected City population, existing and projected sewer system population, and existing and projected sewer system employment through 2044 graphically.

Chart 3-1

Population Projections



4 | FLOW AND LOAD ANALYSIS

INTRODUCTION

A detailed analysis of flow and loading in a sewer system is crucial to the planning efforts of a sewer service provider. When analyzing a sewer system, the first step is to identify current flow and load magnitudes to determine if the existing system can provide adequate service to its customers under the most crucial conditions, in accordance with federal and state laws. A future sewer system analysis identifies projected flow and load to determine where the system will need to be improved to satisfy future growth while continuing to meet federal and state laws.

Flow and load magnitudes in a sewer system are used to determine the size of gravity collection piping, lift station facilities, and force main piping, and the size and type of treatment facilities needed. This information also is used to develop the sewer service provider's National Pollutant Discharge Elimination System (NPDES) Permit required by the Washington State Department of Ecology (Ecology). This chapter presents a planning-level evaluation of the sewer system flow and loading. Several different flow scenarios (existing and projected future) were analyzed and are addressed in this chapter, including average annual flow (AAF), maximum month flow (MMF), maximum day flow (MDF), and peak hour flow (PHF).

System design criteria and standards have been developed to ensure that a consistent minimum level of service is maintained throughout the City of Stanwood's (City) sewer system and to facilitate planning, design, and construction of sewer system projects. A copy of the City's Sanitary Sewer Engineering Standards is included in **Appendix C**. Design requirements for sewer systems are available in Ecology's *Criteria for Sewage Works Design* (Orange Book).

EXISTING POPULATION, EMPLOYMENT, AND SERVICE CONNECTIONS

The City's wastewater collection planning area includes the entirety of the City limits and Urban Growth Area (UGA). As presented in **Chapter 3**, the existing (2020) population served by the sewer system is estimated to be 7,540 people, and the existing (2020) employment served by the sewer system is estimated to be 3,970 employees. The existing population and employment served differs from the total City and UGA population and employment because there are parcels within the sewer service area that are currently served by on-site septic systems.

As of December 2020, there were approximately 2,347 sewer service connections throughout the City's sewer system. The City classifies its sewer utility bills into 10 categories: individually metered, master metered, light commercial, heavy commercial, school-kitchen or gym, nursing homes and care facilities, restaurants, low income, general industrial, and meeting halls. A portion of utility customers are not classified. For the purposes of this General Sewer Plan (GSP), light commercial, heavy commercial, school-kitchen or gyms, and restaurants are all included under one "commercial" customer class. Inactive connections are not included. As shown in **Table 4-1**, 1,988 connections were individually metered connections, 69 were master metered connections, 209 were commercial connections, 5 were connections to nursing homes and care facilities, 61 were low income connections, 2 were industrial connections, and 9 were connections for

churches and meeting halls. Three connections remain unclassified. **Chart 4-1** shows the 2020 system connections broken down by customer class.

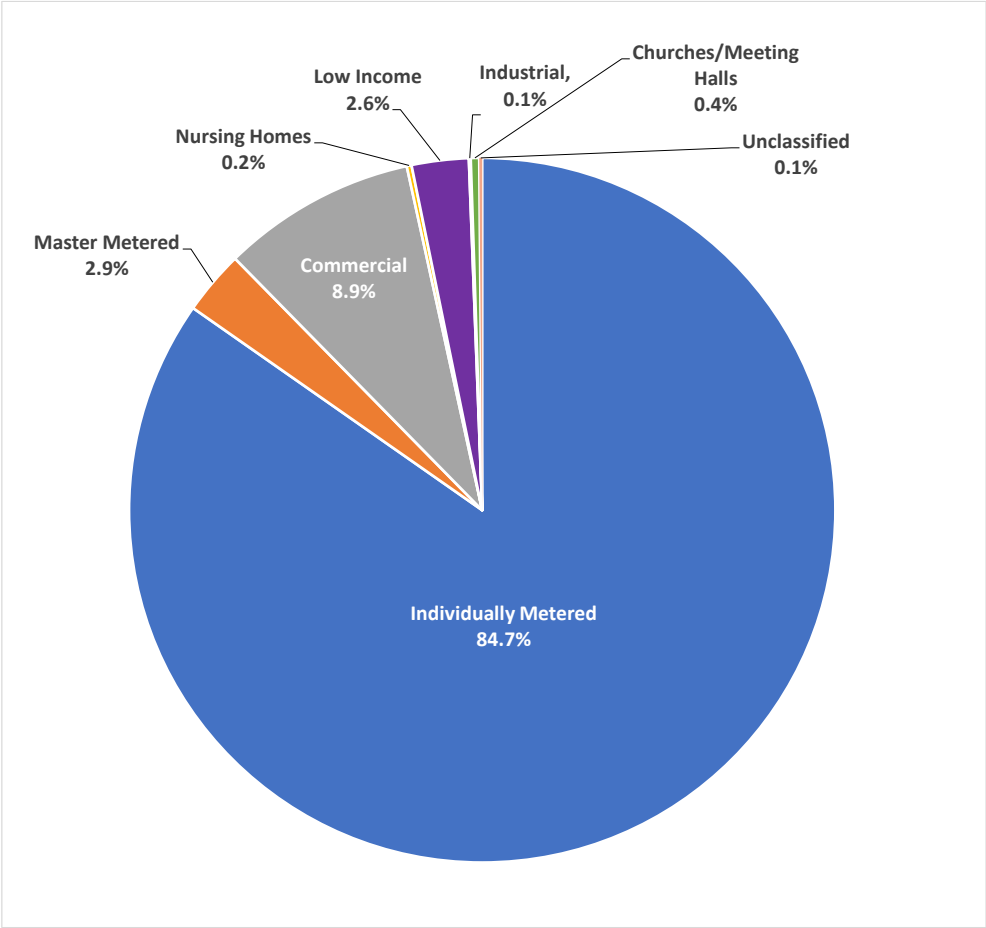
Table 4-1

2020 Sewer Service Connections Summary

Individually Metered Connections	Master Metered Connections	Commercial Connections	Nursing Home and Care Facilities	Low Income Connections	Industrial Connections	Churches and Meeting Halls	Unclassified Connections	Total Sewer Connections
1,988	69	209	5	61	2	9	3	**2,347**

Chart 4-1

2020 Sewer Service Connections by Customer Class



EXISTING WASTEWATER TREATMENT PLANT FLOW AND LOADING

Wastewater Treatment Plant Flow

The total influent flow to the wastewater treatment plant (WWTP) is made up of untreated flow from primarily residential customers, but also includes flow from a number of commercial, industrial, public facility, and other connections. The City's Discharge Monitoring Reports (DMRs)

and WWTP influent flow meter supervisory control and data acquisition data have been reviewed and analyzed to determine existing wastewater flows received at the WWTP.

Table 4-2 summarizes the historical WWTP AAFs, MMFs, MDFs, and PHFs (including infiltration and inflow [I/I]) on an annual basis for the 2016 through 2022 time period. While 2020 is utilized as the "base year" for the GSP, 2021 and 2022 data that became available after the GSP effort commenced is included to provide additional insight into loading changes from the COVID-19 pandemic. The 2020 to 2022 flow data does not appear to show any significant changes that can be attributed to the pandemic; AAF and MMF have remained relatively constant from 2016 to 2022, even as growth has occurred.

Table 4-2

Historical WWTP Influent Flow Summary

Year	AAF (MGD[1])	MMF (MGD)	MDF (MGD)	PHF (MGD)	Percent of NPDES Permit Max. Month Limit[2]	Peaking Factors		
						MMF/AAF	MDF/AAF	PHF/AAF
2016	0.55	0.76	1.38	--	51%	1.37	2.50	--
2017	0.56	0.78	1.15	--	52%	1.40	2.06	--
2018	0.58	0.93	1.90	--	62%	1.60	3.26	--
2019	0.52	0.64	1.03	2.02	43%	1.22	1.96	3.86
2020	0.58	0.85	2.18	2.30	57%	1.47	3.77	3.98
2021	0.60	0.95	1.67	2.28	63%	1.58	2.77	3.79
2022	0.59	0.80	1.54	--	53%	1.35	2.60	--
2016 to 2022 Average	**0.57**	**0.82**	**1.55**	**2.20**	**--**	**1.43**	**2.70**	**3.88**
2016 to 2022 Max.	**0.60**	**0.95**	**2.18**	**2.30**	**--**	**1.60**	**3.77**	**3.98**

1 = "MGD" = million gallons per day

2 = The City's WWTP is permitted for a maximum month average influent flow of 1.5 MGD.

Wastewater Treatment Plant Loading

The City's DMRs have been reviewed and analyzed to determine current wastewater characteristics and influent loadings. The 2016 through 2022 historical average annual and maximum month average 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS) loadings in pounds per day (ppd) and pounds per capita per day (ppcd) are summarized in **Tables 4-3** and **4-4**, respectively. The monthly average, maximum month, maximum week, and maximum day influent flow and loadings recorded at the WWTP for the 2016 through 2022 period are summarized in **Appendix D**.

Table 4-3

Historical WWTP Influent BOD_5 Loading Summary

Year	Sewer System Population	Sewer System Employment	Average Annual BOD_5 (mg/L)	Average Annual BOD_5 (ppd)	Max. Month BOD_5 (mg/L)	Max. Month BOD_5 (ppd)	Percent of NPDES Permit Max. Month Limit[1]	BOD_5 Max. Month Average/Average Annual Peaking Factor
2016	6,635	3,760	292	1,310	389	1,569	38%	1.20
2017	6,785	3,811	284	1,276	365	1,549	38%	1.21
2018	6,835	3,863	357	1,641	461	2,209	54%	1.35
2019	7,020	3,916	368	1,608	434	2,022	49%	1.26
2020	7,540	3,970	326	1,559	428	1,914	47%	1.23
2021	7,734	4,068	358	1,704	462	2,306	56%	1.35
2022	7,927	4,162	442	2,050	598	2,301	56%	1.12
2016 to 2022 Average	--	--	**347**	**1,592**	**448**	**1,981**	--	**1.25**
2016 to 2022 Max.	--	--	**442**	**2,050**	**598**	**2,306**	--	**1.35**

1 = The City's WWTP is permitted for a maximum month BOD_5 influent loading of 4,100 ppd.

Table 4-4

Historical WWTP Influent TSS Loading Summary

Year	Average Annual TSS (mg/L)	Average Annual TSS (ppd)	Max. Month TSS (mg/L)	Max. Month TSS (ppd)	Percent of NPDES Permit Max. Month Limit[1]	TSS Max. Month Average/Average Annual Peaking Factor
2016	289	1,286	331	1,431	35%	1.11
2017	292	1,337	361	1,677	41%	1.25
2018	314	1,452	388	1,893	46%	1.30
2019	332	1,462	399	1,873	46%	1.28
2020	316	1,562	382	2,725	66%	1.75
2021	274	1,339	437	2,099	51%	1.57
2022	306	1,407	498	1,914	47%	1.36
2016 to 2022 Average	**303**	**1,406**	**399**	**1,944**	--	**1.37**
2016 to 2022 Max.	**332**	**1,562**	**498**	**2,725**	--	**1.75**

1 = The City's WWTP is permitted for a maximum month TSS influent loading of 4,100 ppd.

Monthly average influent BOD_5 loadings ranged from 957 ppd to 2,419 ppd for the period of analysis, as shown in **Appendix D**. The monthly average influent TSS loadings ranged from 741 ppd to 2,725 ppd for the same period.

While 2020 is utilized as the "base year" for this GSP, 2021 and 2022 data that became available after the GSP effort commenced is included for reference to provide additional insight into loading changes from the COVID-19 pandemic. With the exception of the BOD_5 loading in 2022, BOD_5 and TSS loading have remained relatively constant from 2016 to 2022, even as growth has occurred. The reason for the 2022 increase in BOD_5 concentration is unknown at this time. Discussions with the City indicate that a dissolved oxygen sensor was replaced at the WWTP in July 2021 and additional restaurants were opened in 2022; However, neither of these explain the timing and magnitude of the BOD_5 increase. An analysis of DMR data from January to May 2023 showed BOD_5

concentration returning to pre-2022 levels. For this reason, future BOD_5 loading projections do not utilize 2022 data.

PEAKING FACTORS

Once existing flow rates are measured and defined, peaking factors can be used to determine future projected flow rates. Projected flows are used to further analyze how well the existing system will perform in the future and to determine the improvements required to maintain or improve sewer system function. Peaking factors are the ratio of higher flows, such as maximum day flow, to the average annual flow. **Tables 4-2, 4-3,** and **4-4** show the existing flow rates and peaking factors as measured at the City's wastewater treatment plant from 2016 to 2022. The peaking factors utilized for flow and loading projections are summarized in **Table 4-5**.

Table 4-5

Summary of Peaking Factors Utilized for Sewer System Flow and Loading Projections

Flow	
MMF/AAF	1.60
MDF/AAF	3.77
PHF/AAF	4.00
BOD_5	
Max. Month Average/Average Annual	1.35
TSS	
Max. Month Average/Average Annual	1.57

Peaking factors for collection system pipes and lift stations typically are based on peak hour flow rates. Peaking factors in the collection system can be greater than those experienced at the wastewater treatment plant due to the smaller size of the sewer drainage basin feeding the particular collector or lift station. As shown in **Table 4-5**, the calculated maximum 2016 to 2022 PHF/AAF peaking factor of 3.98 was increased to 4.00 for consistency with previous City sewer system planning.

For TSS, the second highest calculated peaking factor (2021) from **Table 4-4** was utilized in **Table 4-5**, as the highest calculated peaking factor (2020) is believed to be the result of an inaccurate TSS measurement in February 2020.

PER CAPITA WASTEWATER FLOW AND LOADING

Existing Per Capita Wastewater Flow

The estimated per capita wastewater flow contributed to the collection system (excluding I/I) was calculated using the existing population and employment estimates and water consumption estimates from the City's *Water System Plan* (WSP). The 2020 residential water consumption (individually and master metered sewer) was divided by the estimated 2020 residential population

served by the water system to determine the existing residential per capita flow (excluding I/I). Likewise, the 2020 employment water consumption (commercial/other and industrial) was divided by the estimated 2020 employment served by the water system to determine the existing employment per capita flow (excluding I/I). Irrigation consumption is not included, because this water would not be expected to directly enter the wastewater collection system. **Table 4-6** shows the existing residential and employment per capita flow (without I/I).

Table 4-6

Existing Per Capita Wastewater Flow

2020 Residential Population Served By Water System	8,382
2020 Total Annual Residential Water Consumption (gal)	158,208,971
Existing Residential Per Capita Flow (gal/day/capita)	**52**
2020 Employment Population Served by Water System	4,907
2020 Total Annual Employment Water Consumption (gallons)	74,356,571
Existing Employment Per Capita Flow (gal/day/capita)	**42**
Equivalent Population of Large Users Not Representative of Future Users	255
Annual Consumption of Large Users Not Representative of Future Users (gal)	32,301,176
2020 Employment Population Without Large Users Not Representative of Future Users	4,652
2020 Annual Consumption Without Large Users Not Representative of Future Users (gal)	42,055,395
Estimated Employment Per Capita Flow for Future Flow Projections (gal/day/capita)	**25**

A future employment per capita flow rate was developed by excluding consumption from several of the City's largest water users (Schenk Packing, Perdue Farms, North Star Cold Storage, Carlson Bulk Transport), who are not considered representative of future users. This flow rate is shown in **Table 4-6**.

The existing average flow rate per capita for the sewered residential population in 2020 is approximately 52 gallons per capita per day (gpcd). This per capita flow rate was used for the future residential wastewater flow projections in this GSP. The previous GSP utilized 100 gpcd for future flow projections in residential areas per Ecology guidelines; however, the 2016 to 2022 flow data has shown this was likely an overestimation.

The estimated average flow rate per capita for the sewered employment in 2020, adjusted to exclude large users not representative of future users, is approximately 25 gpcd. This per capita flow rate was used for the future employment wastewater flow projections in this GSP. The previous GSP utilized 35 gpd per person per shift per Ecology guidelines, which the 2016 to 2022 flow data has shown was likely an overestimation.

Numerous factors impact the validity of the per capita flow rates calculated in **Table 4-6**, and the City should regularly assess whether these remain accurate for future projections. Some factors for consideration include:

1. AAF received at the WWTP has remained relatively constant since 2016, while growth has occurred. This implies that per capita flow contributed to the system has been dropping due to reduced water usage, a conclusion that is supported by the fact that system-wide water consumption has remained relatively constant, as shown in WSP Table 4-1. Removal of I/I sources from the system also could be a factor in AAF remaining constant or dropping as

growth occurs. If per capita flow contributed to the system continues to fall and growth follows projections, some sewer system capacity upgrade schedules may be delayed.

2. Unanticipated large commercial/industrial/other water users can contribute a significantly larger per capita employment flow to the sewer system than shown in **Table 4-6**. These types of customers can require sewer system capacity upgrade schedules to be accelerated. The proposed No Meat Factory, discussed later in this chapter, is an example of a large industrial user that requires individual evaluation.

The City should monitor influent flow closely to determine if the average annual influent flow rate per capita continues to remain lower than the guidelines presented in Ecology's Orange Book.

I/I, which is not included in the per capita flow estimates in **Table 4-6**, is currently estimated to comprise approximately 24 percent of the total flow in the collection system on an average annual basis, as shown in **Table 4-13**. For future flow projections, it is assumed that the I/I component of average annual flow will increase with residential and employment growth at 24 percent of total flow.

PROJECTED WASTEWATER FLOW RATES

Future flow rates were calculated for the 2034 (10-year), 2044 (20-year), and 2074 (estimated buildout) planning horizons. Population projections, as shown in **Table 3-5** in **Chapter 3**, were used to calculate the projected flow rates.

Table 4-7 presents the existing and projected flow rates for the WWTP. As described previously, an average annual I/I equal to 24-percent of the total flow was used as a constant and included in all projections. For further discussion on I/I, refer to the **Infiltration and Inflow** section of this chapter.

Table 4-7

Projected Sewer System Average Annual, Maximum Month, and Peak Hour Flow Rates

	Year	Sewer Service Area Residential Population	Sewer Service Area Employment Population	AAF (MGD)	MMF (MGD)	PHF (MGD)	Percent of NPDES Permit Max. Month Limit
Existing	**2020**	**7,540**	**3,970**	**0.58**	**0.85**	**2.30**	**57%**
	2021	7,734	4,068	0.60	0.95	2.28	63%
	2022	7,927	4,162	0.59	0.80	--	53%
Projected	2023	8,119	4,252	0.59	0.94	2.34	62%
	2024	8,311	4,340	0.60	0.96	2.40	64%
	2025	8,505	4,428	0.62	0.99	2.47	66%
	2026	8,702	4,515	0.63	1.01	2.53	67%
	2027	8,901	4,604	0.65	1.04	2.60	69%
	2028	9,104	4,695	0.67	1.06	2.66	71%
	2029	9,312	4,788	0.68	1.09	2.73	73%
	2030	9,524	4,883	0.70	1.12	2.80	75%
	2031	9,741	4,982	0.72	1.15	2.87	77%
	2032	9,963	5,084	0.74	1.18	2.95	78%
	2033	10,191	5,191	0.76	1.21	3.02	80%
	2034 (+10 Years)	**10,426**	**5,302**	**0.77**	**1.24**	**3.10**	**83%**
	2035	10,666	5,418	0.79	1.27	3.18	85%
	2036	10,914	5,540	0.82	1.30	3.26	87%
	2037	11,168	5,668	0.84	1.34	3.35	89%
	2038	11,430	5,802	0.86	1.37	3.43	91%
	2039	11,700	5,944	0.88	1.41	3.53	94%
	2040	11,978	6,093	0.90	1.45	3.62	96%
	2041	12,264	6,250	0.93	1.49	3.72	99%
	2042	12,560	6,417	0.95	1.53	3.82	102%
	2043	12,865	6,593	0.98	1.57	3.92	105%
	2044 (+20 Years)	**13,180**	**6,780**	**1.01**	**1.61**	**4.03**	**107%**
	2074 (Est. Buildout)	**30,498**	**24,950**	**2.76**	**4.42**	**11.1**	**294%**

The City's current NPDES Permit allows a maximum month average influent flow of 1.5 million gallons per day (MGD) at the WWTP. As shown in **Table 4-7**, the flow capacity of the treatment plant will be exceeded within the 20-year planning period. At 85-percent capacity, wastewater treatment plant upgrade planning will need to begin. The City's Capital Improvement Plan (CIP) includes the planning, engineering, and construction of the wastewater treatment plant upgrades.

Individual sewer system basin flow projections for the basins shown on **Figure 4-1** are provided in **Table 4-8**. Existing flow for 2020 was allocated to each basin based on flow monitoring data collected by ADS Environmental Services where available (not all basins had flow monitors installed). Flow was then allocated for population and employment growth using 10- and 20-year distribution maps provided by the City (**Appendix E**). These maps were originally created in 2014 but are the best spatial planning projections the City has available. It was assumed that the 10-year map was representative of the population and employment growth between 2020 and 2034, and the 20-year map was representative of growth between 2020 and 2044. Future I/I was distributed throughout the sewer system proportionally by basin area. For further discussion on I/I, refer to the **Infiltration and Inflow** section. Flows presented in **Table 4-8** are source flows only and do not

include lift station force main discharges. For a discussion of lift station flows applied to the model, reference **Chapter 6**.

Table 4-8

Sewer Drainage Basin Existing and Proposed Peak Hour Flow Rates

Flow Basin	2020 Existing PHF (gpm)	2034 Projected PHF (gpm)	2044 Projected PHF (gpm)
Downtown Westside	254	265	320
Central	322	406	484
Northeast	647	844	1,069
East	92	212	335
Downtown Eastside	282	318	413
Future Service Area[1]	-	106	180
Total	**1,597**	**2,152**	**2,801**

1 = Areas within the UGA but outside the current sewer service area where future population and employment growth are allocated.

PROJECTED WASTEWATER LOADING RATES

Projections for wastewater treatment plant loading were developed by splitting the BOD_5 and TSS loading between residential sources and all other sources (employment). For both BOD_5 and TSS, the Ecology recommended value of 0.2 ppcd was used for residential projections. For employment projections, a value of 0.03 ppcd was used for BOD_5 and TSS (Ecology recommended range of 0.03 to 0.07 ppd per person per 8-hour factory shift). Loading data for the base year of 2020 was used to determine the remaining BOD_5 and TSS received at the treatment plant in excess of the amount attributed to residential users and was allocated as employment. **Table 4-9** summarizes the per capita TSS and BOD_5 loading used for projections.

Table 4-9

BOD_5 and TSS Per Capita Loading Projections

BOD_5	
2020 BOD_5 Pounds Per Capita Per Day (Residential)	0.20
2020 BOD_5 Pounds Per Capita Per Day (Employment)	0.03
TSS	
2020 TSS Pounds Per Capita Per Day (Residential)	0.20
2020 TSS Pounds Per Capita Per Day (Employment)	0.03

The peaking factors shown in **Table 4-5** were used to determine maximum month loading from annual average loading. **Tables 4-10** and **4-11** present the existing and projected BOD_5 and TSS loading rates for the wastewater treatment plant.

Table 4-10

Projected Wastewater Treatment Plant BOD_5 Loadings

	Year	Sewer Service Area Residential Population	Sewer Service Area Employment Population	Annual Average BOD_5 (ppd)	Maximum Month BOD_5 (ppd)	Percent of NPDES Permit Max. Month Limit
Existing	**2020**	**7,540**	**3,970**	**1,559**	**1,914**	**47%**
	2021	7,734	4,068	1,704	2,306	56%
	2022	7,927	4,162	2,050	2,301	56%
Projected	2023	8,119	4,252	1,753	2,372	58%
	2024	8,311	4,340	1,794	2,428	59%
	2025	8,505	4,428	1,836	2,484	61%
	2026	8,702	4,515	1,878	2,541	62%
	2027	8,901	4,604	1,920	2,599	63%
	2028	9,104	4,695	1,964	2,657	65%
	2029	9,312	4,788	2,008	2,717	66%
	2030	9,524	4,883	2,053	2,778	68%
	2031	9,741	4,982	2,100	2,841	69%
	2032	9,963	5,084	2,147	2,905	71%
	2033	10,191	5,191	2,196	2,972	72%
	2034 (+10 Years)	**10,426**	**5,302**	**2,246**	**3,039**	**74%**
	2035	10,666	5,418	2,298	3,109	76%
	2036	10,914	5,540	2,351	3,181	78%
	2037	11,168	5,668	2,406	3,255	79%
	2038	11,430	5,802	2,462	3,332	81%
	2039	11,700	5,944	2,520	3,410	83%
	2040	11,978	6,093	2,580	3,492	85%
	2041	12,264	6,250	2,642	3,576	87%
	2042	12,560	6,417	2,706	3,662	89%
	2043	12,865	6,593	2,773	3,752	92%
	2044 (+20 Years)	**13,180**	**6,780**	**2,841**	**3,845**	**94%**
	2074 (Est. Buildout)	**30,498**	**24,950**	**6,850**	**9,269**	**226%**

Table 4-11

Projected Wastewater Treatment Plant TSS Loadings

	Year	Sewer Service Area Residential Population	Sewer Service Area Employment Population	Annual Average TSS (ppd)	Maximum Month TSS (ppd)	Percent of NPDES Permit Max. Month Limit
Existing	**2020**	**7,540**	**3,970**	**1,562**	**2,725**	**66%**
	2021	7,734	4,068	1,339	2,099	51%
	2022	7,927	4,162	1,407	1,914	47%
Projected	2023	8,119	4,252	1,447	2,268	55%
	2024	8,311	4,340	1,489	2,333	57%
	2025	8,505	4,428	1,530	2,398	58%
	2026	8,702	4,515	1,572	2,463	60%
	2027	8,901	4,604	1,614	2,530	62%
	2028	9,104	4,695	1,658	2,598	63%
	2029	9,312	4,788	1,702	2,667	65%
	2030	9,524	4,883	1,747	2,738	67%
	2031	9,741	4,982	1,794	2,811	69%
	2032	9,963	5,084	1,841	2,886	70%
	2033	10,191	5,191	1,890	2,962	72%
	2034 (+10 Years)	**10,426**	**5,302**	**1,940**	**3,041**	**74%**
	2035	10,666	5,418	1,992	3,122	76%
	2036	10,914	5,540	2,045	3,205	78%
	2037	11,168	5,668	2,100	3,291	80%
	2038	11,430	5,802	2,156	3,379	82%
	2039	11,700	5,944	2,214	3,470	85%
	2040	11,978	6,093	2,274	3,564	87%
	2041	12,264	6,250	2,336	3,661	89%
	2042	12,560	6,417	2,401	3,762	92%
	2043	12,865	6,593	2,467	3,866	94%
	2044 (+20 Years)	**13,180**	**6,780**	**2,536**	**3,973**	**97%**
	2074 (Est. Buildout)	**30,498**	**24,950**	**6,544**	**10,256**	**250%**

The City's current NPDES Permit allows a maximum month average BOD_5 of 4,100 ppd and a maximum month average TSS of 4,100 ppd. As shown in **Table 4-10** and **Table 4-11**, 85-percent of the loading capacity of the WWTP for BOD_5 and TSS will be exceeded within the 20-year planning period. At 85-percent capacity, wastewater treatment plant upgrade planning will need to begin. The City's CIP includes the planning, engineering, and construction of the WWTP upgrades.

PROJECTED WASTEWATER FLOW AND LOADING RATES WITH NO MEAT FACILITY

While the previous Twin City Foods facility is currently not a water or sewer system customer, a business under the name No Meat Factory (NMF), has purchased the plant and is currently renovating. They have requested a proposed connection to the sewer system. NMF is also considering other options for industrial wastewater handling. If NMF connects to the City, it is anticipated to be a substantial contributor of wastewater flow and loading to the City's sewer system; preliminary flow and loading projections provided by NMF for the facility are shown in

Table 4-12. The projected flow and loading contribution from NMF is likely subject to change as additional information becomes available.

Table 4-12

No Meat Factory Projected Flow and Loading

MMF (MGD)	MDF (MGD)	Average BOD_5 (mg/L)	Max. Month BOD_5 (ppd)	Average TSS (mg/L)	Max. Month TSS (ppd)
0.03	0.05	500	142	500	142

Tables 4-13, 4-14, and **4-15** present the projected maximum monthly flow and loading of the system as a whole with the addition of the anticipated NMF flow and loading.

Table 4-13

Projected Sewer System Flow with No Meat Factory Discharge

Year	MMF (MGD)	Percent of NPDES Permit Max. Month Limit
2023	0.97	65%
2034 (+10 Years)	1.27	85%
2044 (+20 Years)	1.65	110%
2074 (Est. Buildout)	4.45	297%

Table 4-14

Wastewater Treatment Plant BOD_5 Loadings with No Meat Factory

Year	Maximum Month BOD_5 (ppd)	Percent of NPDES Permit Max. Month Limit
2023	2,514	61%
2034 (+10 Years)	3,181	78%
2044 (+20 Years)	3,987	97%
2074 (Est. Buildout)	9,411	230%

Table 4-15

Wastewater Treatment Plant TSS Loadings with No Meat Factory

Year	Maximum Month TSS (ppd)	Percent of NPDES Permit Max. Month Limit
2023	2,410	59%
2034 (+10 Years)	3,183	78%
2044 (+20 Years)	4,115	100%
2074 (Est. Buildout)	10,397	254%

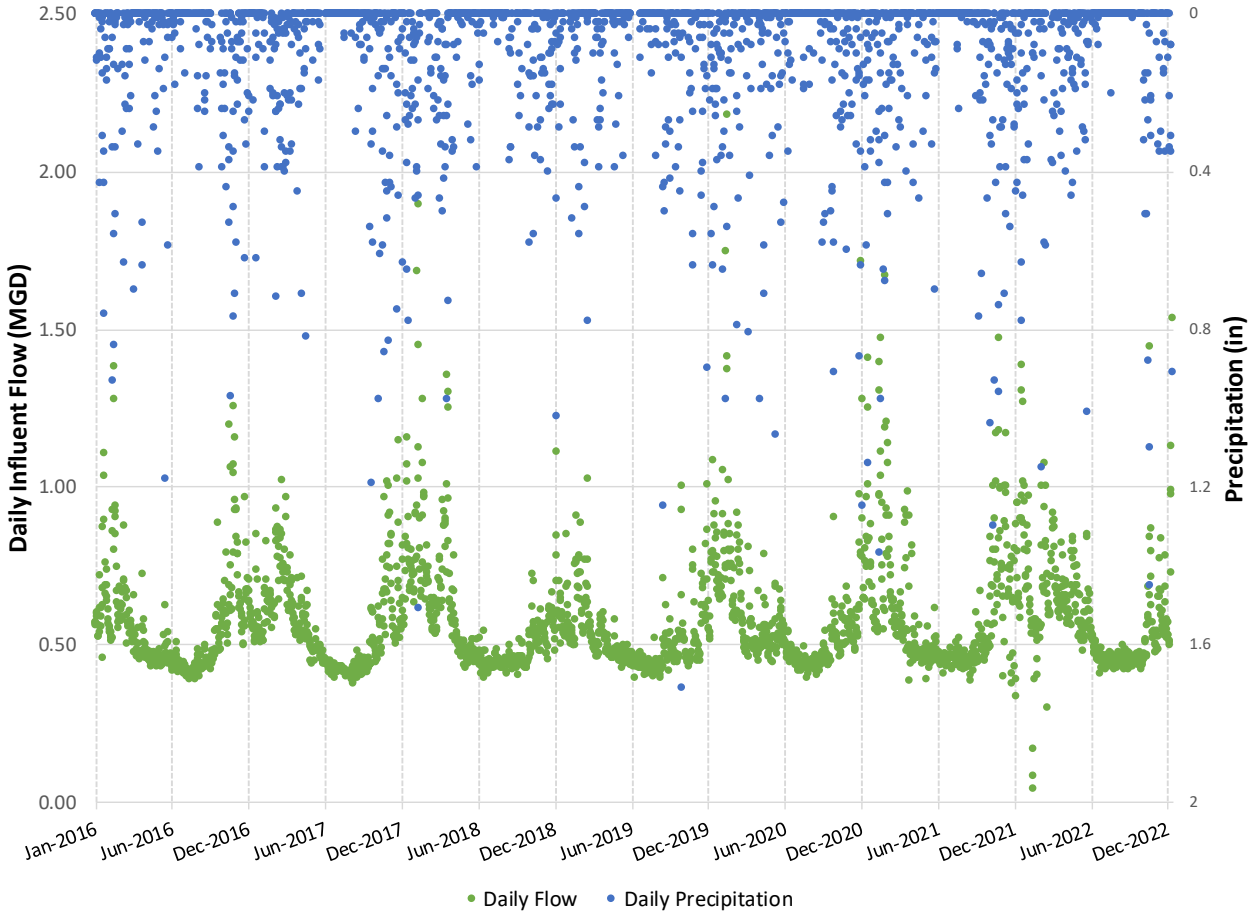
INFILTRATION AND INFLOW

A sanitary sewer system must be able to carry the domestic wastewater generated by utility customers and the extraneous I/I that is a part of every sewer collection system. For this analysis, I/I was evaluated on both the basin level and a complete system level. Analysis of instream flow monitoring data and DMRs shows the highest I/I flow rates are associated with storm events.

The daily influent flow of wastewater to the treatment plant and rainfall data collected are presented in **Chart 4-2** for January 2016 through December 2022. This chart demonstrates the effect of rainfall on the daily average influent flow to the WWTP and confirms that I/I is occurring.

Chart 4-2

Daily Influent Flow and Rainfall



Analysis Methodology

Rainfall data from both the National Oceanic and Atmospheric Administration and ADS was used to determine extended dry weather periods. The system-wide and individual basin dry weather flows were calculated during these periods. These flow rates were then used to estimate base flow volumes over specific time periods and areas. To calculate I/I, the base flow volumes are subtracted from the total flow volumes.

Total System Analysis

DMR data from Ecology was used to calculate daily I/I volumes from January 2016 through December 2022. The annual dry weather flow was then calculated and subtracted from the total flow into the WWTP to determine I/I. The I/I is shown as a percent of the total influent flow in **Table 4-16** and **Table 4-17**.

Table 4-16

System I/I as a Percentage of Annual Influent Volume

Year	Percent of Total Influent as I/I
2016	25%
2017	26%
2018	25%
2019	16%
2020	24%
2021	25%
2022	25%
2016 to 2022 Average	**24%**

The I/I as a percentage of the system's annual flow volume varies from 16 percent to 26 percent through the analysis period, and averages 24 percent.

The maximum I/I as a percentage of the total monthly flow volume coincided with the MMF of each year. **Table 4-17** indicates almost twice as much I/I on a percentage basis during MMF

conditions when compared to the I/I as a percentage of annual influent flow. During the analysis period, 46 percent of MMF was comprised of I/I on average.

Table 4-17

System I/I as a Percentage of MMF Volume

Year	MMF (MGD)	Percent of MMF Influent Volume as I/I
2016	0.76	45%
2017	0.78	47%
2018	0.93	53%
2019	0.64	31%
2020	0.85	48%
2021	0.95	52%
2022	0.80	45%
2016 to 2022 Average	**0.82**	**46%**

Basin Analysis

Flow meters were installed by ADS at four locations in the sewer system from January 25 to August 4, 2022, to monitor and compare the flow rates from different basins (the ADS report is included in **Appendix F**). These basins, shown in **Figure 4-1**, comprise the majority of the sewer system area. A comparison of the flow monitoring data against the DMR data showed that the magnitude of the flow monitoring data largely differed from the magnitude of the DMR data, which presented challenges for analyzing of the flow monitoring data. As such, the I/I analysis at the basin level is presented as percentages of flow in each basin, rather than volumetric flow rates.

Dry weather flow data from the flow monitoring period was used to establish base flow volumes for each basin. These base flow volumes were then subtracted from the total flow volumes from each basin to calculate I/I. The percent of basin flow volume as I/I as recorded during the flow monitoring period are shown in **Table 4-18**. The Downtown Eastside basin is not included in this table as there was no flow monitoring in this basin during this period.

Table 4-18

Basin I/I as a Percentage of Total Flow Volume (2022 Flow Monitoring Period)

Basin	Percent of Basin Flow Volume as I/I	Linear Feet of Sewer Main
Downtown Westside	35%	18,150
Central	17%	19,662
Northeast	23%	72,171
East	5%	21,697

It should be noted that the percentages in **Table 4-18** do not sum to 100-percent as they represent I/I as a percent of the total flow in each respective basin.

The I/I component of flow from the Downtown Westside basin was observed to remain high during extended summer dry weather periods. This pattern was not recorded in any other basin and may

have been caused by infiltration of irrigation water into the sewer system or other phenomena not directly correlated with rainfall.

EPA Excessive I/I Evaluation

The United States Environmental Protection Agency (EPA) published a report in May 1985, *Infiltration/Inflow, I/I Analysis and Project Certification* that developed guidelines to help determine what amount of I/I is considered to be "excessive."

The EPA report gives guidelines for determining whether inflow can be classified as non-excessive. Inflow is considered to be non-excessive if the average daily flow during periods of heavy rainfall or spring thaw (i.e., any event that creates surface ponding and surface runoff) does not exceed 275 gpcd. The peak recorded flow day in recent years of record per the City's DMRs was 2.18 MGD, which occurred on February 6, 2020. The City experienced a 6-day period of rain that resulted in more than 1.55 inches of rainfall. When divided by the number of residential customers in 2020, this peak inflow event equates to a flow rate of 289 gpcd, which is above the EPA maximum of 275 gpcd.

The determination of non-excessive infiltration was based on the national average for dry weather flow of 120 gpcd. In order for the amount of infiltration to be considered non-excessive, the average daily flow must be less than 120 gpcd (i.e., a 7- to 14-day average measured during periods of seasonal high groundwater). Although it can be difficult to determine how much of the flow is due to inflow or infiltration, peak inflow will generally occur immediately during or just after a significant rain event, while peak infiltration will occur during the high groundwater period that follows prolonged precipitation events. In addition, it is difficult to find a 7 to 14-day period without rain in the winter in the Pacific Northwest. Therefore, periods were chosen that include negligible or small amounts of rain (less than or equal to 0.30 inches of rain). The peak dry weather flow period in recent years of record for the City was the 7-day period from December 23 to December 29, 2020. This period was preceded by 4 days of rain and yielded an average flow rate of 0.70 MGD. When divided by the 2020 residential population, this equates to 93 gpcd, which is less than the EPA threshold of 120 gpcd.

Conclusions

The system level I/I analysis shows that although I/I only makes up an average of 24 percent of the annual plant flow, it is a significant component during the highest monthly flows. During the maximum months, it rose as high as 53 percent of the plant flow. The basin level analysis shows I/I is spread throughout multiple basins and is not concentrated in a single area. The 2022 MMF during the flow monitoring period showed 39 percent of the total WWTP flow (0.28 MGD) was I/I, and the basin with the highest I/I volume per linear feet of sewer main was the Downtown Westside basin. This indicates the Downtown Westside basin is the best potential basin for I/I reduction through sewer main rehabilitation or replacement projects.

Although inflow exceeds the EPA threshold, the EPA methodology is limited in that it does not consider the linear footage of sewer main, the actual volume of I/I, or the potential localized

sources of I/I. The results of this evaluation only confirm there is some degree of I/I contribution to the total system flow.

Based upon the estimated I/I from the DMR and flow monitoring data, as well as the determinations of excessive I/I per the EPA recommendation, the City will continue to monitor I/I and evaluate future steps for I/I reduction. The City may consider conducting an I/I study to confirm these results and to locate the affected collection system areas to determine if there are any cost-effective sewer rehabilitation measures to remove any excessive I/I. Any I/I studies conducted in the future should follow the guidelines defined in Chapter C-1 of Ecology's Orange Book.

5 | POLICIES AND DESIGN CRITERIA

INTRODUCTION

The City of Stanwood (City) operates and plans sewer service for the City and associated sewer service area residents and businesses according to the design criteria, laws, and policies that originate from the U.S. Environmental Protection Agency and the Washington State Department of Ecology (Ecology).

These laws, design criteria, and policies guide the City's operation and maintenance of the sewer system on a daily basis, as well as the City's plan for growth and improvements. Their overall objective is to ensure that the City provides high-quality sewer service at a fair and reasonable cost to its customers. They also set the standards the City must meet to ensure that the sewer system is adequate to meet existing and future flows. The system's ability to handle these flows, and the recommended improvements, are detailed in **Chapter 6**, **Chapter 7**, **Chapter 8**, and **Chapter 10**.

The City Council adopts regulations and policies that cannot be less stringent or in conflict with those established by the federal and state governments. The City's policies take the form of ordinances, memoranda, and operational procedures, many of which are summarized in this chapter.

The policies associated with the following categories are presented in this chapter.

- Regulations
- Customer Service
- Collection System
- Lift Stations
- Operational
- Organizational
- Finance

REGULATIONS

National Pollutant Discharge Elimination System Permit

The State of Washington regulates the federal effluent limitations with the National Pollutant Discharge Elimination System (NPDES) program. Wastewater discharge into waters of the state shall have an NPDES Permit from Ecology. The City's permit allows 1.5 million gallons per day for the average flow during the maximum month. The permit also contains influent and effluent quality standards, monitoring requirements, pretreatment requirements, and system maintenance requirements; a copy of the City's NPDES Permit is included in **Appendix A**.

Other Regulations and Required Permits

The City also is regulated by the Puget Sound Clean Air Agency (Registration No. 10947) and maintains a lab accreditation through Ecology. The City is currently regulated under the Puget Sound Nutrient General Permit (WAG994534) and General Permit for Biosolids Management.

CUSTOMER SERVICE POLICIES

Sewer Service and Connection

- The City will strive to provide sewer service to the people within the City's sewer service area, provided all policies related to service can be met.
- Proposed developments within the City's sewer service area shall connect directly to the City's sewer system, unless deemed unfeasible by the Public Works Director at the time of the request.
- Sewer system extensions required to provide sewer service to proposed developments shall be approved by the Department of Public Works and must conform to the City's General Sewer Plan and *Wastewater Facilities Plan*, Ecology and Snohomish County Health Department requirements, and the City's most current, adopted Design and Construction Standards and Specifications. All costs of the extension shall be borne by the developer or applicant. The sanitary sewer section (Chapter 5) from the City's most current edition of the Design and Construction Standards and Specifications is included in **Appendix C**.
- Sewer service can be extended outside of the City limits and within the Urban Growth Area (UGA) only if the project is in compliance with the City's utility regulations, standards, and policies.
- Sewer service cannot be extended outside of the City's UGA, except for certain exceptions identified in the Stanwood Municipal Code.
- Sewer extensions shall be given based on system capacity using the following priorities:
    - Extensions shall first be given to applicants within City limits.
    - Second priority shall be given to those applicants within the UGA.
    - Extensions may be given higher priority where existing environmental problems make extension necessary.
- For sewer service applications within the City limits, the City will review the availability for sewer service at the time of the land use permitting, site development permit review, and building permit. During the land use permitting process, the City will determine if sewer is available for the site. During the site development permit review, the City will address the sizing and location of the sewer extension. The formal sewer service application begins at the time of building permit when service sizing is evaluated.
- For sewer service applications outside of the City limits but within the UGA, the applicant must first obtain a sewer utility service agreement from the City. The City will review the agreement and determine the availability of sewer. Annexation is required before service can be provided outside City limits.

- Sewer collection system, lift station, and treatment plant capacity will be considered when providing sewer availability to applicants.
- Sewer availability shall expire at the time that the associated permit expires (i.e. land use, site development, or building permit).
- Time extensions in regard to sewer availability shall be granted in accordance with the associated permit requirements. When extensions are denied, the disputes are handled through the rules guiding the associated permit process. Disputes can be brought to the City Council for discussion.

Septic Systems

- Existing single-family homes with septic systems in good working condition, per the Snohomish County Health Department, may continue to be used. All septic systems in the City shall be monitored per the Snohomish County Health Department's regulations.
- Property owners with a failing septic system, as documented by the Snohomish County Health Department, shall connect to the sewer system.
- Connection to the public sewer system is not required for structures that generate sewage that are located 200 feet or more away from the public sewer.
- Any private residential or commercial development property that is adjacent to a public sewer location is required to connect to the public sewer system regardless of distance from the public sewer.

COLLECTION SYSTEM POLICIES AND DESIGN CRITERIA

Sanitary Sewer Design Criteria

- All sewer lines within the City shall be designed in accordance with good engineering practice by a professional engineer with the minimum design criteria presented in the *Criteria for Sewage Works Design*, prepared by Ecology, May 2023, or as superseded by subsequent updates. Chapter C1 of this document includes standards and guidelines for design considerations (minimum pipe sizes, pipe slopes, and wastewater velocities), maintenance considerations, estimating wastewater flow rates, maintenance hole locations, leak testing, and separation from other underground utilities. These criteria have been established to ensure that the sanitary sewers convey the sewage and protect public health and the environment. The sewer lines also shall conform to the latest regulatory requirements relating to design.
- Sewers shall be designed and constructed in accordance with the City's most current Design and Construction Standards and Specifications.

Gravity Sewer Design Criteria

- All sewers shall be designed as a gravity sewer whenever feasible and buried at a minimum depth of 5 feet.

- Layout of extensions shall provide for the future continuation of the existing system as determined by the City.
- The smallest diameter sewer allowed is 8 inches for sub-mains and mains and 4 inches for laterals. A 6-inch-diameter sub-main lateral is required for all commercial, multi-family, or business owners.
- Maintenance holes shall be 48 inches in diameter and will be spaced at intervals not to exceed 400 feet for 8- to 15-inch sewers and 500 feet for 18- to 30-inch sewers.
- Maintenance holes shall be located at changes in grade, direction, and sewer size, and at intersections.
- New mains connecting to an existing main shall be made via a new or existing maintenance hole.

Design Flow Rates

- New gravity sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day (gpd).
- Laterals and sub-main sewers should be designed to carry not less than 400 gpd per capita when running full.
- All sewers will be laid on a grade to produce a mean velocity of at least 2 feet per second (fps) when flowing full.
- Sanitary sewer system flows are composed of residential, institutional, business, commercial, and industrial wastewater, along with infiltration and stormwater inflow. Sanitary sewer systems must be capable of conveying the ultimate peak flows of these sources.
- No overflows will be permitted.

Gravity Pipe Material and Roughness

- Gravity sewer main shall be polyvinyl chloride (PVC) unless otherwise approved by the Public Works Director. All materials shall be in accordance with the City's most current Design and Construction Standards and Specifications.
- The Manning equation is used to design and analyze wastewater flow characteristics of sanitary sewers. The Manning roughness coefficient "n" varies depending on the pipe material; an "n" value of 0.013 shall be used unless deemed justifiable on the basis of research or field data submitted.

Separation Between Sanitary Sewer and Other Utilities

- A minimum horizontal separation of 10 feet is required between sewer and water lines (edge to edge).
- The guidelines provided in Ecology's *Criteria for Sewage Works Design* should be followed for difficult spacing or other situations.

Design Period

- The design period is the length of time that a given facility will provide safe, adequate, and reliable service. The design period selected is based on the economic life of a given facility, which is determined by the structural integrity of the facility, the rate of degradation, the replacement cost, the cost of increasing the capacity of the facility, and the projected population growth rate serviced by the facility.
- Collection and interceptor sewers are designed for the peak development of a contributing area.
- The life expectancy for new sanitary sewers, using current design practices, is in excess of 50 years.

Force Main Design Criteria

- All force mains within the City shall be designed in accordance with good engineering practice by a professional engineer with the minimum design criteria presented in the *Criteria for Sewage Works Design*, prepared by Ecology, May 2023, or as superseded by subsequent updates. Chapter C2 of this document contains design considerations for force mains.
- A control method to mitigate hydrogen sulfide odor and the buildup of sulfuric acid shall be used.
- A minimum velocity of 2 fps at average dry weather flow should be maintained to keep solids in suspension. A minimum scouring velocity of 3 fps should be maintained, and velocities should not exceed 8 fps.
- Allowable force main pipe material shall include ductile iron, PVC, or high-density polyethylene for sizes up to 12 inches. Ductile iron and PVC shall be used for pipe sizes 14 to 24 inches, unless otherwise approved by the Public Works Director. All materials shall be in accordance with the City's most current Design and Construction Standards and Specifications. Force mains shall have a minimum of 36 inches of cover.
- Extension layouts shall provide for the future continuation of the existing system as determined by the City. Main extensions may be extended to and through the side of the affected property fronting the main.
- Provisions to drain the force main for repair or temporarily remove the force main from service shall be provided.

Side Sewer Design Criteria

- Side sewers shall provide a single service. Each individual single-family, duplex, and triplex unit shall have its own side sewer. Four-plex and larger multi-family buildings, as well as other non-residential buildings, shall have one side sewer per building. The property/building owner shall own and maintain sewer service from the building to the sewer main.
- Side sewers shall be installed in accordance with the City's most current Design and Construction Standards and Specifications.

- A side sewer shall be stubbed to the existing lots at their property line when a new main is installed in front of or alongside existing properties.

LIFT STATION POLICIES AND DESIGN CRITERIA

- Lift stations shall be designed in accordance with the City's most current Design and Construction Standards and Specifications and Ecology's *Criteria for Sewage Works Design*.
- The design of the lift station, including layout, building, equipment, and control systems, shall be equal to the City's existing Copper Station Lift Station unless otherwise approved by the Public Works Director.
- A lift station emergency bypass connection shall be provided per the City's Standard Details.
- Lift stations shall be designed for peak design flow with the largest pump out of service.
- Lift stations should be designed for a 20-year design life.
- All existing and future lift stations will be modified/constructed to comply with the following minimum standards:
    - All structures will be non-combustible, where practical.
    - All buildings will have adequate heating, cooling, ventilation, insulation, lighting, and work spaces necessary for on-site operation and repair.
    - Sites will be fenced to reduce vandalism and City liability.
    - Each station will be equipped with a flow meter and all necessary instrumentation to assist personnel in operating and troubleshooting the facility.
    - Emergency power capability will be provided at all lift stations.
    - Each station shall be equipped with a bypass to allow manual control.
    - Each station shall address corrosion control.
    - Each station shall include an intrusion alarm system.
- Pumps will be operated automatically, with flexibility in pump start/stop settings.
- Pumps shall be a submersible Wemco-Hidrostal Prerostal pre-rotation pumping system unless otherwise approved by the Public Works Director.
- Stations will be operated with the provision for at least two methods of control to minimize system vulnerability.

OPERATIONAL POLICIES

Maintenance

- Equipment breakdown is given highest maintenance priority, and repairs should be made as soon as possible.
- Equipment should be replaced when it becomes obsolete.
- Worn parts should be repaired, replaced, or rebuilt before they represent a high failure probability.

- Equipment that is out of service should be returned to service as soon as possible.
- A preventive maintenance schedule shall be established for all facilities, equipment, and processes.
- Spare parts shall be stocked for all equipment items whose failure will impact the ability to meet other policy standards.
- Tools shall be obtained and maintained to repair all items whose failure will impact the ability to meet other policy standards.
- Dry, heated shop space shall be available to all maintenance personnel to maintain facilities.
- All maintenance personnel shall be trained in the procedures and techniques necessary to efficiently perform their job descriptions.
- Written records and reports will be maintained on each facility and item of equipment showing the operation and maintenance history.

Temporary Emergency Services

- Compliance with construction standards (not quality standards) may be deferred for temporary sewer service.
- Compliance with all standards may be deferred for emergency sewer service.

Reliability

- The City shall ensure that the sewer system is constructed, operated, and maintained to protect against failures of power supply, treatment processes, equipment, or structures with appropriate backup facilities.

ORGANIZATIONAL POLICIES

Structure

- The Utilities Department Manager (Public Works Director) is responsible for the overall sewer utility financial planning and management.
- The Sewer Utility Supervisor is responsible for the day-to-day operations of the sewer system, including system operation and maintenance, personnel staffing and management, and reporting requirements.
- The sewer utility is responsible for adequate system operation and maintenance.
- Planning, design, operations, maintenance, and construction will be accomplished or overseen by the Public Works Department.

Staffing

- Sewer utility staffing levels are established by the City Council based on the financial resources of the City and needs of the sewer utility.
- Personnel certification and training will comply with state-established standards.

Relationship with Other Departments

- The Finance Department works in conjunction with the Utilities Department Manager (Public Works Director). The Utilities Department Manager and Finance Director coordinate all sewer-related financing requirements. The Finance Department is responsible for customer billing and payment collection, collects connection fees for the utility and Utility Division, and oversees project cost accounting.
- The Human Resources Department is responsible for employee records, union labor negotiations, and salary schedules.
- The Fire Department is responsible for emergency responses to hazardous events at sewer system facilities.
- The Police Department and/or Sewer Department are responsible for enforcing violations of the City's sewer ordinances.
- The Water Department is responsible for shutting off water service if a customer does not pay their sewer bill.
- The Sewer Department will participate in the implementation of the Water Department's Water Use Efficiency and Cross-Connection Control Programs.

FINANCIAL POLICIES

General

- The City will set rates that comply with state regulations.
- Rates and additional charges established for the City should:
    - Be cost-based rates that recover historical, current, and future costs associated with the City's sewer system and its services;
    - Be equitable charges to recover costs from sewer customers commensurate with the benefits they receive;
    - Be an adequate and stable source of funds to cover the current and future annual cash needs of the sewer utility; and
    - Not subsidize the operation of other City departments.
- The City's existing customers will pay the direct and indirect costs of operating and maintaining the sewer facilities through user rates. In addition, the user rates will include debt service incurred to finance the capital assets of the utility.
- New customers seeking to connect to the sewer system will be required to pay a connection charge for an equitable share of the cost of the system's capital improvement plan (CIP). This revenue will be used to finance the CIP, in conjunction with rate revenue.
- New and existing customers will be charged for extra services through a separate ancillary charge based on the cost to provide the service. Ancillary charges can increase equitability and operating efficiency by discouraging unnecessary demand for services by the customers. The charges should be reviewed regularly and updated annually based on

increases in the Consumer Price Index for the City area. Revenue from ancillary charges will be used to finance annual operations and maintenance.

- The City will maintain information systems that provide sufficient financial and statistical information to ensure conformance with rate-setting policies and objectives.
- User charges must be sufficient to provide cash for the expenses of operating and maintaining the utility. To ensure the fiscal and physical integrity of the utility, an amount should be set aside each year for capital expenditures from retained earnings. That is, an amount should be set aside to cover some portion of the depreciation of the physical plant. The amount may be transferred from the operating fund to the capital fund for general or specific purposes.
- A working capital reserve will be maintained to cover unanticipated emergencies, bad debts, and fluctuations in cash flow.
- The sewer rates will be based on the cost of providing sewer service. Service requirements relate to the total volume of water used, peak rates of use, and other factors.
- The City's fees and charges should be calculated for the service area as a whole. Rates will be the same regardless of service location for existing customers. Rates charged in annexed areas or outside the City limits shall be assessed a rate consistent with the Stanwood Municipal Code.

Connection Charges

The owners of properties that have not been assessed, charged, or borne an equitable share of the cost of the sewer collection and treatment facilities shall pay one or more of the following connection charges prior to connection to a sewer main:

1. Latecomers Fees: Latecomers fees are negotiated with the City, developers, and property owners for the reimbursement of a pro rata portion of the original costs of sewer system extensions and facilities and are documented in a Recovery Contract or City resolution, depending on the application.
2. Connection Charge: The connection charge shall be assessed against any property connecting to the sewer system. This charge is for the major facilities that deliver the sewage to a treatment facility and for the facilities to treat and dispose of the sewage. This charge reimburses customers who have paid for the facilities described and for building capacity to accommodate growth.
3. Developer Extension Charges: These charges are for the administration, review, and inspection of a developer extension project.
4. Developer-Funded Improvements: These are costs incurred by a developer to upgrade and increase capacity in the sewer system to accommodate the increase in flow from the proposed development.

6 | WASTEWATER COLLECTION SYSTEM EVALUATION AND DEFICIENCIES

INTRODUCTION

The City of Stanwood (City) will require improvements to its collection system to accommodate growth and collection system expansions and to repair damaged and deteriorating facilities. This chapter presents the evaluation of the City's existing sewer collection system. Individual sewer system components were analyzed to determine their ability to meet policies and design criteria under both existing and future flow conditions. The policies and design criteria are presented in **Chapter 5**, and the sewer system flow and loading analysis is presented in **Chapter 4**. A description of the existing sewer system facilities and current operation is presented in **Chapter 2**.

GENERAL AND SEWER MODEL BACKGROUND

Hydraulic Model

Background

A computer-based hydraulic model of the existing sewer system was developed using the SewerGEMS program by Bentley Systems, Inc. The sewer collection system model includes the City's gravity mains, force mains, and sewer lift stations. Pipe locations, lengths, diameters, and materials were added based on as-built drawings and various system maps acquired from the City since the previous General Sewer Plan (GSP). Maintenance hole invert and rim elevation data was used, if available, and the remaining elevation data was extracted from Snohomish County topographic and United States Geological Survey data. Minimum slope and cover values were used in the model when no other information was available. These areas are annotated in the model. The hydraulic model was calibrated using information provided by the City, including lift station flow data and treatment plant flow data. The output from this model was used to evaluate the capacity of the existing collection system and identify improvements that will be required to handle existing and projected 10-year (2034), 20-year (2044), and estimated build-out (2074) wastewater flows. The model can be updated and maintained for use as a tool to aid in future planning and design.

Model Limitations

Due to the number of data gaps and assumptions used in the model, the accuracy of the input information from the City and other sources should be confirmed prior to undertaking any replacement or rehabilitation projects. The results of the modeling should be considered approximate and additional investigations, such as field surveys or flow monitoring, should be performed in the vicinity of any proposed improvements prior to design and construction. If it is found that the input information differs significantly from actual conditions, then the model should be updated accordingly and rerun to confirm the original results. Some flow monitoring in the

gravity portions of the system has been performed to assist with the verification/calibration process. This work should continue.

The modeling was performed using a steady-state analysis, which shows all flows reaching all downstream points simultaneously. This is conservative and not truly representative of conditions that occur since it takes some time for wastewater to travel downstream through the sewer system. Therefore, the modeling results at the Main Lift Station are conservative and unlikely to occur. Due to this, system-wide peak hour flow (PHF) based on a peaking factor of 4 (per **Table 4-5**), rather than the modeling results, was used to analyze the capacity of the Main Lift Station.

Flow Data

Hydraulic model scenarios were prepared to simulate peak flows in the years 2020, 2034, 2044, and 2074. These scenarios were based on the sanitary flow projections described in **Chapter 4**. The City's existing collection system can be broken into five sewer drainage basins with six additional sub-basins, as shown in **Figure 2-3**. Flow data for the 2020 average day was distributed throughout the maintenance holes in the model based on allocation levels that reflect the proportionate share of total flow derived from lift station flow records and flow monitoring results. The flow monitoring results are included in **Appendix F**. Flows from the City's largest water users were entered separately into the model at their service locations to approximate higher flows at these locations. Average day flows were scaled to peak hour per **Table 4-5**.

Population and employment data received from the City's Planning Department provided the basis for distributing future flows throughout the City. Per capita flow projections are discussed in **Chapter 4**.

Facilities

The hydraulic model of the existing system contains all active, existing system facilities. Available information for each lift station, such as pump capacity, total dynamic head, horsepower, wet well diameter, wet well depth, and force main diameter, is included in the model. For simplicity, the lift stations are modeled as constant-discharge pumps so that they produce a constant discharge regardless of head conditions.

COLLECTION SYSTEM AND LIFT STATION ANALYSES

Gravity Collection System Pipe Capacity Analysis and Deficiencies

Hydraulic analyses were performed with the existing flow rates (2020), as well as future flow rates for the 2034 (10-year), 2044 (20-year), and 2074 (estimated build-out) projections. All analyses assumed that the Cedarhome Lift Station has been decommissioned. In the evaluation, the criteria for listing a sewer pipe as deficient is that the PHF exceeds 70 percent of the pipe flow capacity. The results of the hydraulic analyses are provided in **Appendix G** and **Figure 6-1**. **Figure 6-1** highlights pipes that will be deficient in capacity under existing, 2034, and 2044 PHF rates, respectively, without improvements to the collection system.

Existing System (2020 Peak Hour Flow)

The hydraulic analysis of the existing collection system indicates that there are several sections of the collection system in Sewer Drainage Basins 3, 4, and 5 that have insufficient capacity at existing peak hour flows and may need to be upsized. These alignments are shown on **Figure 6-1**.

- Sewer Drainage Basin 3
  - Approximately 997 linear feet (lf) of sewer main east of the intersection of Cedarhome Drive and 83rd Drive NW (model conduits P-50, P-52, P-54, P-56, P-58, P-60, P-62, and P-64) is between 70-percent and 100-percent capacity.
  - Approximately 220 lf of sewer main in Triangle Drive (model conduits P-749 and P-1392) is between 70-percent and 100-percent capacity.
- Sewer Drainage Basin 4
  - Approximately 131 lf of sewer main south of the intersection of 70th Avenue NW and 278th Street NW (model conduit P-1619) is between 70-percent and 100-percent capacity.
  - Approximately 104 lf of sewer main east of the intersection of 68th Avenue NW and 277th Street NW (model conduit P-632) is over 100-percent capacity.
  - Approximately 440 lf of sewer main south of the intersection of 68th Avenue NW and 278th Street NW (model conduits P-733 and P-736) is over 100-percent capacity.
  - Approximately 51 lf of sewer main southeast of the intersection of 68th Avenue NW and 277th Street NW (model conduit P-737) is between 70-percent and 100-percent capacity.
- Sewer Drainage Basin 5
  - Approximately 35 lf of sewer main at the intersection of 72nd Avenue NW and Centerville Court (model conduit P-750) is over 100-percent capacity.
  - Approximately 40 lf of sewer main west of the intersection of 72nd Avenue NW and 265th Street NW (model conduit P-770) is over 100-percent capacity.
  - Approximately 365 lf of sewer main east of the intersection of 72nd Avenue NW and 265th Street NW (model conduits P-740 and P-742) is over 100-percent capacity.
  - Approximately 201 lf of sewer main extending east from 72nd Avenue NW, between 267th Street NW and 265th Street NW (model conduit P-798), is over 100-percent capacity.
  - Approximately 206 lf of sewer main west of the intersection of 72nd Avenue NW and 267th Street NW (model conduits P-791 and P-793) is over 100-percent capacity.
  - Approximately 1,511 lf of sewer main in 72nd Avenue NW, between 267th Street NW and 262nd Street NW (model conduits P-795, P-796, P-744, P-746, P-748, and P-800), is over 100-percent capacity.
  - Approximately 778 lf of sewer main in Pioneer Highway within and west of the intersection with 77th Avenue NW (model conduits P-820, P-822, and P-1431) is between 70-percent and 100-percent capacity.

- Approximately 355 lf of sewer main in Pioneer Highway between 267th Street NW and State Route (SR) 532 (model conduits P-840 and P-842) is between 70-percent and 100-percent capacity.

The hydraulically deficient sewers at current PHF according to the modeling results, which equal approximately 5,434 lf, are shown on **Figure 6-1**. Collection system improvement projects to resolve these capacity deficiencies are included in the City's Capital Improvement Plan (CIP) in **Chapter 10**. The flow projections for 2044 (and 2074, if applicable) were used to establish the proposed pipe diameters for the pipe capacity upgrades.

2034 (10-Year Peak Hour Flow) System Projection

Based on the hydraulic analysis of the system using projected flow rates for 2034 and assuming that no improvements to the collection system have been completed, the following additional alignments in Sewer Drainage Basins 4 and 5 have insufficient capacity at peak hour flows and may need to be upsized. These alignments are shown on **Figure 6-1**.

- Sewer Drainage Basin 4
  - Approximately 258 lf of sewer main in 68th Avenue NW, north of the intersection with 279th Street NW (model conduit P-730), is between 70-percent and 100-percent capacity.
  - Approximately 51 lf of sewer main southeast of the intersection of 68th Avenue NW and 277th Street NW (model conduit P-737), previously identified in the existing analyses as between 70-percent and 100-percent capacity, is over 100-percent capacity.
  - Approximately 206 lf of sewer main in 278th Street NW, east of the intersection with 68th Avenue NW (model conduits P-1773 and P-1772), is over 100-percent capacity.
- Sewer Drainage Basin 5
  - Approximately 107 lf of sewer main extending south from 265th Street NW, just west of the Lindstrom Lift Station (model conduit P-738), is over 100-percent capacity.
  - Approximately 582 lf of sewer main in 267th Street NW, west of the intersection with 72nd Avenue NW (model conduits P-785, P-787, and P-789), is over 100-percent capacity.
  - Approximately 473 lf of sewer main in 72nd Avenue NW from SR 532 to 267th Street NW (model conduits P-1613, P-1614, P-1615, and P-1616) is over 100-percent capacity.
  - Approximately 133 lf of sewer main in Pioneer Highway, east of the intersection with 77th Avenue NW (model conduits P-1536 and P-1446), is between 70-percent and 100-percent capacity.
  - Approximately 16 lf of sewer main in Pioneer Highway, east of the intersection with 77th Avenue NW (model conduit P-1440), is over 100-percent capacity.
  - Approximately 778 lf of sewer main in Pioneer Highway within and west of the intersection with 77th Avenue NW (model conduits P-820, P-822, and P-1431),

identified as being between 70-percent and 100-percent capacity in the existing analysis, is over 100-percent capacity.

- Approximately 297 lf of sewer main in Pioneer Highway, west of the intersection with 77th Avenue NW (model conduit P-1659), is between 70-percent and 100-percent of capacity.
- Approximately 116 lf of sewer main in Pioneer Highway, between 267th Street NW and SR 532 (model conduit P-842), identified as being between 70-percent and 100-percent capacity in the existing analysis, is over 100-percent capacity.

The hydraulically deficient sewers at projected 2034 PHF according to the modeling results, which equal approximately 2,072 additional lf, are shown in **Figure 6-1**. Collection system improvement projects to resolve these capacity deficiencies are included in the City's CIP in **Chapter 10**. The flow projections for 2044 (and 2074, if applicable) were used to establish the proposed pipe diameters for the pipe capacity upgrades.

2044 (20-Year Peak Hour Flow) System Projection

Based on the hydraulic analysis of the system using projected flow rates for 2044, and assuming that no improvements to the collection system have been completed, the following additional alignments in Sewer Drainage Basins 3, 4, and 5 have insufficient capacity at peak hour flows and may need to be upsized. These alignments are shown on **Figure 6-1**.

- Sewer Drainage Basin 3
  - Approximately 440 lf of sewer main in Cedarhome Drive, west of Triangle Drive (model conduit P-1389), is between 70-percent and 100-percent capacity.
- Sewer Drainage Basin 4
  - Approximately 78 lf of sewer main in the intersection of 68th Avenue NW and 278th Street NW (model conduit P-624) is over 100-percent capacity.
  - Approximately 308 lf of sewer main in 68th Avenue NW, north of the intersection with 278th Street NW (model conduit P-732), is over 100-percent capacity.
  - Approximately 290 lf of sewer main in 278th Street NW, east of the intersection with 68th Avenue NW (model conduit P-1774), is over 100-percent capacity.
- Sewer Drainage Basin 5
  - Approximately 16 lf of sewer main in 72nd Avenue NW at the intersection with SR 532 (model conduit P-1612) is over 100-percent capacity.
  - Approximately 358 lf of sewer main in 72nd Avenue NW, between approximately 262nd Street NW and 261st Street NW (model conduits P-1750, P-1751, and P-1752), is between 70-percent and 100-percent capacity.
  - Approximately 133 lf of sewer main in Pioneer Highway, east of the intersection with 77th Avenue NW (model conduits P-1536 and P-1446), previously identified as between 70-percent and 100-percent capacity in the 2034 analyses, is over 100-percent capacity.

- Approximately 140 lf of sewer main in 77th Avenue NW, north of the intersection with Pioneer Highway (model conduit P-883), is between 70-percent and 100-percent capacity.
- Approximately 239 lf of sewer main in Pioneer Highway between 267th Street NW and SR 532 (model conduit P-840), identified as being between 70-percent and 100-percent capacity in the existing and 2034 analysis, is over 100-percent capacity.

The hydraulically deficient sewers at projected 2044 PHF according to the modeling results, which equal approximately 1,630 additional lf, are shown in **Figure 6-1**. Collection system improvement projects to resolve these capacity deficiencies are included in the City's CIP in **Chapter 10**. The flow projections for 2044 (and 2074, if applicable) were used to establish the proposed pipe diameters for the pipe capacity upgrades.

2074 (Estimated Build-Out Peak Hour Flow) System Projection

Limited hydraulic analyses of the system were performed using projected flow rates for 2074 to inform the sizing of the collection system upgrades for the 20-year CIP. For example, if a pipe required replacement for capacity related reasons by 2044, the hydraulic model was utilized to determine if additional upsizing would be required for the pipe to convey the estimated 2074 PHF. In instances where additional upsizing is recommended, it is described in the City's CIP in **Chapter 10**.

Other Existing Gravity Collection System Deficiencies

In addition to the capacity related deficiencies described previously, City staff desire to repair and rehabilitate other regions of the collection system due to condition, frequently required maintenance, and/or infiltration and inflow (I/I) issues. These deficiencies are summarized as follows, and associated CIP projects are described in **Chapter 10**.

Sewer Drainage Basin 1 – Pipes in the downtown area are among the oldest in the system. The City conducted an investigation in this area to evaluate which pipes need to be replaced. An ongoing CIP project, described in **Chapter 10**, addresses the replacement of these pipes.

272nd Street NW and 76th Drive NW – The road along 272nd Street NW between 78th Avenue NW and 76th Drive NW is in need of repair. The City suspects the sewer main trench may be failing in this area, likely causing increased infiltration. The City has observed I/I issues with some of the maintenance holes along 76th Drive NW. The City is currently planning to replace the sewer mains and maintenance holes when this section of road is repaired. In addition, root intrusion is occurring in the sewer main along 76th Drive NW near 276th Street NW, which is likely causing increased infiltration in this area. The sidewalks in this area have already been replaced due to the root growth. The City is currently planning to replace the sewer main and maintenance holes along 76th Drive NW between 276th Street NW and 272nd Street NW to eliminate the root intrusion. The sewer improvements are described in **Chapter 10**.

Inflow and Infiltration Analysis and Deficiencies

As indicated in the I/I evaluation section of **Chapter 4**, the existing per capita flow rates for the City are slightly above the criteria for inflow and below the criteria for infiltration set by the U.S. Environmental Protection Agency in the *Infiltration/Inflow, I/I Analysis and Project Certification* report, indicating that there might be an inflow problem based on the limited analyses completed as part of this GSP. There are several projects discussed in the previous section that will address known I/I areas, and these projects are included in the City's CIP in **Chapter 10**.

The City should consider conducting an I/I study to confirm the results of the I/I evaluation and locate the affected collection system areas to determine if there are any cost-effective sewer rehabilitation measures to remove excessive I/I. This study is described in **Chapter 10**.

Lift Station Capacity Analysis and Deficiencies

The City's existing sewer system has eight lift stations, including the Main Lift Station that pumps to the City's wastewater treatment plant. All of the City's existing lift stations were designed in the last 30 years. **Chapter 2** provides additional history and background on the City's lift stations.

Flow Capacity

The hydraulic analysis of the City's existing lift stations indicates that the City's existing lift stations have no existing or projected capacity deficiencies for the 20-year planning period. As discussed previously, capacity analyses of the lift stations are based on estimated PHF. According to discussions with the system operators, there are no known capacity deficiencies in the City's existing lift stations. Flows at the lift stations should continue to be monitored to determine if influent flow during peak events begins to approach or exceed the pumping capacity of the lift stations.

In particular, the peak hour influent flow rates for the Main Lift Station should be monitored to determine when capacity upgrades may be required. The Main Lift Station has sufficient capacity to pump the system-wide 20-year PHF, but this flow rate may be temporarily exceeded if multiple upstream lift stations run simultaneously. A project to increase the capacity of the Main Lift Station is described in **Chapter 10**.

Other Existing Lift Station Facility Deficiencies

Taylor's Landing Lift Station – This lift station is in need of new wet well coatings and does not have a flow meter installed. Upgrades are described in **Chapter 10**.

Cedarhome Lift Station – This lift station will need to be properly decommissioned once it is removed from service. This project is described in **Chapter 10**.

Pioneer Hills Lift Station – This lift station requires replacement of the aging pumps and generator in the near future. A security fence also should be installed. These projects are described in **Chapter 10**.

Church Creek Lift Station – This lift station has been removed from service and needs to be properly decommissioned. This project is described in **Chapter 10**.

Copper Lift Station – This lift station requires supervisory control and data acquisition upgrades and the removal of a hazardous tree. These projects are described in **Chapter 10**.

7 | EXISTING TREATMENT PLANT EVALUATION

BACKGROUND

History and Introduction

The City of Stanwood's (City) original wastewater treatment plant (WWTP) was constructed in 1963 to receive wastewater from the City's original sewer collection system serving downtown, former east Stanwood, and the City's eastern hill, and to provide anaerobic primary treatment in 4 lagoons with an additional 35-acre facultative lagoon. An effluent chlorination disinfection facility was added in 1973. The WWTP was expanded in 2004 to increase capacity to 1.5 million gallons per day (MGD), provide full secondary treatment, and switch to ultraviolet (UV) disinfection. This project included reclaiming two of the original four treatment lagoons and adding a new headworks facility, oxidation ditches, secondary clarifiers, a UV disinfection system, a scum system, a plant water system, a yard pump station, an operations building, a vehicle storage and maintenance building, decant pump stations for the remaining lagoons, and an electrical and supervisory control and data acquisition (SCADA) system.

This chapter presents evaluations of the existing WWTP conditions, including the existing liquid stream and solids handling processes. It also presents an evaluation of the electrical and SCADA systems. Deficiencies identified from the evaluations are described and recommendations for capital improvements are summarized. The analysis of alternatives and recommended improvements for the WWTP is provided in **Chapter 8**. All WWTP capital improvements are identified in **Chapter 10**.

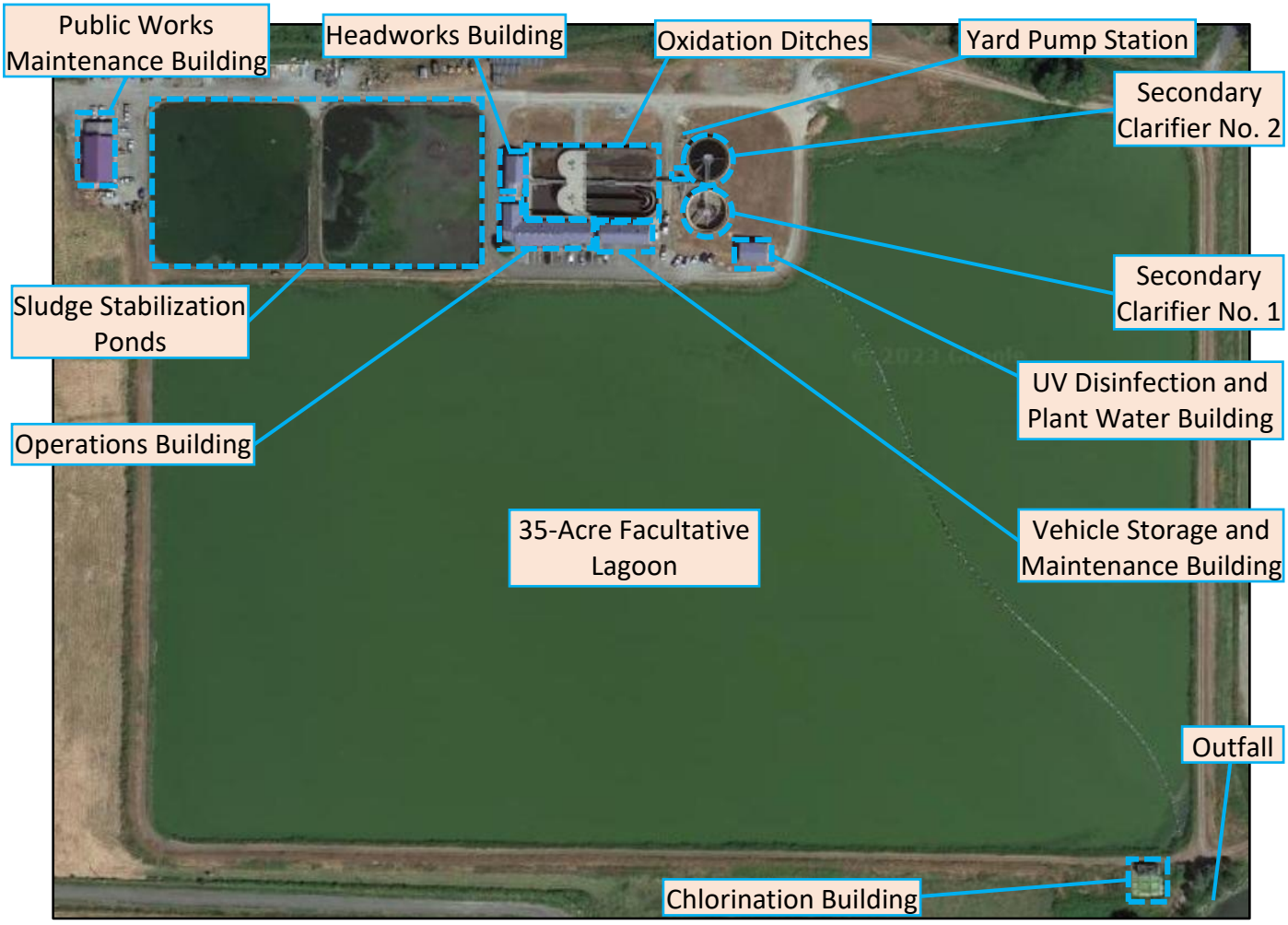
System Overview

Wastewater from the City's collection system flows via gravity to the Main Lift Station (MLS) and is conveyed to the WWTP headworks via two influent force mains. Influent from an adjacent shopping center and City Public Works maintenance building flows directly to the WWTP Yard Pump Station (YPS), where it is pumped to the headworks with the facility-generated wastewater and process drains. From the headworks, wastewater enters the oxidation ditches, secondary clarifiers, and UV reactors before heading to the Stillaguamish River through an outfall pipe anchored across the 35-acre facultative lagoon. Waste sludge is captured in the sludge stabilization ponds until they are full, and the solids in the ponds are dredged, screened, and hauled away for land application.

The approximate locations of major WWTP process units are outlined in **Figure 7-1**.

Figure 7-1

Existing WWTP Overall Site Plan



Historical WWTP Performance

The historical performance of the WWTP from 2019 through 2022 is compared to the City's National Pollutant Discharge Elimination System (NPDES) Permit limits as shown in **Table 7-1**.

Table 7-1

WWTP Performance Compared to NPDES Permit Effluent Limits (2019-2022)

			Highest Recorded Value by Year			
Parameter	**Interval**	**NPDES Limit**	**2019**	**2020**	**2021**	**2022**
BOD (mg/L)	Avg. Month	30	8.5	5	9.8	8.1
	Avg. Week	45	11	6.5	14.5	16.5
TSS (mg/L)	Avg. Month	30	6.7	4.1	8.6	11.5
	Avg. Week	45	9.5	5.5	17	15
pH	Daily Min.	6	7.18	6.86	6.87	6.05
	Daily Max.	9	7.96	7.88	7.95	8.21
Fecal Coliform Bacteria (colonies/100 mL)	Monthly[1]	200	8.8	3.6	14.2	14.5
	Weekly[1]	400	13	5.5	100.3	32.0

BOD = Biochemical Oxygen Demand
TSS = Total Suspended Solids
mg/L = milligrams per Liter
(1) Geometric mean.

As shown in the table, the City has maintained compliance with its NPDES Permit limits, and no exceedances of the permit were reported for the last 4 years. As required by the NPDES Permit, the City also monitors priority nutrients, priority pollutants, and other parameters and undergoes whole effluent toxicity testing in the winter and summer of the final year of each permit cycle. None of these items have prompted additional activities or permit actions in recent years. The WWTP is well maintained and earned the Washington State Department of Ecology's (Ecology) Outstanding Performance Award for the years 2006 through 2009, 2011 through 2013, 2017, 2018, 2020, and 2021, as well as the Special Recognition Award 5 Consecutive Years of Outstanding Performance for 2006 through 2010 and 2015 through 2019.

As noted in **Chapter 2**, the City also is subject to the Puget Sound Nutrient General Permit (PSNGP). As of February 2022, the City is required to monitor and report nitrogen compounds on Discharge Monitoring Reports. **Table 7-2** provides a summary of the monthly sampling results for 2022.

Table 7-2
Monthly Nitrogen Sampling Results (2022)

Sample Date	Calculated TIN (mg/L)	Sample Date	Calculated TIN (mg/L)
2/23/2022	4.51	2/24/2022	4.53
3/10/2022	18.34	3/11/2022	17.1
4/12/2022	4.23	4/13/2022	3.57
5/12/2022	2.30	5/13/2022	0.88
6/7/2022	0.82	6/8/2022	0.75
7/14/2022	6.22	7/29/2022	12.76
8/16/2022	3.08	8/17/2022	3.86
9/15/2022	11.4	9/16/2022	8.62
10/11/2022	8.61	10/12/2022	9.65
11/17/2022	9.82	11/18/2022	19.01
12/13/2022	10.19	12/14/2022	8.87

The average annual Total Inorganic Nitrogen (TIN) for 2022 is below 10 mg/L. Six samples exceeded 10 mg/L in the sampling period.

DESIGN CRITERIA OF EXISTING PROCESSES

Projected WWTP Flow and Loading

The projected flow and organic, solids, and nutrient loading from the sanitary sewer systems, as developed in **Chapter 4**, are summarized in **Table 7-3**.

Table 7-3

Sanitary Sewer Existing and Projected Flow and Loading

Parameter	Units	Existing (2020)	2034	2044	NPDES Permit Limits
Service Population	people	7,540	10,426	13,180	-
Annual Average Daily Flow	MGD	0.58	0.78	1.01	-
Maximum Month Daily Flow	MGD	0.85	1.24	1.61	1.5
Peak Hour Flow	MGD	2.30	3.10	4.04	-
Annual Average Daily BOD	ppd	1,559	2,246	2,841	-
Maximum Month Daily BOD	ppd	1,914	3,039	3,845	4,100
Annual Average Daily TSS	ppd	1,562	1,940	2,536	-
Maximum Month Daily TSS	ppd	2,725	3,041	3,973	4,100

ppd = pounds per day

The following sections provide the design criteria of each major process within the WWTP and identify capacity-based deficiencies in the WWTP for the planning period based on the projected flows and loads presented in this section. A detailed capacity analysis for ancillary equipment is not provided as such equipment is not expected to limit WWTP capacity and can be replaced through normal operations and maintenance (O&M) as necessary. Design criteria herein have been derived from previous construction contract documents, planning documents, equipment name plates, and manufacturer documentation. Where noted, existing design criteria have been estimated.

Preliminary Treatment Design Criteria

The existing influent screening system design criteria are provided in **Table 7-4**.

Table 7-4
Design Criteria for Existing Influent Screening System

Parameter	Value	Units
System Peak Capacity	7	MGD
Main Screening Channel		
Screen Type and Configuration	In-channel mechanical fine screen	
Channel Width	36	Inches
Channel Nominal Depth	51	Inches
Screen Opening Diameter	0.236	Inches
Overall Screen Width	2.3	feet
Single Screen Capacity	5.2	MGD
Backup Screening Channel		
Screen Type	Manual bar screen	
Channel Width	30	Inches
Channel Nominal Depth	51	Inches
Bar Spacing	1.5	inches
Screenings Compactor System		
Screw Diameter	7⅞	Inches
Quantity	1	-
Screenings Volume Reduction	80	Percent
System Rated Capacity	10	Cubic feet per hour

The mechanical fine screen is compliant with the state biosolids rule of a ⅜-inch bar screen or equivalent, but the manual bar screen should be replaced to meet the rule. At 5.2 MGD capacity, the mechanical fine screen provides sufficient capacity for the existing peak hour flow and will provide adequate capacity for the projected peak hour flows during the planning period. The headworks currently produces roughly 2 cubic yards per week of screenings, and this load is expected to increase proportionally to flow. This system does not appear to limit WWTP capacity for the loading projected through the planning period.

Secondary Treatment Design Criteria

The current secondary treatment system was constructed in the 2004 expansion with the capacity described in the current NPDES Permit and summarized in **Table 7-5**.

Table 7-5
WWTP Design Criteria from NPDES Permit

Parameter	Design Criteria
Hydraulic Loading	
Maximum Month Average Daily Flow	1.5 MGD
Organic and Solids Loading	
Maximum Month Average Daily BOD	4,100 ppd
Maximum Month Average Daily TSS	4,100 ppd

The WWTP provides all secondary treatment using an activated sludge system consisting of two oxidation ditches each preceded by an anoxic zone and followed by a secondary clarifier. The maximum month average daily flow projected through the planning period exceeds the NPDES Permit capacity of the WWTP; therefore, this system is expected to limit WWTP capacity by the end of the planning period. The projected exceedance of WWTP capacity during the planning period necessitates consideration of expansion of the activated sludge system, which is further analyzed in **Chapter 8**. The maximum month average daily BOD and TSS projected through the planning period exceed 85 percent of the NPDES Permit capacity of the WWTP. The NPDES Permit for the WWTP stipulates that when the actual flow or waste load reaches 85 percent of any one of the design criteria in **Table 7-5** for 3 consecutive months, the City must submit a plan and schedule for continuing to maintain capacity to Ecology. A full analysis of the liquid stream process of the WWTP is included in **Chapter 8**, including consideration of the PSNGP and the ramifications for system capacity. The individual design criteria for the major components of the activated sludge system are provided in **Table 7-6** and **Table 7-7**.

Table 7-6

Design Criteria for Existing Oxidation Ditches and Associated Equipment

Parameter	Value	Units
Oxidation Ditches		
Quantity	2	-
Dimensions (each)	198x51x14	feet (LxWxSWD)
Anoxic Zone Volume (each)	0.25	MG
Aerobic Zone Volume (each)	0.75	MG
Total Volume	2.00	MG
Aeration System		
Mixer-Aerator Quantity per Ditch	1	-
Mixer-Aerator Motor Size	100	hp
Mixers		
Type	Submerged propeller	
Quantity per Anoxic Zone	1	
Quantity per Aerobic Zone	1	
Internal Recycle		
Configuration	Gated Channel	
Wasting System		
Configuration	Wasting manually to sludge lagoons via RAS pumps	

L = length
W = width
SWD = sidewater depth
MG = million gallons
hp = horsepower

Table 7-7

Design Criteria for Secondary Clarifiers and RAS System

Parameter	Value	Units
Clarifiers		
Configuration	Circular, center feed, peripheral effluent	
Quantity	2	
Diameter	65	feet
Sidewater Depth	14	feet
Volume	0.37	MG
Nominal Area	3,318	sf
RAS/WAS Pumps		
Pump Type	Centrifugal	
Pump Quantity	2 in service, 1 standby	
RAS Recycle Rate		percent influent
Single Pump Capacity	0.78	MGD
Total RAS Capacity	1.56	MGD
Motor Size	5	hp

sf = square feet
RAS = return activated sludge
WAS = waste activated sludge

Effluent Disinfection Design Criteria

The effluent disinfection design criteria are provided in **Table 7-8**.

Table 7-8

Design Criteria for Effluent Disinfection System

Parameter	Value	Units
Configuration	Contact UV	
Design Flow	3.7	MGD
Reactors (Channels)	2	
UV Banks per Reactor	2	
Minimum UV Transmittance	60	percent
Minimum UV Dose	30,780	$\mu W\text{-}s/cm^2$

$\mu W\text{-}s/cm^2$ = microwatt-seconds per square centimeter

The existing UV disinfection system consists of 4 total banks with 2 modules per bank, for a total of 8 modules with 6 lamps per module, or 48 lamps. The peak hour flow projected through the planning period exceeds the peak capacity of the current disinfection system. Therefore, this system is expected to limit WWTP capacity by the end of the planning period. The projected exceedance of WWTP capacity during the planning period necessitates consideration of expanding the disinfection system.

Solids Handling System Design Criteria

Pumping of waste activated sludge (WAS) at the WWTP is performed by the periodic switching of valves at the RAS pump station to redirect the activated sludge to the sludge stabilization ponds. Therefore, the RAS pump station doubles as the WAS pump station. The design criteria for these pumps are provided in **Table 7-7**. The design criteria for the existing sludge stabilization ponds are provided in **Table 7-9**. Applicable projected flow and loading parameters are provided in **Table 7-10**.

Table 7-9

Design Criteria for the Sludge Stabilization Ponds

Parameter	Value	Units
Quantity	2	-
Configuration	Pond with liner, surface aerators, water cap, and decant pumps	
Surface Area, each	1.25	acres
Operating Depth	5.00	feet
Sludge Depth	3.00	feet
Water Cap Depth	2.00	feet
Sludge Volume (each)	1.26	MG
Operating Volume (each)	2.10	MG
Total Sludge Volume	2.52	MG
Total Operating Volume	4.20	MG
Design Solids Loading (Average Annual)	1,904	ppd
Design Sludge Storage Capacity	2.7	years
Decant Pumps		
Pump Type	Centrifugal	
Pump Quantity	2	-
Single Pump Capacity	0.50	MGD
Total Decant Capacity	1.00	MGD
Motor Size	3.00	hp

Table 7-10

Sludge Flow and Loading to the Sludge Stabilization Ponds

Parameter	Units	Existing	2034	2044
Influent BOD (Average Annual)[1]	ppd	1,600	2,300	2,900
Sludge Yield Ratio (Sludge TS:Influent BOD)[2]	percent	79	79	79
Sludge Production (TS)[1]	ppd	1,300	1,900	2,300
Sludge Concentration (Nominal)[2]	mg/L	7,000	7,000	7,000
Sludge Production (Hydraulic)[1]	gpd	22,300	32,600	39,400

TS = total solids
gpd = gallons per day
(1) Values rounded up to nearest 100 ppd or gpd.
(2) Sludge yield ratio and nominal sludge concentration from 2004 project contract drawings.

Waste sludge flows to the active sludge pond until it is filled; at that point Ecology considers it to be sludge storage, which has a maximum time of 2 years before it must be dredged. The City has worked with Ecology to dredge both ponds at the same time, which requires extensions to the allowable sludge storage time. A previous analysis of sludge production, storage, removal, and disposal at the WWTP can be found in **Appendix H**, which includes a previous removal and disposal plan and discusses operational considerations for the existing solids handling system. Within the planning period, the City plans to maintain the dredging intervals within a range where Ecology will allow the dredging of both ponds at the same time. Also, the projected sludge production exceeds the design solids loading to the sludge stabilization ponds within the planning period. As the solids loading rate to the sludge stabilization ponds increases, the maximum storage time will be easier to achieve since dredging will be required more frequently. However, if the system is operating beyond its design solids loading rate, full stabilization of the biosolids may not be achieved. The projected exceedance of solids handling capacity during the planning period necessitates consideration of expansion of the solids handling system. A full analysis of the different options for expanding solids handling system capacity is included in **Chapter 8**.

EVALUATION OF EXISTING PROCESS UNITS

Introduction

This section provides a review of the general conditions of each major process or area within the WWTP. The analyses and findings provided herein were based on visual observation of the processes, review of available process data, information on design life from manufacturers, and discussions with O&M staff.

Preliminary Treatment

Influent Screening (Headworks Building)

Overview

The headworks building and existing influent channels were constructed as part of the 2004 expansion project to include a mechanical fine screen in the main screening channel and a manual bar screen in a redundant backup channel to provide screening when the mechanical fine screen is undergoing maintenance. The mechanical fine screen provides screening to all influent during normal operations. East of the screening channels there is a bypass channel for screened raw sewage to bypass the activated sludge system in case of an operational emergency. Bypass sewage flows through a 20-inch screened raw sewage pipe directly to the 35-acre facultative lagoon.

The MLS conveys influent from the City's sewer collection system to the headworks building and discharges from above-grade piping to the screening channels. The YPS conveys influent wastewater from the adjacent shopping center and Public Works building and facility-generated wastewater to the headworks building where it is combined with wastewater from the facility's decant pump stations and discharged directly to the main screening channel. Influent from the MLS is directed with manual slide gates to the main screening channel or backup channel, whereas the influent from the YPS and decant pumps discharges directly into the main screening channel and cannot be redirected to the backup channel.

Influent flow is measured by a 12-inch magnetic flow meter on one of the two sewer collection system influent force mains from the MLS. There also are two 9-inch Parshall flumes in the channels between the headworks and the oxidation ditches and a third 9-inch Parshall flume in the screened raw sewage bypass channel.

An automatic composite sampler is on the upper floor of the headworks building just west of the influent channels. The sampler collects a sample of the influent directly upstream of the isolation gates.

Screenings from the mechanical fine screen are discharged into a washer-compactor system that dewaters the screenings and deposits them into a roll-off dumpster housed in the odor control room of the headworks building. Screened effluent flows out of the building through two channels to the oxidation ditches.

Heating, ventilation, and air conditioning (HVAC) equipment is housed in the mechanical room of the headworks building. The upper floor is open on three sides so it does not utilize HVAC equipment. Electrical and control equipment for the headworks is housed on the upper floor of the headworks building. The headworks building also contains an odor control system that is designed to pull air from the screening channels and bypass channel, pass it through two carbon scrubber odor control units, and discharge it through the roof of the building.

Condition Assessment

The screening channels are constructed of cast-in-place concrete, and the headworks building is a steel building with a steel roof and pre-cast concrete elements. These structures appear to be in

satisfactory condition and do not warrant budgeting for major improvements during the planning period. Some rehabilitation work may be necessary. Specifically, the roof of the building above the upper floor has ceiling insulation that is being torn out by birds and needs repair or removal. It also was noted that while the chain hoist mechanism above the screening channel is in good condition, it slides off its track on the ceiling occasionally.

The existing mechanical fine screen is original from the 2004 expansion and is a Frankenberger Stahl & Maschinenbau (FSM) filterscreen (Model 500). The existing manual bar screen is also original from the 2004 expansion. The mechanical fine screen was fully rebuilt in 2015 other than the drives (one of which was replaced), the scraper-roller, and the original washer-compactor. The brushes of the brush roller were replaced in 2023. New parts for the screen are readily available through FSM's North American licensee, Saveco. Per visual observation of the WWTP, some bypass of the screens to downstream processes occurs such that ragging is visible in the anoxic zone of the drained oxidation ditch and on its propeller mixer. The mechanical fine screen and the washer-compactor system will exceed their 20-year design life during the planning period. Therefore, these are recommended for replacement during the planning period.

Influent Grit Removal Current Operations

The WWTP does not have any grit removal equipment; grit accumulates in the bottom of the ditches and is removed through normal O&M. To remove grit and solids that accumulate in the oxidation ditches, each ditch is taken offline after being in service for roughly a year. The ditch is drained, and grit accumulated on the bottom of the anoxic zone and in the channels between the anoxic and aerobic zones is washed out. As previously noted, during visual assessment of the drained oxidation ditch, this grit accumulation was observed. Therefore, consideration of the addition of a grit removal system during the planning period is recommended. A grit removal system will be necessary if the City decides to transition to an active solids handling system at the WWTP.

Summary of Major Findings

A summary of the major recommendations for the preliminary treatment system is as follows:

1. Replace the aging mechanical fine screen during the planning period.
2. Replace the manual bar screen to meet the state biosolids rule.
3. Evaluate the addition of an active grit removal system.

Minor items noted during the evaluation that can be included in the City's annual O&M budget include:

1. Repair or remove roof insulation on the headworks building's upper floor;
2. Refurbish the chain hoist mechanism's tracks; and
3. Other minor items such as refurbishment and/or replacement of the flow measurement equipment, automatic composite sampler, odor control equipment, slide gates, or sensors.

Secondary Treatment

Activated Sludge System

Overview

The activated sludge system consists of two equally sized treatment trains with oxidation ditches preceded by anoxic zones and followed by secondary clarifiers. The City normally runs one ditch at a time, allowing the offline ditch to undergo maintenance or to be used for wet weather events. This is a suspended growth system that utilizes microorganisms suspended in the liquid of the oxidation ditches to provide biological treatment of the wastewater.

Screened influent and RAS are combined in the channels exiting the headworks building and discharged into the anoxic zones. The anoxic zones are each equipped with a submerged propeller mixer. The anoxic zone mixers normally operate continuously. Each anoxic zone is connected to its oxidation ditch aerobic zone by a manual flow control gate. Adjustment of these gates is intended to optimize nitrogen removal. Both anoxic zones will be equipped with oxidation-reduction potential (ORP) probes and sensors. It is anticipated that manual operation of the flow control gate based on ORP data from the anoxic zones will optimize nitrogen removal. Optimization of the recycle rate to the anoxic zone for nitrogen removal will be important for the WWTP to meet PSNGP requirements at the current and projected loading rates.

Mixed liquor flows from the anoxic zones into the oxidation ditch aerobic zones and travels around the oval-shaped racetrack. The aerobic zones of the oxidation ditches each contain one mixer-aerator and a submerged propeller mixer. This installation allows for mixing to occur in the aerobic zone independent of aeration, which allows dissolved oxygen (DO) setpoints to be maintained separately from mixing. The mixer-aerators were intended for operation in DO mode, where they run full time at variable speeds to maintain a DO setpoint. Alternate modes of operation for the mixer-aerators include running at constant speed for set intervals of time and a flow-paced mode. Each oxidation ditch has one DO sensor in the aerobic zone. A manual slide gate exists to connect both ditches, allowing equalization of flow between the ditches. The mixed liquor exits the ditches through two effluent weirs per ditch that are height-adjustable by manual slide gates, then flows through pipes to a flow splitter box east of the ditches where it is split between two 20-inch pipes and fed into each clarifier.

The two secondary clarifiers are identical in size and construction and consist of below-grade circular concrete tanks. Each clarifier uses an Eimco C30HT oil-splash lubricated drive. The clarifier mechanism collects settled sludge for conveyance to the RAS/WAS pumps, where it is returned to the influent channels or wasted to the sludge stabilization ponds. The clarifiers also collect floatable items (referred to herein as scum) with the original full radius scum baffles and direct the collected material to a scum box that discharges to the scum tank. Clarified effluent flows over the V-notch weirs into the secondary effluent launder, from which it flows through 20-inch piping to the disinfection system.

Condition Assessment

City operators noted that a couple minor cracks exist in the interior wall of oxidation ditch no. 2, but there is no issue yet. Oxidation ditch no. 1 was drained, and its concrete structure appeared to

be in decent condition. The operators noted that clarifier no. 1 has some deformed concrete and is slightly out of round. Other structural elements are in satisfactory condition and no improvements are expected to be necessary to the structures during the planning period.

The original submerged propeller mixer in anoxic zone no. 1 was replaced in 2021. The original submerged propeller mixer in anoxic zone no. 2 failed in early 2023 and is awaiting replacement.

Both oxidation ditch aerobic zones include a DO sensor, which were replaced in 2022. Each oxidation ditch aerobic zone includes the original Eimco mixer-aerators that were installed as part of the 2004 expansion when the ditches were constructed. The mixer-aerators received new variable frequency drives (VFD) in 2015 and 2017. Since the mixer-aerators will exceed their design life during the planning period, they are recommended for replacement if it is determined that they will continue to be used through the planning period.

The clarifiers include original elements from the 2004 expansion. Clarifier no. 1 will require re-coating of the troughs and launders within the planning period. The secondary effluent V-notch weir also may require refurbishment. Rehabilitation of the submerged mechanisms in the clarifiers may be necessary due to potential corrosion. This was not visually observed since the clarifiers are currently in operation, so it is recommended that a condition assessment be performed on each clarifier to inspect the condition of the submerged mechanisms. Each clarifier includes the original Eimco C30HT drive from the 2004 expansion. These items have been in service for approximately 20 years now and are nearing their expected design life. Therefore, these items are recommended to be replaced during the planning period.

Due to the projected exceedance of secondary treatment system capacity identified earlier, the activated sludge system is recommended to be expanded during the planning period. Options for expanding secondary treatment capacity are discussed in **Chapter 8**.

For information on the RAS/WAS pumps, refer to the **Solids Handling** section of this chapter.

Summary of Major Findings

A summary of major recommendations for the secondary treatment system is as follows:

1. Replace the oxidation ditch mixer-aerators if they are planned for continued use through the planning period.
2. Replace the clarifier drives.
3. Recoat troughs and launders of clarifier no. 1.
4. Repair or replace the clarifier mechanisms as determined by the condition assessment.
5. Prepare an Engineering Report to evaluate and select the preferred alternative to increase the activated sludge system capacity.

Minor items noted during the evaluation that can be included in the City's annual O&M budget include:

1. Enhance nitrogen removal by optimizing the recycle rate, including the use of ORP data to guide connecting gate operation; and
2. Perform a condition assessment of the clarifiers to inspect the submerged mechanisms for corrosion.

Effluent Disinfection and Discharge

Disinfection

Overview

Prior to discharge to the Stillaguamish River, treated water must be disinfected. The current system utilizes two identical equipment trains, each with two banks of lamps for UV treatment. Secondary effluent enters the UV building in 24-inch pipes and flows into 2 reactor channels with UV modules as described in the **Effluent Disinfection Design Criteria** section of this chapter. The UV equipment was manufactured by Wedeco (Xylem) and consists of horizontal, submerged lamps. Both channels typically operate with all UV lamps at 100-percent power. The secondary effluent receives the UV dose in the reactors and flows out of the UV building in one 30-inch disinfected secondary effluent pipe to the outfall. Disinfected secondary effluent is also redirected to the non-potable plant water basin in the UV building for use as plant water. On an emergency basis, the effluent can be directed to the 35-acre facultative lagoon in case of an operational emergency or scheduled maintenance.

Condition Assessment

The existing UV system is the original system installed in 2004 as part of the expansion project. The system has provided reliable disinfection and Xylem continues to support the system with replacement parts. Attempts to implement a flow-paced system to control lamp power and save energy have not been successful with the existing UV system. Since the existing UV system is original from the WWTP expansion, it is nearing the end of its design life. Additionally, the system is expected to limit flow capacity of the WWTP by the end of the planning period as identified earlier. Therefore, the UV system is recommended for replacement during the planning period.

Outfall

Overview

The outfall to the Stillaguamish River consists of a concrete outlet structure where the 30-inch disinfected secondary effluent pipe enters and discharges to the structure with a slide gate, then the effluent enters a 24-inch corrugated metal pipe that serves as the final outfall. The chlorine contact chambers from the original WWTP are adjacent to the outfall but have been bypassed since the implementation of UV disinfection.

Condition Assessment

The concrete structure and 24-inch corrugated metal pipe were part of the original WWTP, and the structure was modified as part of the 2004 expansion. An inspection of the outfall was performed in 2021 and confirmed that the outfall pipe in the Stillaguamish River is in good condition and performing as designed. Although the original design documents for the outfall were not located or provided, the construction record drawings for the 2004 expansion used flow conditions of 5.2 MGD peak instantaneous, 3.7 MGD peak hour, and 1.5 MGD maximum month to calculate the hydraulic profile. Based on the inspection results, the outfall is expected to maintain this capacity. Since some of these flow conditions will need to be increased in the planning period, it is

recommended that an analysis of the hydraulic profile and an outfall mixing zone study be included in the Engineering Report previously recommended for increasing the activated sludge system capacity.

Summary of Major Findings

A summary of major recommendations for the effluent disinfection and discharge system is as follows:

1. Replace the UV disinfection system during the planning period.
2. Perform a Mixing Zone Study and assess the hydraulic capacity of the outfall structures as part of the Engineering Report required to expand permitted WWTP capacity.

Minor items noted during the evaluation that can be included in the City's annual O&M budget include:

1. Refurbish the disinfected secondary effluent valve actuators and other ancillary equipment.

Solids Handling

Waste Activated Sludge Pumping (Headworks Building)

Overview

The RAS/WAS pumps are used as part of the activated sludge system and the solids handling system. These pumps normally return activated sludge from the secondary clarifiers to the screened influent channels feeding the anoxic basins. The pumps are used to intermittently feed the sludge stabilization ponds from the headworks building based on a fixed volume or timer. Activated sludge settled in the clarifiers flows to the headworks building via two 8-inch pipes. The two RAS/WAS pumps drawing the activated sludge are centrifugal pumps, each rated for 543 gallons per minute (gpm) and driven by 5 hp motors operated with VFDs that can be controlled in time mode or flow proportional mode. A third pump is meant to provide redundancy, and there is space for a fourth pump if necessary.

Condition Assessment

One of the active pumps (P312-1) was previously rebuilt with a new impeller, bearings, and seals. The other active pump (P311-1) has been maintained with new bearings and seals but still has an old impeller. Currently, the third pump in the system has been out of commission waiting for new parts. Staff keep three motors on hand in case of motor failure in the active pumps. Continued maintenance of the RAS/WAS pumps is expected to occur as part of routine O&M.

Sludge Stabilization Ponds

Overview

The WWTP currently includes two sludge stabilization ponds. These were constructed as part of the original 1963 WWTP as anaerobic primary treatment lagoons along with two others that were reclaimed during the 2004 expansion. Sludge stabilization pond no. 2 was equipped with five

surface aerators during a small upgrade project in 1996. As part of the 2004 expansion, one of the previous surface aerators was moved to sludge stabilization pond no. 1 along with two new aerators. The 2004 expansion also added decant pump stations, liners, and level transmitters to each pond. The ponds were last dredged in 2017 and before that in 2010/2011. A pond is determined to be full when the decant pumps start to have trouble, then a water cap is left over the stored sludge until dredging. During the winter, the decant pumps run every day, but during the summer less decanting is needed due to evaporation.

Condition Assessment

The sludge stabilization ponds initially were designed to be aerated, but the surface aerators in the ponds are not functional and need to be replaced if the ponds are to be maintained as the solids handling system. Due to the failure of the surface aerators, a water cap is currently used in both the active pond and the storage pond. An enclosure may need to be added to the decant pump stations to prevent freezing in the winter.

Summary of Major Findings

A summary of major findings for the solids handling system evaluation is as follows:

1. Replace or refurbish both ponds' surface aerators if the ponds are to be maintained as the solids handling system.
2. Consider implementation of a new solids handling system (**Chapter 8**).

Minor items noted during the evaluation that can be included in the City's annual O&M budget include:

1. Add enclosures for the ponds' decant pump stations if the ponds are to be maintained as the solids handling system; and
2. Replace liners and other failing appurtenances if the ponds are to be maintained as the solids handling system.

OTHER SYSTEMS AND FACILITIES

35-Acre Facultative Lagoon

Overview

The existing facultative lagoon was built as part of the original WWTP in 1963. The lagoon is 2.5 to 3.5 feet deep and has a volume between 28 and 42 MG. The lagoon has one 5 hp aspirating aerator and is decanted by a 20 hp submersible pump with a 1,050 gpm capacity in the east outlet structure. The east outlet structure also contains a level transmitter for the lagoon. Bypass flow to the lagoon is measured by a 12-inch magnetic flow meter with a 4,860 gpm capacity. Decant flow out of the lagoon is measured by a 6-inch magnetic flow meter with a 1,750 gpm capacity. The lagoon is decanted during the winter. Presently, the lagoon is used for emergency bypass of the secondary treatment system or when the sludge stabilization ponds are offline for maintenance, dredging, or emergencies.

Condition Assessment

Since this is not a critical part of the WWTP's normal operations, it is not expected to limit the WWTP capacity and no improvements are expected to be necessary during the planning period. The City intends to keep this lagoon to maintain functionality.

Plant Water System

Overview

Effluent from the disinfection system can be directed to a plant water tank in the UV disinfection building just to the north of the UV channels. This non-potable water is drawn to the headworks building by two pumps in the RAS/WAS pump room. The original plant water system design included a strainer in the RAS/WAS pump room, but this has been removed as the operators reported frequent clogging and did not feel it was necessary. The RAS/WAS pump room also houses a chlorination dosing system for the plant water consisting of a 30-gallon sodium hypochlorite tote and 2 metering pumps on a skid. The plant water is chlorinated and pumped around the WWTP for non-potable uses. The RAS line also can be chlorinated with this dosing system for control of filamentous bacteria. Plant water flow is measured by a 3-inch magnetic flow meter with a 450 gpm capacity.

Condition Assessment

One of the two pumps drawing plant water to the RAS/WAS pump room contains minor cracking in its piping and is offline. Its repair should be included in the City's annual O&M budget. No major improvements are expected to be necessary during the planning period.

Yard Pump Station

Overview

The YPS takes wastewater from the nearby shopping center and Public Works building, as well as drainage and sanitary sewage from the headworks building, oxidation ditches, scum tank, operations building, vehicle storage and maintenance building, and UV building, and pumps it to the headworks via a 6-inch pumped drainage pipe where it enters the main screening channel. It contains one duty and one standby 5 hp submersible pump, each with 200 gpm capacities, and an 8-inch magnetic flow meter with a 3,150 gpm capacity.

Condition Assessment

Refurbishment of structural and mechanical components of the YPS should be included in the City's annual O&M budget. No major improvements are expected to be necessary during the planning period.

Scum System

Overview

Scum from the secondary clarifiers is directed to the scum tanks. Liquid in the scum tanks is decanted to the YPS. Solids collect and age in the scum tanks and are vactored out one to two times per year.

Condition Assessment

Refurbishment of structural and mechanical components of the scum system should be included in the City's annual O&M budget. No major improvements are expected to be necessary during the planning period.

WWTP Electrical and Control Systems

Electrical Service and Distribution

The existing electrical service is sized at 1,000 Amperes (A), and the service voltage is 277/480 Volts Alternating Current, 3 phase. The service is adequately sized for the existing load at the WWTP. If the electrical load increases, the service equipment can be uprated to 1,600 A with the replacement of the utility transformer, main circuit breaker, and secondary conductors.

Standby Power

The generator appears to be adequately sized but reliability has been a growing concern. The City reports that during power switchovers, the UV system is prone to faulting and the RAS system can fail. Manual reset of the equipment is mandatory to resume operation. It has been noted by the City that cold weather correlates with additional generator issues and alarms, again requiring a manual reset of the equipment. The generator is exercised weekly and is refueled approximately once per year. D Square Energy performs maintenance of the generator. Due to the generator's age and observed unreliability, it is recommended to perform a load analysis and replace the generator.

Plant-Wide Electrical Short Circuit, Protective Device Coordination, and Arc Flash Analysis

It is recommended that the City conduct an electrical short circuit, protective device coordination, and arc flash analysis and label all three-phase electrical equipment accordingly.

Telemetry System

The existing telemetry system was last updated 5 years ago. Both software and hardware are based on supported platforms, mostly comprised of Rockwell and Allen-Bradley equipment. The existing SCADA system operates on a computer with a desktop screen. A larger screen for the operations building may be desired depending on operator preference.

Influent Screening System Major Electrical and Control Equipment

The electrical system for the screen and all controls are original and unmodified. The motors for the exhaust supply fans to the odor control system had to be replaced due to a previous failure. The equipment remains functional but, due to the environment, the enclosures are degrading. Long-term planning should include replacement of the critical equipment.

Activated Sludge System Major Electrical and Control Equipment

The activated sludge system motor control center is manufactured by Cutler-Hammer. There is no room for expansion beyond an additional ditch and two more clarifiers. Parts remain available for repairing the equipment.

Effluent Disinfection System Major Electrical and Control Equipment

The effluent disinfection electrical equipment is original to the installation of the disinfection system. The overall condition is good, and parts remain available for repairing the equipment.

Solids Handling System Major Electrical and Control Equipment

The solids handling system motor control center is original to the installation. Due to its outdoor location, the enclosure is showing signs of degradation. Operation remains unaffected, but long-term plans should include replacement of this motor control center.

Summary of Major Findings

A summary of major findings for the WWTP electrical and control systems evaluation is as follows:

1. Perform a load analysis and replace the generator within the planning period due to its age and observed unreliability.
2. Replace influent screening system critical electrical and control equipment within the planning period.
3. Replace the solids handling system motor control center within the planning period if the ponds are to be maintained as the solids handling system.

Minor items noted during the evaluation that can be included in the City's annual O&M budget include:

1. Conduct an electrical short circuit, protective device coordination, and arc flash analysis and label all three-phase electrical equipment accordingly;
2. Refurbish the outdoor enclosures of the influent screening electrical and control equipment and the solids handling system motor control center; and
3. Replace the telemetry system screen in the operations building with a larger screen if this is the operators' preference.

Administration, Operations, and Maintenance Facilities

Operations Building

The operations building houses the administrative offices, laboratory, lunchroom, bathrooms, showers, operator lockers, storage areas, the electrical room, the WWTP generator, a computer room with the SCADA system human machine interference, and other rooms. The operations building is adequate for the operators' needs and no improvements should be necessary during the planning period.

Vehicle Storage and Maintenance Building

The vehicle storage and maintenance building contains four vehicle storage bays, including one with floor drains for washing vehicles, as well as a shop and equipment storage room. The building is adequate for the operators' needs and no improvements should be necessary during the planning period.

SUMMARY

This chapter identified a variety of capacity- and condition-based needs that will warrant improvement during the planning period. **Chapter 8** includes an analysis of alternatives for WWTP improvements and summarizes the recommended improvements. **Chapter 10** identifies the WWTP capital improvements for the purposes of establishing capital improvement project costs and a schedule for implementation.

8 | TREATMENT PLANT RECOMMENDED IMPROVEMENTS

INTRODUCTION

This chapter evaluates the ability of the City of Stanwood's (City) wastewater treatment plant (WWTP) to reliably meet the requirements of its National Pollutant Discharge Elimination System (NPDES) Permit and Puget Sound Nutrient General Permit (PSNGP) through the planning period given the major considerations presented in previous chapters. Existing and future regulatory requirements for the WWTP are outlined in **Chapter 2** of this General Sewer Plan (GSP). **Chapter 4** projects growth of the influent flow and loading. **Chapter 7** evaluates the condition of the existing infrastructure. This chapter analyzes alternatives to meet the needs of the WWTP through the planning period and provides recommendations for improvements.

MAJOR CONSIDERATIONS FOR WWTP IMPROVEMENTS

Based on the analyses of the previous chapters, the major factors influencing the WWTP planning are:

- New regulatory requirement for nitrogen removal per the PSNGP;
- Projected growth in flow and loading to the WWTP; and
- Age and condition of the existing facility.

These factors are introduced in the following sections and are considered in the analyses of recommended WWTP improvements in this chapter.

Regulatory Changes – Nitrogen Reduction

As discussed in **Chapter 2**, the nitrogen limits imposed by the PSNGP that came into effect in 2022 will significantly influence WWTP planning. The City is considered to be in the category of "WWTPs with small TIN [Total Inorganic Nitrogen] loads" by the PSNGP. As detailed in **Chapter 2**, the City was covered under the original PSNGP at the time this GSP was drafted. The original PSNGP required dischargers in this category to:

- Develop and implement a Nitrogen Optimization Plan (NOP). The general intent of the NOP is to assess and recommend optimization strategies to maximize TIN removal at the existing WWTP primarily through operational changes, minor on-site improvements, and off-site source control. Dischargers were required to select an initial optimization strategy by December 31, 2022. The NOP should analyze and document the performance of the selected optimization strategy. The NOP must be submitted by March 31, 2026;
- Complete an all known, available, and reasonable methods of prevention, control, and treatment (AKART) analysis that evaluates the reasonable treatment alternatives that will maintain the WWTP annual average effluent TIN below 10 milligrams per liter (mg/L). This analysis must include wastewater characterization, analysis of treatment technologies, economic evaluation, environmental justice review, recommendations of the most

reasonable treatment alternative, and an implementation schedule. The AKART analysis must be submitted by December 31, 2025. Notably, the PSNGP states that "permittees that maintain an annual TIN average of < 10 mg/L and do not document an increase in load through their DMRs [Discharge Monitoring Reports] do not have to submit this analysis;" and

- Meet additional monitoring and record retention requirements as discussed in **Chapter 2**.

For the purposes of this GSP, the existing PSNGP limit of 10 mg/L for annual average effluent TIN is considered the benchmark for analyzing alternatives for improvements to the activated sludge system. The existing WWTP was designed to achieve some TIN removal, but its design predates the effluent TIN limit from the PSNGP, so it is not designed to achieve TIN removal to below 10 mg/L. In 2022, the WWTP provided TIN reduction such that the annual average was below 10 mg/L as discussed in **Chapter 7**; however, the amount of TIN removal was variable. Therefore, improvements to the activated sludge system must consider the ability to reliably meet the TIN limit through the planning period.

Continued modeling by the Washington State Department of Ecology or other factors may change the structure of the final TIN limit. The final TIN limit may be different from an annual average of 10 mg/L for the City. As discussed in the **Activated Sludge System** section in this chapter, the City is currently utilizing an optimization strategy to meet a TIN limit of 10 mg/L. If regulatory conditions result in more stringent limits, the timeline for planning improvements may be accelerated and capital costs increased.

Growth in Flow and Loading

The existing and projected flow and loading are defined in **Chapter 4**. The projected values are summarized in **Table 8-1**, along with the current rated capacity of the WWTP per the NPDES Permit.

Table 8-1

Projected Influent Flow and Loading

Parameter	Existing (2020)	2034	2044	Buildout (2074)	NPDES Permit Rating	85% of Permit Rating
Hydraulic Loading (MGD)						
Annual Average Daily Flow	0.58	0.78	1.01	2.78	-	-
Maximum Month Daily Flow	0.85	1.24	1.61	4.44	1.50	1.28
Peak Hour Flow	2.30	3.10	4.04	11.1	-	-
BOD Loading (ppd)						
Annual Average Daily BOD	1,559	2,246	2,841	6,850	-	-
Maximum Month Daily BOD	1,914	3,039	3,845	9,269	4,100	3,485
TSS Loading (ppd)						
Annual Average Daily TSS	1,562	1,940	2,536	6,544	-	-
Maximum Month Daily TSS	2,725	3,041	3,973	10,256	4,100	3,485

Green shaded cells exceed 85% of the rated capacity and orange shaded cells exceed 100% of the rated capacity.
ppd = pounds per day

As shown in the table, the projected 2044 flow exceeds the permitted capacity of the WWTP. In addition, the projected 2044 biochemical oxygen demand (BOD) and total suspended solids (TSS) loadings exceed 85 percent of the rated capacity. The City's NPDES Permit requires the City to begin planning for an expansion of facility capacity when flow or loading exceeds 85 percent of the permitted maximum month value for 3 consecutive months.

It takes considerable time to properly plan for and implement major WWTP expansions. This is a significant consideration when deciding on a capital improvements schedule that includes expansion of WWTP capacity to accommodate the projected increases in flow and loading.

Age and Condition

Chapter 7 summarized the existing conditions of the major unit processes and areas of the WWTP. The last major improvements to the facility were made approximately 20 years ago, and improvements will be needed during the planning period due to the age of the infrastructure. Changes to the WWTP process may be necessary due to regulations and growth as discussed previously; therefore, the recommendations in this chapter seek to avoid unnecessarily investing in the rehabilitation of aging items that are likely to be substantially reconfigured or replaced later in the planning period.

Since the WWTP was last updated roughly 20 years ago, many components are reaching the end of their design life. Some of these components are still in good condition and/or are supported by the manufacturer but should be replaced within the planning period. Some of these components include the influent screens, clarifier drives, and ultraviolet (UV) disinfection system (**Chapter 7**). Options for improvements to these components include in-kind replacement, temporary refurbishment until replacement later in the planning period, or replacement with a new model as part of capacity expansions or to accommodate a larger process reconfiguration.

The activated sludge and solids handling systems at the WWTP contain aging components such as the oxidation ditch mixer-aerators and the sludge stabilization pond surface aerators. In addition to evaluating the option to replace the aging components, this chapter will consider alternatives for new secondary treatment and solids handling systems. A reconfigured or expanded activated sludge system is needed to accommodate growth and to reliably meet the new regulatory requirements. A new solids handling system is needed to accommodate growth and eliminate the need for dredging. Due to the potential size and scope of process reconfigurations involved in new activated sludge and solids handling systems, these items are expected to have the largest impact on WWTP capital planning.

APPROACH TO WWTP ANALYSES

For the purposes of this chapter, the WWTP is divided into four areas: preliminary treatment, secondary treatment (i.e. the oxidation ditches and secondary clarifiers), effluent disinfection and discharge, and solids handling. Improvements to the preliminary treatment system are needed to address the age and condition of the equipment. Improvements to the activated sludge system are needed to replace aging equipment, expand WWTP capacity, and achieve nitrogen reduction reliability at projected flow and loading through the planning period. Improvements to the effluent disinfection and discharge system are needed to address the age and condition of the equipment and expand WWTP capacity. Improvements to the solids handling system are needed to replace aging equipment and expand WWTP capacity. The analyses of potential improvements for each system are discussed in the following order:

1. Preliminary Treatment System.
2. Activated Sludge System.
3. Effluent Disinfection and Discharge.
4. Solids Handling System.

PRELIMINARY TREATMENT SYSTEM

Summary of Analysis

Chapter 7 identified age and condition-based replacement needs for the existing preliminary treatment system. The existing screens have been in use continuously since the WWTP was expanded to 1.5 million gallons per day (MGD) in 2004. Since the approximate lifespan of the mechanical screen is 20 years, it is at the end of its design life and is recommended for replacement during the planning period. The manual bar screen also should be replaced to meet the state biosolids rule (Chapter 173-308 Washington Administrative Code (WAC)).

As discussed later in this chapter, process upgrades to both the activated sludge system and solids handling system are recommended. The implementation of grit removal in the preliminary treatment system is preferred for the implementation of each of these process upgrades.

Preliminary Treatment System Recommendations

Screening

Due to the age of the mechanical screen, planning for replacement within the first 5 years of the planning period is recommended. The projected peak hour flow rate to the WWTP will not exceed the rated capacity of the mechanical screen during the planning period so it can be replaced in-kind. The existing manual bar screen should be upgraded to meet the state biosolids rule for all biosolids to have significant removal of paper, plastic, and other inorganic waste prior to final disposition. The rule stipulates that screens need to accomplish removal equivalent to a ⅜-inch bar screen or finer somewhere within the WWTP process.

The recommended approach to the replacement of both screens is to budget for two new mechanical fine screens so that the headworks screening meets the state biosolids rule, the headworks has the redundancy of two mechanical screens, and the budget for the project is conservative. The City should identify options for replacement screens that require minimal structural or mechanical alterations to the headworks building to be implemented. This means the new screens should fit into the existing screening channels and ancillary equipment should be able to be configured within the upper floor of the headworks building without major modifications.

Grit Removal

The addition of a grit removal system should be evaluated due to the negative effect of grit accumulation on processes recommended for the WWTP in this chapter and the additional wear grit places on equipment throughout the WWTP.

During current WWTP operations, grit accumulates in the anoxic basins and oxidation ditches and is periodically removed by City operations and maintenance (O&M) staff. The addition of an automated grit removal system at the headworks would reduce or eliminate the need for this activity. Any grit that does not settle in the anoxic basins or oxidation ditches is removed with the waste activated sludge (WAS) from the secondary clarifiers. Grit accumulation has not been a problem for the WWTP due to the use of surface mixer-aerators in the oxidation ditches and open sludge stabilization ponds for solids handling.

However, the recommended alternative for the activated sludge system includes floor-mounted diffused aeration grids in the oxidation ditches. Accumulation of grit at the bottom of the oxidation ditches will affect the performance of aeration diffusers, and grit removal at the headworks should be implemented before implementing diffused aeration in the ditches. Additionally, the recommended alternative for the solids handling system includes aerobic digesters and thickening and dewatering equipment. The addition of grit removal to the headworks is preferable for these processes as well.

The implementation of grit removal should occur simultaneously with, or before, the implementation of the recommended alternative for the activated sludge system. The recommended approach to the addition of a grit removal system is to use the space set aside for this purpose in the 2004 expansion plans. There is space for a grit removal system south of the

headworks channels between the headworks building stairway and oxidation ditch no. 1, and space for a classifier and hopper on the lower floor of the headworks building.

ACTIVATED SLUDGE SYSTEM

Existing Activated Sludge System

The existing activated sludge system consists of two identical treatment anoxic basins, oxidation ditches, and secondary clarifiers. Refer to **Chapter 7** for details on the existing infrastructure and process, including the age and condition of the structures and equipment.

Table 8-1 shows the NPDES permit maximum month design flow and load for the WWTP and compares that to flow and load projections through the planning period. The table demonstrates that 85 percent of permitted load and 100 percent of permitted flow are projected to be surpassed during the planning period. The addition of the PSNGP limits on effluent TIN discussed earlier in this chapter provides further limitation on system capacity as a result of the solids retention time (SRT) required to achieve sufficient nitrogen removal.

The age and condition of equipment and growth in flow and load to the WWTP create the need for improvements to the activated sludge system. Alternatives for these improvements are discussed in the **Screening of Activated Sludge System Alternatives** section.

Nitrogen Removal with Activated Sludge Systems

Nitrogen removal with an activated sludge system is achieved using an anoxic zone and internal mixed liquor recycle (IMLR). Nitrogen removal is accomplished by nitrification in the aerobic zones and subsequent denitrification in anoxic selectors. In the aerobic zones, nitrifying microorganisms use oxygen to metabolize ammonia and convert it to nitrate. Mixed liquor from the aerobic zones is recycled to the anoxic selectors to provide the nitrate to denitrifying microorganisms. This recycle flow is referred to as IMLR. The anoxic zone provides an environment without oxygen, so denitrifying microorganisms use the nitrate instead of oxygen to metabolize carbonaceous BOD from the influent. In this process, the nitrate is converted to nitrogen gas that escapes to the atmosphere.

Typical IMLR rates for nitrogen removal activated sludge systems are 3 to 4 times the influent flow rate. At lower IMLR rates, not enough nitrate is returned to the anoxic zone to achieve maximal nitrogen removal. At higher IMLR rates, there is more than enough nitrate recycled to the anoxic zone for sufficient denitrification. For systems with pumped IMLR, the increase in energy usage to pump higher IMLR rates is typically not worth the cost. At very high IMLR rates, the dissolved oxygen (DO) recycled into the anoxic zone can inhibit denitrification by providing oxygen to the microorganisms to metabolize BOD more efficiently than with nitrate.

Since nitrifying organisms require more time to develop than those that oxidize carbonaceous BOD, a longer SRT is needed to maintain this population and consistent full nitrification. Operating at a longer SRT leads to a more concentrated mixed liquor. The maximum mixed liquor concentration that a system using secondary clarifiers can operate with is dependent on how well the activated sludge settles and separates from the secondary effluent. This is because activated sludge with

good settleability can be treated by secondary clarifiers at higher solids loading rates. The essential operational considerations for nitrogen removal with an activated sludge system are IMLR rate and SRT; the capacity of the system is then subject to the necessary mixed liquor suspended solids (MLSS) concentration that must be maintained and the settleability of the mixed liquor.

Current Strategy for Nitrogen Reduction

The existing activated sludge system at the WWTP was not designed to meet the effluent nitrogen limit of the PSNGP. The PSNGP required the WWTP to "develop, implement, and maintain a Nitrogen Optimization Plan to evaluate and implement operational strategies for maximizing nitrogen removal…". The *Stanwood Wastewater Treatment Plant Nitrogen Optimization Plan* (**Appendix I**) includes a description of the strategies for the WWTP to optimize nitrogen removal with the existing system in the near term without requiring major physical changes to the system. These strategies are:

- Implementing nitrogen testing of a secondary treatment process and recycle streams;
- Optimization of DO concentrations to limit the return of DO to the anoxic zones;
- Continuous oxidation-reduction potential monitoring of the anoxic basins to optimize IMLR recycle rates by adjusting the IMLR gate position; and
- Replacing the mixer in anoxic basin no. 1 (**Chapter 7**).

Existing System Limitations for Nitrogen Removal

Regardless of the strategies implemented to maximize nitrogen removal, the design of the existing system makes optimized nitrogen removal challenging. This is due to the configuration of the oxidation ditches, in which IMLR flows through a gate instead of pumps and is not automatically controlled. Adjusting the opening position of the gate also does not provide precise control over the IMLR rate. In this configuration, the IMLR rate is primarily driven by the speed of the mixer-aerator and cannot be adjusted independently of the aeration. Therefore, as growth in flow and load occurs, higher mixer-aerator speeds required to meet the oxygen demand will cause increased IMLR rate and inhibit denitrification.

The IMLR rates for the existing system range from 6 to 15 times the influent flow rate. Biowin process modeling completed for the **Screening of Activated Sludge System Alternatives** indicated that 6 to 8 times the influent flow rate achieves optimal nitrogen removal, but 8 to 15 times the influent flow rate causes increasing inhibition of denitrification. The inability to control the IMLR rate within this range causes varying levels of inhibition of denitrification. The WWTP consequently achieves highly variable nitrogen removal, as demonstrated by the 2022 monthly nitrogen sampling results included in **Table 7-2**.

When the existing system was designed, the design capacity considered the MLSS necessary for BOD removal in accordance with the NPDES Permit. The addition of the PSNGP effectively reduces the capacity of the WWTP since a greater MLSS is necessary to achieve the required nitrogen removal. Additionally, the mixed liquor produced by the existing system has poor settleability so the necessary MLSS concentrations will be increasingly difficult to achieve. These limitations are considered in the **Screening of Activated Sludge System Alternatives** section.

Primary Objectives for Improvements

Improvements to the WWTP should expand the capacity of the system to meet the projected growth in flow and load through the planning period and remove nitrogen in accordance with the PSNGP limit. These objectives require the existing system to operate at greater MLSS concentrations to provide sufficient SRT for nitrogen removal. Due to the limitations of the existing system discussed previously, the increase in necessary MLSS concentration and the inability of the existing system to accommodate this due to poor settleability means that the existing system will need to be expanded to meet the objectives of the improvements.

For other potential improvements under consideration, the primary objectives are to address the limitations of the existing system for nitrogen removal. This includes controlling IMLR rates and facilitating improved settleability to increase the achievable MLSS concentration. Activated sludge systems designed for precise control of IMLR rates use pumping instead of gates. Pumped IMLR has the benefits of automatic control and decoupling from aeration and mixing. Activated sludge systems designed for enhanced settling properties typically use anaerobic selectors to develop phosphorus accumulating organisms (PAOs). Microbial communities with PAOs have good settling characteristics. Improved settleability will make greater MLSS concentrations possible, which increases the capacity of the system and provides sufficient SRT for nitrogen removal without the need to build more tanks and/or clarifiers.

Initial screening of potential improvements finds that these primary objectives can be achieved with different alternatives that continue using activated sludge within the existing tanks and clarifiers.

Screening of Activated Sludge System Alternatives

Three activated sludge system alternatives were screened for the purpose of establishing a budget for the City to fund necessary improvements to the system through the planning period. A future Engineering Report will be required to provide a full alternatives analysis per WAC 173-240-060 and will include design criteria for the recommended improvements. The following three alternatives are the most feasible alternatives for the WWTP based on the considerations of the **Primary Objectives for Improvements**:

- Alternative 1: Expand the existing system per the original 2004 plans.
- Alternative 2: Improve the existing oxidation system with partitioned selectors and diffused aeration.
- Alternative 3: Convert the existing oxidation ditches to plug flow reactors with partitioned selectors and diffused aeration.

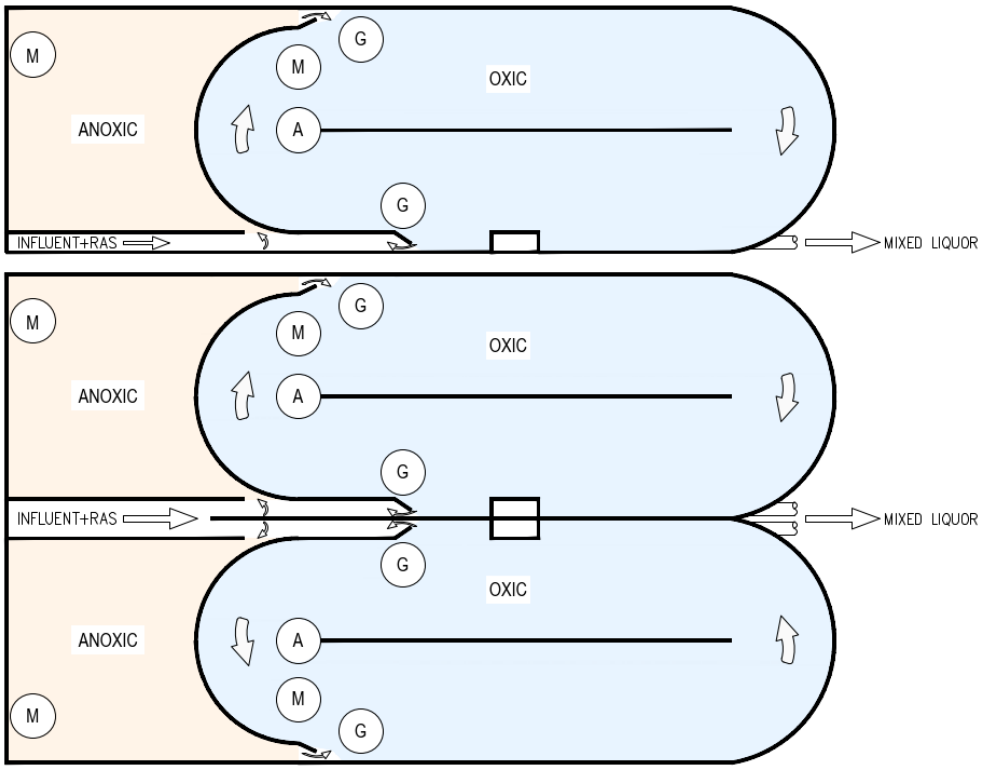
Alternative 1: Expand the Existing Complete Mix System

Alternative 1 consists of constructing a third anoxic selector, oxidation ditch, and secondary clarifier to provide the necessary increase in capacity to meet the projected flow and load through the planning period. A fourth clarifier also would be added to provide redundancy to the system and because it will be relatively convenient and economical to construct it as part of the larger expansion project. Additionally, the existing mixer-aerators would be replaced due to age. This

alternative expands the existing process as described in the City's 2000 *Wastewater Facilities Plan* and associated contract drawings. **Figure 8-1a** shows a schematic of the expanded existing process, and **Figure 8-1b** shows the layout of the expansion.

Figure 8-1a

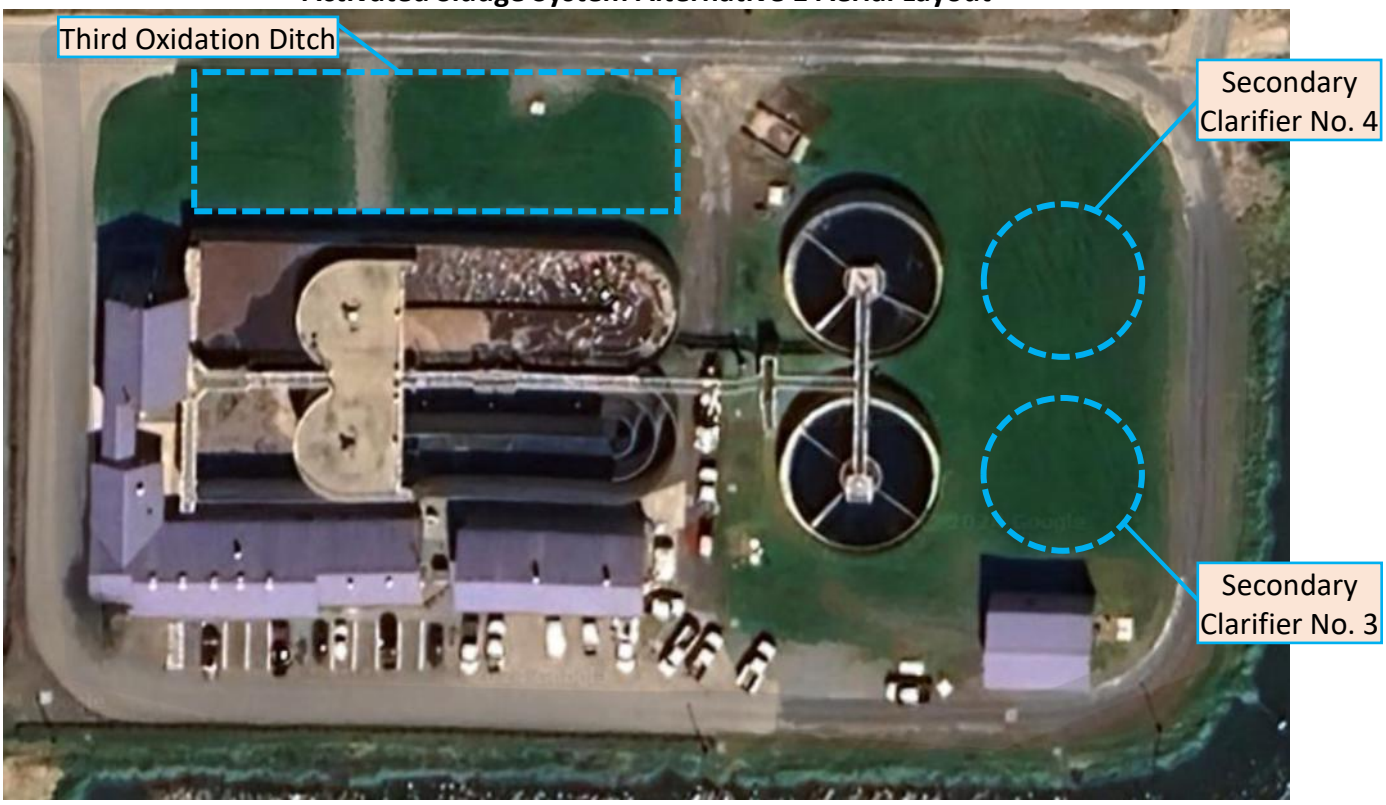
Activated Sludge System Alternative 1 Diagram



M = mixer
A = mixer-aerator
G = gate
RAS = return activated sludge

Figure 8-1b

Activated Sludge System Alternative 1 Aerial Layout



Biowin modeling was used for this analysis to determine the SRT that the activated sludge systems must maintain to achieve reliable nitrification and system capacity relative to the flow and load projections throughout the planning period. For Alternative 1, an SRT of 15 days was determined to be sufficient for reliable nitrification in winter temperatures. The low end of the range of IMLR rates was used to model the capacity of Alternative 1 since that is the optimal IMLR rate for nitrogen removal as discussed in the **Existing System Limitations for Nitrogen Removal** section.

Based on the modeling, the existing system with two ditches and two clarifiers in operation is predicted to have capacity through 2033 for maximum month conditions. The 2034 maximum month projected flow and load requires a MLSS concentration that cannot be achieved due to the poor settleability of mixed liquor produced by the oxidation ditches as described previously in the **Existing System Limitations for Nitrogen Removal** section. The expansion of the existing system would need to be completed in time for 2034 maximum month conditions at the latest. The modeling predicts that the expanded system will have sufficient capacity for the flow and load projections through the planning period.

Cost Estimate

The cost of the expansion was estimated based on a planning-level analysis of the necessary structures and equipment for similar projects and recent budget proposals. The estimates produced include $4 million for in-kind replacements to maintain the existing system, $4 million for each new secondary clarifier, and $10 million for a third oxidation ditch. The total planning-level

estimate is $22 million. This cost is significantly greater than the planning-level estimates for the other alternatives evaluated.

Summary

The primary advantage of this alternative is that it maintains the existing system configuration, which is familiar to operating staff. However, there are significant disadvantages to this alternative. This alternative represents a significant expansion of the WWTP infrastructure and will require a complicated construction project to integrate the new tankage into the existing facility. There will be significant geotechnical, structural, and mechanical considerations in undertaking such a project, and the high capital cost is representative of these complexities. Further, there are significant process control disadvantages with this alternative relative to the other alternatives. These inherent disadvantages include the lack of ability to control and quantify the IMLR rate, the poor settleability of the mixed liquor produced, and the consequential need to expand the footprint to increase capacity in the future. Once the process is expanded to three oxidation ditches and four secondary clarifiers, there will be no more footprint left within the WWTP and the system will be at maximum capacity without a process change.

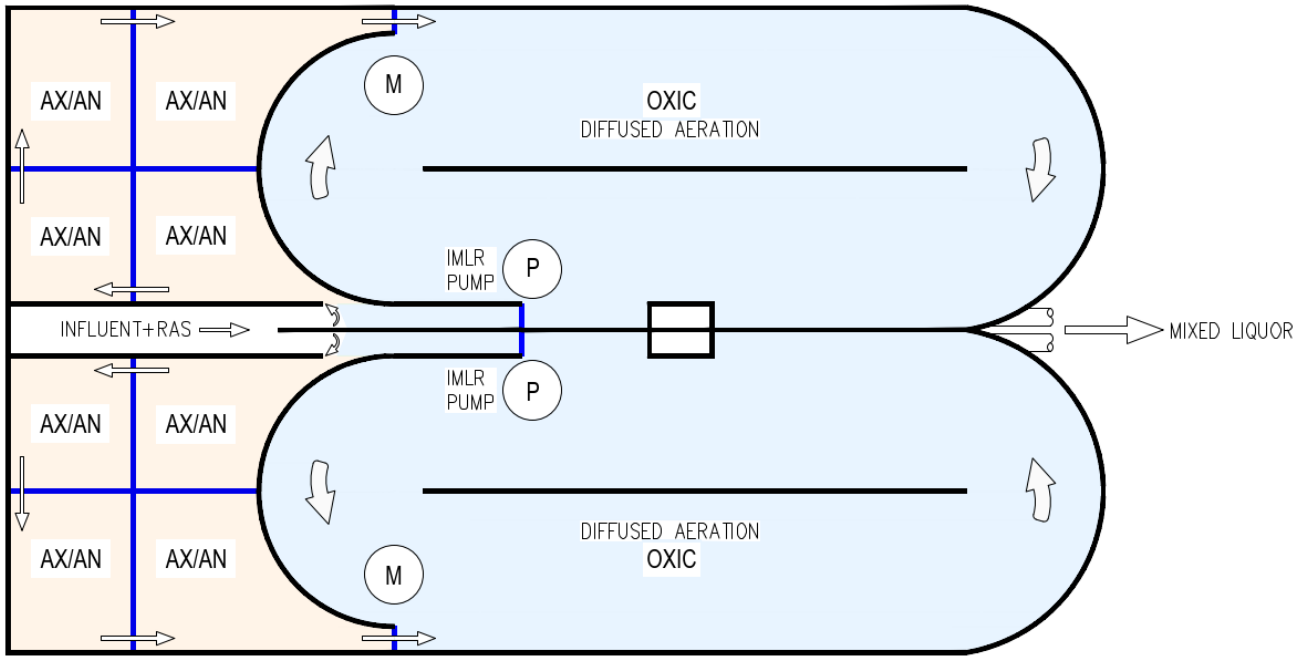
Due to the significant disadvantages associated with this alternative, it is not recommended for further consideration.

Alternative 2: Complete Mix with Diffused Aeration

Alternative 2 consists of partitioning the anoxic basins into smaller selectors with more operational flexibility, converting the oxidation ditches to diffused aeration instead of surface mixer-aerators, implementing pumped IMLR for precise and automatic control, and implementing surface wasting. These improvements will provide the necessary increase in capacity to meet the projected flow and load through the planning period. **Figure 8-2** shows a schematic of the proposed process.

Figure 8-2

Activated Sludge System Alternative 2 Diagram



AX/AN = anoxic/anaerobic
P = pump
Note: IMLR can be directed to any or all AX/AN selector zones.

Anoxic Zone Partitions

Anoxic zone partitioning would be implemented by installing concrete walls or stainless steel baffles to divide the existing anoxic basins into four selector zones. Mixing could be achieved by individual propeller mixers or compressed gas mixing in each zone. IMLR could be directed to any or all of the selector zones via a valve manifold in the center of the basins. The partitioned selector zones will provide the flexibility to operate with anaerobic selectors that can be transitioned back to anoxic selectors when required. Anaerobic selectors enhance the settleability of the mixed liquor, as discussed in the **Primary Objectives for Improvements** section.

Diffused Aeration

Diffused aeration would be implemented by removing the existing surface mixer-aerators and constructing an aeration system consisting of an outdoor blower pad to supply diffused aeration grids installed along the floors of the ditches. Simultaneously, a larger directional mixer would be added to each ditch to maintain the flow around the oval-shaped ditch. Transitioning the oxidation ditches to diffused aeration will allow for independent control of aeration and mixing. Better control of aeration may help limit DO recycling to the selectors and provide improved conditions for the activated sludge biological community.

Pumped IMLR

Pumped IMLR would be implemented by replacing the existing gates with walls and equipping each ditch with pumps for IMLR that lead to the valve manifold described previously. Transitioning the oxidation ditches to pumped IMLR will allow for better control of the IMLR rate to accomplish sufficient denitrification without inhibition caused by excess DO in the anoxic selectors.

Surface Wasting

Each ditch would use surface wasting as a physical selector to improve settleability of the mixed liquor by wasting mixed liquor off the surface of the aerobic zones. Microorganisms that form foam and filaments and float on the surface of the mixed liquor are preferentially wasted to prevent their proliferation in the activated sludge biological community. This helps select against the microorganisms with poor settling properties.

Biowin Modeling

Biowin modeling for Alternative 2 determined that an SRT of 15 days is sufficient for reliable nitrification in winter temperatures. An IMLR rate of 4 times the influent flow rate was used for modeling this alternative since that is typical of activated sludge systems (**Nitrogen Removal with Activated Sludge Systems**). Although the models for Alternative 1 and Alternative 2 show similar MLSS concentration requirements, the improved settleability expected from Alternative 2 provides for greater capacity since a greater MLSS concentration will be achievable.

Based on the modeling and settleability, and with both ditches and clarifiers operating, Alternative 2 is predicted to have capacity through the 2044 maximum month conditions. As previously discussed, expansion of the activated sludge system would need to be completed to meet 2034 maximum month conditions at the latest based on the Biowin modeling of the capacity of the existing system. While the modeling predicts that Alternative 2 will have sufficient capacity for the flow and load projections through the planning period, analysis of the model results at 2044 maximum month conditions indicate that two ditches and two clarifiers would be in operation for portions of the year; therefore, additional tankage likely would be needed early in the next planning period.

Cost Estimate

During the creation of this GSP, initial planning-level cost estimates and descriptions of the alternatives were presented to the City for review to guide the analysis. The City indicated interest in Alternatives 2 and 3 due to decreased cost and increased capacity; therefore, more detailed cost estimates were created for these alternatives. A breakdown of the cost estimate for Alternative 2 is included in **Table 8-2**.

Table 8-2

Activated Sludge System Alternative 2 Cost Estimate

		Total Cost
1	**Mob/Demob, Site Preparation, and Cleanup (10%)**	**$550,000**
2	**Civil**	**$100,000**
3	**Structural**	**$960,000**
4	**Mechanical**	**$2,860,000**
5	**Electrical**	**$1,500,000.00**
Construction Cost Subtotal		$5,970,000
Sales Tax (9.3%)		$556,000
Total Estimated Construction Cost		**$6,526,000**
Indirect Costs (25%)		$1,632,000
Total Estimated Project Cost		**$8,158,000**
Contingency (25%)		$2,040,000
Total Project Cost (with Contingency)		**$10,198,000**

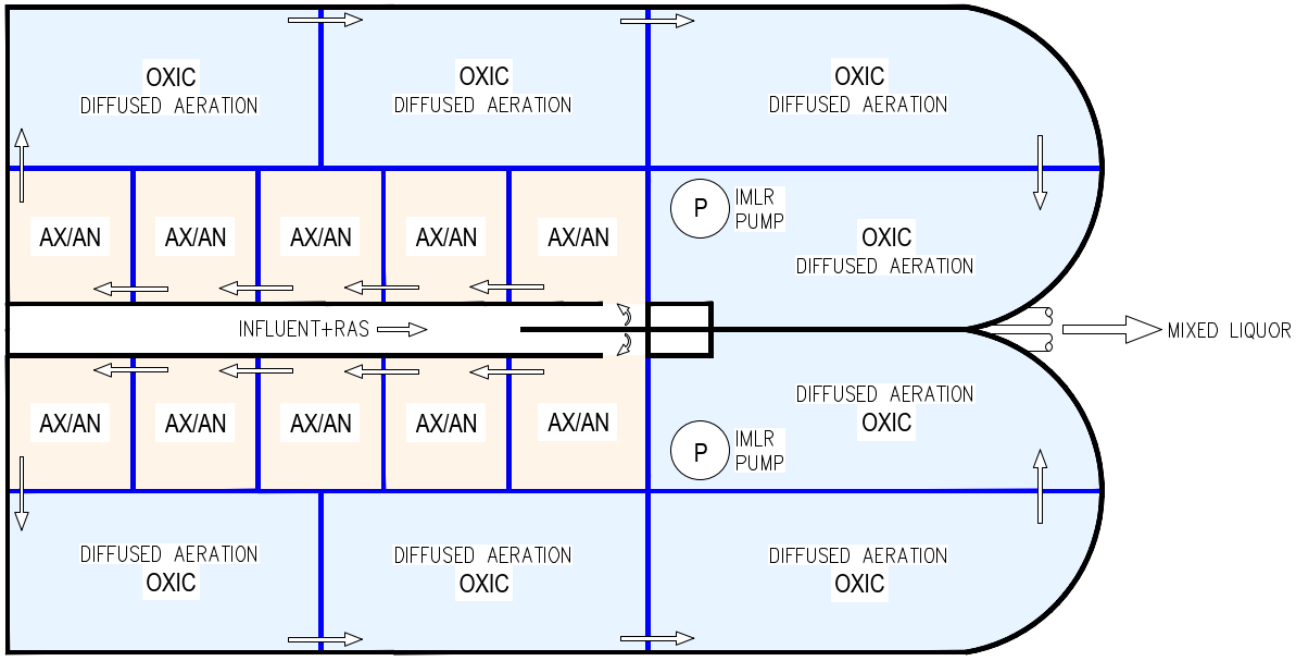
As indicated in the table, the total estimated cost with contingency is approximately $10.2 million, less than half the planning-level estimate for Alternative 1, which does not include a contingency.

Alternative 3: Convert to Plug Flow Reactors

Alternative 3 consists of removing the interior walls of the existing oxidation ditches and anoxic basins and creating partitioned selector basins and aerobic zones in a plug flow reactor configuration within the existing tankage. Plug flow reactors accomplish secondary treatment more efficiently than complete-mix systems like Alternatives 1 and 2 due to favorable microbial kinetics and food to mass ratios. This alternative also would implement pumped IMLR, diffused aeration, and surface wasting. These improvements provide the same benefits as discussed for Alternative 2. These improvements will provide the necessary increase in capacity to meet the projected flow and load through the planning period. **Figure 8-3** shows a schematic of the proposed process.

Figure 8-3

Activated Sludge System Alternative 3 Diagram



Note: IMLR can be directed to any or all AX/AN selector zones

Partitioned Selector Basins

Alternative 3 would take advantage of the internal reconfiguration of each oxidation ditch to establish greater selector volume such that there could be dedicated anaerobic selectors in addition to anoxic selectors. Partitioning, mixing, and IMLR could be implemented in a similar manner as described for Alternative 2. The creation of dedicated anaerobic selectors will enhance the settleability of the mixed liquor as discussed in the **Primary Objectives for Improvements**.

Plug Flow Reactors

The oxidation ditches can be transitioned to plug flow reactors by removing the existing mixer-aerators, concrete walls, and platforms in the interior of each ditch and replacing them with either concrete walls or stainless steel baffles to divide the former oxidation ditch into discrete aerobic zones.

Biowin Modeling

Biowin modeling for Alternative 3 determined that an SRT of 10 days is sufficient for reliable nitrification in winter temperatures. The required SRT is less than that of Alternatives 1 and 2 due to the transition from a complete mix aerobic zone to discrete aerobic zones making up a plug flow reactor, the improved kinetics, and associated increase in treatment efficiency. As with Alternative 2, an IMLR rate of 4 times the influent flow rate was used for modeling. Modeling Alternative 3 showed that a lower MLSS concentration is required to treat the projected flow and loads through the planning period compared to the other alternatives. Among the three alternatives, the

Alternative 3 configuration would be expected to produce mixed liquor with the best settling characteristics, providing for even greater capacity than the increase in treatment efficiency alone.

Based on the modeling and settleability considerations, Alternative 3 with both ditches and clarifiers operating is predicted to have capacity through the 2044 maximum month conditions and beyond. As with Alternatives 1 and 2, expansion of the activated sludge system would need to be completed to meet 2034 maximum month conditions at the latest based on the Biowin modeling results for the existing system. The process modeling results for Alternative 3 indicate that this alternative likely has sufficient capacity through the next planning period, possibly requiring the addition of a third clarifier.

Cost Estimate

A breakdown of the detailed cost estimate made for Alternative 3 is included in **Table 8-3**.

Table 8-3

Activated Sludge System Alternative 3 Cost Estimate

		Total Cost
1	**Mob/Demob, Site Preparation, and Cleanup (10%)**	**$740,000**
2	**Civil**	**$100,000**
3	**Structural**	**$1,960,000**
4	**Mechanical**	**$3,510,000**
5	**Electrical**	**$1,750,000**
Construction Cost Subtotal		$8,060,000
Sales Tax (9.3%)		$750,000
Total Estimated Construction Cost		**$8,810,000**
Indirect Costs (25%)		$2,203,000
Total Estimated Project Cost		**$11,013,000**
Contingency (25%)		$2,754,000
Total Project Cost (with Contingency)		**$13,767,000**

As indicated in the table, the total estimated cost with contingency is approximately $13.8 million, roughly half the planning-level estimate for Alternative 1 if it were to include contingency.

Activated Sludge System Recommendations

For the reasons discussed in **Alternative 1: Expand the Existing Complete Mix System**, Alternative 1 is not recommended for further evaluation. To establish a budget for activated sludge system improvements during the planning period, Alternatives 2 and 3 are both considered viable options and are compared herein. Both alternatives provide sufficient capacity for the projected flow and load through the planning period. Alternatives 2 and 3 contain several of the same process modifications to the existing system. The fundamental difference between the two alternatives is that Alternative 2 maintains the complete mix closed loop reactor configuration of the aerobic zone and Alternative 3 transitions to a fully compartmentalized plug flow configuration, which is inherently a larger project than Alternative 2.

Long-Term Considerations

Alternative 3 is estimated to cost roughly 35 percent more than Alternative 2, at $13.8 million compared to $10.2 million. The primary advantage of Alternative 2 is the lower capital cost compared to Alternative 3. However, while there is an increased cost for Alternative 3, there is also substantial value added when thinking beyond the current planning period.

While both alternatives provide sufficient capacity through the current planning period within the existing tankage, early in the next planning period, Alternative 2 is expected to require major modifications to the ditches or a third process train and third clarifier. As the Alternative 2 system nears its capacity, both ditches will be in simultaneous operation more frequently, such that additional tankage would be needed so that a ditch can be taken offline to perform major modifications. Major modifications to increase the capacity of Alternative 2 near the beginning of the next planning period also would dismantle much of the work completed to implement Alternative 2. The necessity for footprint expansion near the beginning of the next planning period, and the potential sunk cost of the improvements made for the current planning period, indicate that implementing Alternative 2 and then transitioning to plug flow in the future to increase capacity will be significantly more costly than choosing Alternative 3 this planning period.

The anticipated cost of adding a third process train is approximately $10 million in current dollars, and additional clarifiers are anticipated to cost $4 million each. The next planning period could cost $14 million for Alternative 2. Alternative 3 would only be expected to require a third clarifier near the end of the next planning period. This is due to the increase in treatment efficiency associated with compartmentalized plug flow reactors relative to large complete mix reactors, as demonstrated by the modeling of both alternatives (Alternative 2 requires a mixed liquor concentration roughly 35 percent greater than Alternative 3 to treat the projected 2044 maximum month flow and load). The anticipated cost of a third clarifier is approximately $4 million in current dollars. Therefore, choosing Alternative 3 and spending $3.57 million more this planning period is expected to save $10 million in the next planning period.

Summary

It is recommended that the City budget for Alternative 3. This alternative provides the most value to the City in the long term. Budgeting for this alternative provides the City the most flexibility in the future to implement improvements to the activated sludge system determined by the detailed analyses of a future Engineering Report. It is recommended that these improvements occur simultaneously with the addition of grit removal at the headworks (**Preliminary Treatment System**) and are completed no later than 2034.

EFFLUENT DISINFECTION AND DISCHARGE

Summary of Analysis

Chapter 7 identified both conditions-based and capacity-based replacement needs for the existing UV disinfection system. The existing UV disinfection system has been in use continuously since the WWTP was expanded in 2004. Since the approximate lifespan of the UV system is 20 years, the

system is at the end of its design life and is recommended for replacement during the planning period.

The capacity of the UV system also must be increased to be sufficient for the projected flows through the planning period. Additionally, increasing the capacity of the outfall to be sufficient for the flows projected through the planning period necessitates the performance of a mixing zone study. Other necessary refurbishments are expected to be included in the City's annual O&M budget.

Effluent Disinfection Recommendations

Due to the age of the UV system, planning for replacement within the first 5 years of the planning period is recommended. The replacement system should have a design capacity large enough to accommodate the 2044 projected peak hour flow. The existing reactor channels were designed with a baffle in the channel to be removed to expand each reactor channel from two to three modules of lamps. The recommended approach is to identify options for a horizontal lamp system that fits into the expanded reactor channels with minimal structural alterations.

All ancillary equipment should be able to be configured within the UV disinfection building without major modifications. It is recommended that the City choose a system that requires minimal operator attention and has the ability to pace dosing to the secondary effluent flow rate for energy savings.

Outfall Recommendations

As discussed in **Chapter 7**, the capacity of the outfall is equivalent to the design flow conditions in the 2004 expansion plans used to calculate the hydraulic profile. Since these flow conditions are projected to be surpassed during the planning period, an outfall mixing zone study is recommended to be included as part of a future Engineering Report related to increasing the capacity of the activated sludge system.

Reclaimed Water

At the time this GSP was drafted, there was no current plan to produce Class A or Class B reclaimed water meeting the treatment requirements defined in Chapter 173-219 WAC.

SOLIDS HANDLING SYSTEM

Existing Solids Handling System

Activated sludge is wasted from the secondary clarifiers via a RAS/WAS pump station with three pumps that send WAS to two sludge stabilization ponds, where it is treated and stored. The sludge stabilization ponds each contain liners, surface aerators, and a decant pump station.

Each sludge stabilization pond consists of 2.1 million gallons of storage volume. Pond no. 1 contains three surface aerators and pond no. 2 contains four; however, these aerators are in need of replacement. The ponds are decanted with decant pumps, and this sidestream is returned to the

headworks where it is treated at the WWTP. During normal operation, one pond actively receives WAS at a time. When the active pond has reached its sludge storage capacity, the other pond is activated to receive WAS and the filled pond transitions to sludge storage. When both ponds are at sludge storage capacity, they are dredged and the contents are screened and hauled away for land application. The ponds were last dredged in 2025 and before that in 2017.

The 2004 expansion project contract drawings indicate that the sludge stabilization ponds were designed for a 2023 average annual load of 1,904 ppd of solids, or approximately 32,610 gallons per day assuming a solids concentration of 0.7 percent by weight. The ponds were estimated to have a combined solids storage capacity of 2.7 years at this solids loading rate. According to flow and load projections developed in **Chapter 4**, the capacity of the solids handling system will be exceeded within the planning period. Alternatives to the existing solids handling system were developed that could be implemented to meet the growth needs within the planning period, provide other benefits to the WWTP, and eliminate the need to continue investing in the sludge stabilization ponds.

Screening of Solids Handling System Alternatives

Four solids handling system alternatives were screened and a recommended alternative is proposed for the purposes of establishing a budget to fund necessary improvements in the planning period. A future Engineering Report will be required to provide a full alternatives analysis per WAC 173-240-060 and will include design criteria for the recommended improvements. There are several alternatives available to treat solid waste at the WWTP in the future. A list of alternatives was developed to represent the full variety of options available as follows:

- Alternative 1: Existing Sludge Stabilization Ponds
- Alternative 2: Digestion
    - Alternative 2a: Anaerobic Digestion
    - Alternative 2b: Aerobic Digestion
- Alternative 3: Drying
- Alternative 4: Composting

Alternative 1: Existing Sludge Stabilization Ponds

Alternative 1 maintains the existing sludge stabilization ponds as the solids handling system. The advantages of this alternative are the simplicity of continuing to use the same system and avoiding the cost of investing in new types of equipment and processes.

However, this alternative will require investment in the aging equipment of the existing system to maintain it for future use, including the replacement of each pond's surface aerator and aging liner that risk failure, as well as other minor items identified in **Chapter 7**. The solids loading projections presented in **Table 7-10** of this GSP predict that the ponds will reach a design capacity of 1,900 ppd by 2034 and 2,300 ppd by 2044. If the sludge stabilization ponds are maintained, this increase in loading may lead to incomplete stabilization of solids (unable to meet Class B Biosolids requirements) in the ponds before they must be dredged to continue receiving WAS. Dredging the

ponds is costly for the City, and increased loading will lead to increased dredging frequency and greater costs.

Alternative 2: Digestion

Alternative 2a: Anaerobic Digestion

Anaerobic digestion is a common solids handling approach used by many WWTPs. However, due to the extensive capital and operational needs of this type of system, they are only economical for larger WWTPs (typically 5 MGD or greater). The projected flow to the City's WWTP does not reach this threshold during the planning period. Anaerobic digestion is not considered an economical option, and this alternative is not recommended.

Alternative 2b: Aerobic Digestion

Aerobic digestion is another common solids handling approach used by many WWTPs, especially those similar in size to the City. In a typical aerobic digestion operation, WAS is thickened prior to entering a mixed and aerated digester where stabilization occurs, then the digested sludge is dewatered and can be hauled away for land application.

The advantages of aerobic digestion include relatively low capital costs for small facilities, ease of construction and operation, and the absence of gas handling. Additionally, the stable end product is relatively odorless and recovers basic fertilizer values for land application.

The approximate footprint of an aerobic digestion system for the City's WWTP was estimated to be 11,000 square feet based on the footprints of existing aerobic digestion systems at similarly sized facilities. Including the space surrounding the building, a conservative estimate for the total system footprint is roughly one third of the footprint of one existing sludge stabilization pond. Therefore, this alternative has the advantage of making space within the WWTP available for a new public works building.

Some disadvantages associated with aerobic digestion include the cost of power to mix and aerate the digesters, the cost of providing alkalinity for the process, and the relative complexity of the process and equipment compared to the sludge stabilization ponds.

Alternative 3: Drying

Drying is a solids handling approach that uses either air, solar radiation, or a thermal system to greatly reduce the water content of the solids and meet biosolids treatment requirements simultaneously. Outdoor beds for air drying are infeasible and indoor enclosures for solar drying are unproven in the regional climate of the City's WWTP. Drying could be achieved at the WWTP using a mechanized thermal drying system.

The advantage of drying is an end product with a lower moisture content that reduces storage and transportation costs and provides greater pathogen reduction making it more marketable. The disadvantages of drying include the increased life-cycle cost associated with the energy and mechanical complexity required relative to the sludge stabilization ponds. Due to the disadvantages associated with the life-cycle cost of drying, this alternative is not recommended.

Alternative 4: Composting

Composting is a solids handling approach in which the biosolids are stabilized by biological degradation. The heat produced in this process pasteurizes the solids, producing a stable end product. Generally this process consists of dewatering, mixing with an amendment or bulking agent such as wood chips, then composting in an aerated static-pile, windrows, or vessels before curing.

The advantages of composting include its relative simplicity since it can be performed outdoors in most climates, and the production of marketable fertilizer or soil amendment that can be stored long term. The disadvantages of composting include the space required if it is to be done on-site, the labor requirement, the necessity of mechanized mixing and/or aeration, and the potential necessity for odor control and/or temperature control. In addition, the supply of necessary bulking agent(s) can be inconsistent and require storage and handling.

The approximate footprint for composting at the WWTP was estimated to be 2.5 acres based on the footprint of an existing composting facility used by the Port Townsend, Washington WWTP with similar loading. This footprint is equal to the area of both sludge stabilization ponds, leaving no room for a new public works building on reclaimed land. If composting is achieved offsite, the City would have to acquire land and separate infrastructure to accomplish this or use land not owned by the City with a reliable third-party partner such that the WWTP does not risk losing its solids handling capacity.

Due to the space limitation of the WWTP and the odor potential, composting onsite is not feasible. Finding a reliable partner for off-site composting is uncertain; therefore, this alternative is not recommended.

Solids Handling System Recommendations

Anaerobic digestion, drying, and composting are not recommended based on this analysis. The remaining alternatives for future solids handling at the WWTP are the continued use of the sludge stabilization ponds or the construction of an aerobic digestion system.

The existing system is simpler and less expensive to operate than aerobic digestion. Constructing aerobic digestion will be more expensive than refurbishing the existing system, although expanding the existing system and continuing to dredge at an increasing rate may result in similar costs over the planning period. Maintaining the existing system introduces the risk of failing to achieve Class B biosolids at higher loading rates and equipment failure due to age. Aerobic digestion is a low risk option for reliable capacity and solids treatment.

Expanding the existing system to increase capacity as necessary is not preferred. If an expansion of the solids handling system is required during the planning period as predicted, aerobic digestion is the recommended option. Additionally, the City has indicated preference toward an alternative that allows the reclamation of land within the WWTP for new structures such as a public works building, which can be accomplished with aerobic digestion. The recommendation of this analysis is for the City to budget for the construction of an aerobic digestion system within the planning period. Aerobic digestion at the WWTP should occur following implementation of an active grit removal system for the reasons discussed in the **Preliminary Treatment System** section.

ELECTRICAL AND CONTROLS

The primary recommended improvements to electrical and control systems at the WWTP are for the standby power and telemetry systems, which each constitute a capital improvement plan (CIP) item. The generator has sufficient capacity for the WWTP but has become unreliable and is at the end of its useful life. It is recommended to perform a load analysis and replace the generator within the planning period. The generator should be replaced with a similar unit in the same location, and be accompanied by upgrades to the ventilation systems, exhaust, and power distribution equipment. The existing supervisory control and data acquisition system is operated from a human machine interface (HMI) on a desktop computer screen. A larger HMI screen is recommended for the WWTP to provide an overview of all processes and assist in day-to-day operations.

Other CIP items represent major electrical and control upgrades to integrate large-scale process changes for the activated sludge and solids handling systems. The construction of aerobic digesters for solids handling requires power and control for the mixing and aeration of the digesters, operation of thickeners and dewatering units, and WAS pumping. This project would include a solids handling building with an electrical room. The conversion of the activated sludge system to plug flow reactors requires power and control for the mixing of each selector, actuated weirs, IMLR pumps, blowers, and surface wasting devices. Limited expansion space in the existing electrical room in the operations building may necessitate a new electrical room.

Minor electrical and control improvements associated with other CIP items and existing conditions also are necessary. Electrical and control integration is required to replace the screens, install grit removal, and replace the UV system. These improvements may require an increase in power feeder size and additional instrumentation for full integration. Additionally, a plant-wide electrical short circuit, protective device coordination, and arc flash analysis is recommended for the WWTP.

REFERENCES

Metcalf & Eddy, Inc. (2014). *Wastewater engineering: Treatment and resource recovery* (5th ed.). McGraw-Hill, New York.

Washington Administrative Code 173-308-205. (2023). Significantly remove manufactured inerts. https://app.leg.wa.gov/wac/default.aspx?cite=173-308-205

9 | OPERATIONS AND MAINTENANCE

INTRODUCTION

The City of Stanwood's (City) sewer system operations and maintenance program consists of the following five elements.

1. Normal Operations
2. Emergency Operations
3. Preventive Maintenance
4. Staffing
5. Construction Inspection

SEWAGE SPILL NOTIFICATION AND REPORTING

In the event of a sewage spill, the City will immediately notify the Washington State Department of Ecology using one of the following methods.

1. Phone: (206)-594-0000
2. Email: nwroerts@ecy.wa.gov
3. Online Reporting Form: https://ecology.wa.gov/footer-pages/report-an-environmental-issue/statewide-reporting-form-erts.

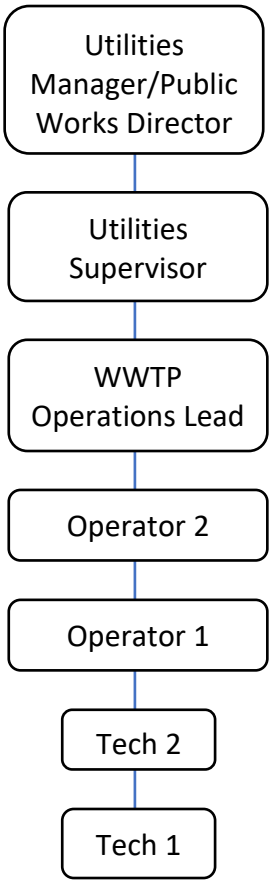
NORMAL OPERATIONS

City Personnel

The City's Utilities Department functions under the direction of the Public Works Director/Utilities Manager, Mr. Kevin Hushagen. The Wastewater Utility Superintendent reports to the Utility Manager and is responsible for supervising the daily operations of the sewer utility. The City Engineer assists with the implementation of capital improvement projects.

The current sewer division operations and maintenance (O&M) staff consists of several operation and maintenance personnel that function under the Wastewater Utility Supervisor; the organization structure of the sewer utility is presented in **Figure 9-1**. The sewer system tasks that are performed by the O&M staff include development review, inspection, testing, installation, and repair of system facilities, routine operation and preventive maintenance, water quality sampling, regulatory compliance monitoring, recordkeeping, administrative tasks, general clerical work, and corrective or breakdown maintenance required in response to emergencies.

Figure 9-1
Sewer Division Organization Chart



The City allocates funds annually for personnel training, certification, and membership in professional organizations. The City believes that the time and money invested in training, certification, and professional organizations are repaid many times in improved safety, skills, and confidence.

Personnel Responsibilities

The key responsibilities of the sewer operations and maintenance staff are summarized as follows.

Public Works Director – Supervises, organizes, directs, and performs activities related to the overall operation of the water, sewer, and storm water utilities.

City Engineer – Oversees new development and construction review processes to ensure compliance with water distribution and sewage collection regulations and City standards and specifications. Conducts reviews and coordinates comments from lead personnel in the water distribution and sewage collection systems. Ensures the City's utility standards and specifications are up to date. Assists the Utilities Manager with special projects as assigned.

Wastewater Utility Supervisor – Organizes, directs, and performs activities related to the operation and maintenance of the City's wastewater treatment and sewage collection systems, as well as the City's water treatment and distribution systems.

Lead Wastewater Treatment Plant (WWTP) Operator – Evaluates samples and analyzes water quality data collected by wastewater treatment staff. Ensures compliance with applicable Washington State Department of Ecology (Ecology) regulations and directs all necessary routine tasks. This position is required to be a fully licensed and trained Wastewater Treatment Plant Operator (WWTPO) III.

Wastewater Treatment Plant Operators – Performs skilled routine maintenance activities at the WWTP and collection system to efficiently operate and maintain the City's wastewater treatment plant, collection system, and other related facilities. This position is required to be a fully licensed and trained WWTPO I or II.

Wastewater Treatment Technicians – Performs non-routine troubleshooting, maintenance, development review, inspection, installation, and repair work for the sewage collection system and WWTP, and directs all necessary routine tasks.

Available Equipment

The sewer division has several types of equipment available for daily routine operation and maintenance of the sewer system. If additional equipment is required for specific projects, the City will rent or contract with a local contractor for the services needed. A stock of supplies in sufficient quantities for normal system operation and maintenance and short-term emergencies are stored at the wastewater treatment plant. A list of major equipment and chemicals used in the normal operation of the sewer system that is available to the sewer utility is shown in **Table 9-1**.

Table 9-1

Wastewater Department Equipment List

Wastewater Department Equipment
1 - Vactor
1 - F-250
1 - F-150
1 - F-350 Service Truck
1 - Transit Camera Van and Camera Setup
1 - Godwin Bypass Pump
1 - Pressure Washer
2 - Portable Generators
Miscellaneous tools
Equipment Available from Other Departments
1 - John Deere Backhoe
1 - CAT Backhoe
2 - 5-Yard Dump Trucks
2 - 3-Yard Dump Trucks
1 - Sweeper
1 - Additional Vactor
1 - Compressor
1 - Mini Excavator
1 - Skid Steer
1 - Bucket Truck
Chemical Inventory
Sodium Hypochlorite (12.5% and 0.8%)
Communications Equipment
Cell Phones and Tablets

The following representatives typically provide supplies and chemicals to the City:

- Lab Supplies: USA Bluebook, 3781 Bur Wood Drive, Waukegan, IL 60085, (800) 548-1234.
- Analytical Supplies: Hach Company, PO Box 389, Loveland, CO 80539, (800) 227-4224.
- Supplies: Microflex, 2301 Robb Drive, Reno, NV 89253, (800) 876-6866.
- Process Equipment: Siemens, 601 S Snoqualmie Street, Seattle, WA 98108, (206) 329-3090.
- Pumps and Monitoring Equipment: Whitney, 21222 30th Avenue SE, Bothell, WA 98021, (425) 486-9499.
- Pumps and Monitoring Equipment: APSCO, Inc., PO Box 2639, Kirkland, WA 98083, (425) 822-3335.
- Process Equipment: Jenco, 7968 Arjons Drive, Suite C, San Diego, CA 92126, (858) 578-2828.
- Equipment: Granich Engineering, 1546 Boalch Avenue NW, Suite 30, North Bend, WA 98045, (425) 889-8744.

- Monitoring Equipment: Flow Products, 3921 Spur Ridge Lane, Bellingham, WA 98226, (800) 251-9698.

Sewer division employees are equipped with cell phones that have two-way radio capability. The phones provide the capability for personnel to communicate with other cities and Snohomish County as necessary.

Routine Operations

Routine operations involves the analysis, formulation, and implementation of procedures to ensure the facilities are functioning efficiently and meeting the demands of the system. The utility's maintenance procedures are good, with repairs being made promptly.

Continuity of Service

As a municipality, the City has the structure, stability, authority, and responsibility to ensure that sewer service will be continuous. For example, changes in the City Council or staff would not have a pronounced effect on the City's customers or quality of service.

Routine Sampling

Ecology has adopted federal regulations that specify minimum monitoring requirements for the sewer system. The sampling requirements typically depend on the type of treatment provided and site-specific conditions. The sampling, testing, and reporting requirements are contained in the National Pollutant Discharge Elimination System and Puget Sound Nutrient General Permits, copies of which are included in **Appendix A**. Reference **Chapter 2** for details regarding the status of the original Puget Sound Nutrient General Permit and its invalidation.

Operations and Maintenance Records

Facilities Operations and Maintenance Manuals

O&M manuals are available for staff members' reference. These manuals are kept on file at the wastewater treatment plant, lift stations, and utilities office. The City intends to maintain its policies of requiring complete operation and maintenance manuals for all new equipment and facilities.

Mapping and As-Built Drawing Records

Maintenance of drawings is essential to maintenance crews, City planners, developers, and anyone else needing to know how the sewer system is laid out throughout the City. Record drawings are currently in paper format and stored in an organized file at the utilities office that is maintained by the Utilities Department. The Utilities Department is in the process of converting all files to an electronic format for storage in the City's database. The City is in the process of creating a GIS program with modern GIS standards and mapping.

Operations and Maintenance Records

Records are stored at the wastewater treatment plant office for the following items.

- Pump motor tests
- Wastewater flow records
- Wastewater system maintenance
- Sewer collection notes
- Side sewer connections
- Sewer main cleaning/inspection
- Sampling, testing, and reporting records
- New development inspections and reviews
- Customer complaints

Safety Procedures and Equipment

Safety is the concern and responsibility of all sewer operations and maintenance staff. To maintain the highest level of safety, the City actively educates and trains employees as to safe working procedures. Safety equipment and other resources are always available to employees. The sewer utility has a dedicated Safety Coordinator who ensures that safety topics are discussed at each department meeting and that the shop safety locker is always adequately supplied. Regular Utility Division Safety Coordination meetings are conducted between the Public Works Director, Utilities Supervisor, and each utility safety coordinator. The City is fully dedicated to providing a safe and secure work environment for each of its employees. A copy of the City's Safety Manual is included in **Appendix J**.

The following identifies procedures to be followed for O&M tasks that involve the most common potential workplace hazards in the City's sewer system.

Use of Chlorine Products

Standard Procedure – Handle with care, provide adequate ventilation, and wear safety glasses and rubber gloves.

Standard Procedure – Handle with care, provide adequate ventilation, wear safety goggles, apron, and rubber gloves. Keep container tightly closed and store in a dry, corrosion-proof area. Protect from unintentional contact with water. Never return contaminated material to its original container. Immediately contact the chemical supplier/manufacturer for handling instructions if drums appear to be swollen.

Working in Confined Spaces

Standard Procedure – Follow state requirements for confined space entry and the Public Works Department, Utilities Division's Confined Space Program.

Working Around Heavy Equipment

Standard Procedure – Obtain proper training and follow all safety procedures. Use noise protection equipment and follow standard Labor and Industries (L&I) safety procedures.

Working in Traffic Areas

Standard Procedure – Wear proper clothing and provide adequate signage and flagging for the work area. Follow standard Washington State Department of Transportation and L&I safety procedures.

Working on or Around Tall Structures

Standard Procedure – Follow proper safety harness procedures for working on tall structures and standard L&I safety procedures.

Working in or Around Pump Stations

Standard Procedure – Obtain proper training and follow all safety procedures for working on pumps and electrical equipment. Use noise protection equipment.

Sewer utility personnel are required to take training courses regarding the following topics: confined spaces, fall protection, CPR, first aid, traffic flagging, lockout-tagout, and blood-borne pathogens.

The City's facilities are equipped with confined space entry equipment, oxygen-gas meters, and lockout-tagout equipment. Each City vehicle is equipped with first aid and blood-borne handling kits. The utility also owns flagging signs and equipment for safe handling of traffic.

The Public Works Department follows all appropriate Occupational Safety and Health Administration and Washington Industrial Safety and Health Act regulations in its day-to-day operations and complies with the following state requirements:

- Chapter 296-809 Washington Administrative Code (WAC) – Confined Spaces.
- WAC 296-155-650 to 66411 – Part N Excavation, Trenching, and Shoring.
- WAC 296-155-429 – Lockout and tagout of circuits.
- Chapter 296-880 WAC – Unified Safety Standards for Fall Protection.
- Chapter 296-800 WAC – Safety and Health Core Rules.
- *Manual on Uniform Traffic Control Devices* – Traffic control for work in the public right-of-way.

EMERGENCY OPERATIONS

Capabilities

The City is well equipped to accommodate short-term system failures and abnormalities. The City's capabilities are as follows.

Emergency Equipment

The City is equipped with the necessary tools to deal with common emergencies. If a more serious emergency should develop, the City will hire a local contractor who has a stock of spare parts necessary to make repairs to alleviate the emergency condition.

Emergency Telephone

The sewer department has a published emergency phone number for the public to directly contact sewer department personnel. The police or other City departments can reach the sewer department via the on-call operator, who is available 24 hours a day, 7 days a week.

Material Readiness

Some critical repair parts, tools, and equipment are on-hand and kept in fully operational condition. As repair parts are used, they are re-ordered. Inventories are kept current and adequate for most common emergencies that can reasonably be anticipated. The City has ready access to an inventory of repair parts, including parts required for the repair of each type and size of pipe within the service area. Additionally, the City has been provided with after-hours emergency contact phone numbers for key material suppliers, which gives the City 24-hour access to parts not kept in inventory.

PREVENTIVE MAINTENANCE

Maintenance schedules that meet or exceed the manufacturer's recommendations have been established for all critical components in the sewer system. The following schedule is used as a minimum for preventive maintenance, and the manufacturer's recommendations should be followed where conflict exists.

Sewer Collection System	
Frequency	***Task or Activity***
Annually or As Needed	Conduct leak survey primarily on force mains.
Every 2 to 5 Years or As Needed	Inspect, clean, and evaluate manholes and sewer pipeline condition.

Wastewater Treatment Plant	
Frequency	***Task or Activity***
Daily	Log and record run hours, motor starts, chemicals used, chemicals added, fuse indicators, flow, and loading; visually inspect pumps/blowers; check pump/blower packing; check pump/blower oil levels; check equipment for proper function and operation; check security.
Annually	Check all valves and screens; check control valve settings; re-grease pumps/blowers; change pump/blower oil.
As Needed	Maintain electrical and mechanical equipment; paint structures and piping; calibrate equipment; maintain and repair indoor and outdoor facilities.

Sewage Lift Stations	
Frequency	***Task or Activity***
Daily	Conduct visual and audio inspection; check security; check pump motors for excessive heat and vibration.
Weekly	Observe and record motor current draw (three phases); log and record flow rates and pump motor hours; measure and record discharge pressure; check motor noise, temperature, and vibration.
Annually	Change motor oil.
Annually	Take inventory of parts, pumps, and motors.
As Needed	Calibrate flow meter; maintain electrical and mechanical equipment; paint structures and piping; perform routine maintenance of equipment.

Engine Generator Sets	
Frequency	***Task or Activity***
Weekly	Operate to achieve normal operating temperatures; observe output.
Semi-Annually	Perform routine maintenance in accordance with manufacturer's recommendations.
As Needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on amount of use).
As Needed	Perform tune-up; replace parts as necessary.

Telemetry and Control System	
Frequency	***Task or Activity***
Daily	Back-up program and data.
Monthly	Visually inspect cabinets and panels for damage, dust, and debris.
Semi-Annually	Inspect inside of cabinets and panels for damage, dust, and debris.
	Vacuum clean all modules.
	Test alarm indicator units.
	Clean and flush pressure sensitive devices.
	Visually inspect meters to coordinate remote stations.
Annually	Check master and remote telemetry units for proper operation; repair as necessary.

Tools and Equipment	
Frequency	***Task or Activity***
Rolling Stock	
Weekly	Check all fluid levels and brakes. Fluid levels and brakes are checked each time the equipment is used if less than weekly.
As Needed	Replace fluids and filters in accordance with manufacturer's recommendations (or more frequently depending on type of use); perform preventive maintenance per manufacturer’s recommendation.
Tools	
As Needed	Clean after each use; lubricate and maintain as necessary; inspect for damage and wear before each use; preventive maintenance performed per manufacturer’s recommendations.

STAFFING

The preventive maintenance procedures, as well as normal and emergency operations of the sewer utility, are described in the previous sections. The labor and supervision required to effectively implement the work of the maintenance and operations schedules form the basis for determining staffing levels.

Current Staff

The Wastewater Utility budget allows for one full-time employee (FTE) manager for the sewer utility. Only a portion of the Public Works Director, Wastewater Utility Supervisor, and Administrative Clerical Assistant's time is available for the sewer utility. Additional support services such as utility billing, legal reviews, and general administrative functions for the utility are transferred out of the Wastewater Utility to the City General Fund.

The current staff includes management personnel, supervisory personnel, operators, technicians, and office personnel engaged in the activities necessary to see to the continuous safe operation and maintenance of a sewer system and sewer utility. There are currently five FTEs for the sewer utility.

An estimate of sewer utility full-time employees is based on assigned tasks and duties as shown in **Table 9-2**.

Table 9-2

Sewer Utility Full-Time Employee Estimate

Task/Duty Assignment	Current Full-Time Employees	Recommended Full-Time Employees
Managerial	0.20	0.20
Supervisory	0.55	0.55
Wastewater Treatment Plant Operator	5.00	5.00
Total	**5.75**	**5.75**

CONSTRUCTION INSPECTION

Sewer inspections are performed by staff or, if necessary, by an on-call consultant funded through developer extension projects.

10 | CAPITAL IMPROVEMENT PLAN

INTRODUCTION

This chapter presents proposed improvements to the City of Stanwood's (City) sewer system that are necessary to resolve existing system deficiencies and plan for projected growth. The sewer system improvements were identified from an evaluation of the results of the system analyses presented in **Chapter 6**. Improvements specific to the wastewater treatment plant (WWTP) were identified from the analysis of the existing WWTP in **Chapter 7** and the subsequent recommendations made in **Chapter 8**. The sewer system improvements were sized to meet the system's existing and future demand conditions.

A Capital Improvement Plan (CIP) number has been assigned to each improvement. Numbers were assigned to the improvements as shown in **Figure 10-1**. The improvements are organized and presented in this chapter according to the following primary categories.

- Sewer Main Improvements
- Lift Station Improvements
- Miscellaneous Collection System Projects
- Wastewater Treatment Plant Improvements

Improvements for gravity collection piping and lift stations, as well as other miscellaneous projects, are listed under each of the three primary categories. Improvements to the WWTP are listed in their own category separate from the rest of the sewer system. The remainder of this chapter presents a brief description of each group of improvements, the criteria for prioritization, the basis for the cost estimates, and the schedule for implementation.

For planning purposes, the improvement projects described herein are based on one alternative route or conventional concept for providing the necessary improvement. Other methods of achieving the same result, such as obtaining flow capacity increases by adding one large gravity main versus using multiple gravity mains should be considered during predesign to ensure the best and lowest cost alternative design is selected. Further evaluation should be performed when more information is available regarding when and where future developments will occur.

DESCRIPTION OF IMPROVEMENTS

This section provides a general description of each group of improvements and an overview of the deficiencies they will resolve. Some of the improvements are necessary to resolve existing system deficiencies, and others are required to provide capacity for projected future flow rates. The CIP numbers for sewer main improvements have an "SM" prefix (example: SM1). The CIP numbers for lift station projects have an "LS" prefix (example: LS1). The CIP numbers for miscellaneous collection system projects have an "M" prefix (example: M1). The CIP numbers for the WWTP improvements have an "F" prefix (example: F1).

Some improvements will be necessary to serve currently undeveloped areas in the Urban Growth Area. The required capacity and timing of each recommended improvement is provided for budgeting and financial projection purposes only. The actual design parameters should be

evaluated at the design phase of the project using the hydraulic model or another accepted engineering procedure. Updated population and flow data should be used when available to ensure the proposed facilities are adequately sized to handle build-out flows.

Sewer Main Improvements

The following collection system improvements were identified from the results of the system analyses and by City staff, as discussed in **Chapter 6**. The project descriptions detail whether the improvements are required to properly serve the existing sewer service area or are triggered by projected growth. The costs of providing sufficient capacity for the existing system shall be borne by the existing customers, unless over-sizing of the improvements provides a benefit to developers.

The collection system was analyzed under existing, 10-year, and 20-year conditions to identify capacity deficiencies. If a sewer main alignment was projected to require upsizing within the 20-year planning period, estimated required build-out (2074) capacity also was evaluated for the alignment, and additional upsizing was recommended if necessary to accommodate build-out flows. Any additional recommended upsizing beyond that required for 20-year conditions is detailed in the project descriptions.

The recommended sewer main improvements are illustrated in **Figure 10-1**. A variety of alternatives are possible for the CIP projects listed; alternatives should and will be considered during the design of each project.

CIP SM1: 72nd Ave Sewer Main Replacement

Estimated Cost: $1,925,000 (City cost estimate)

Proposed Years: 2025

Description: The City plans to replace approximately 2,000 linear feet (lf) of existing sewer main with 15-inch-diameter gravity pipe along 72nd Avenue NW between Pioneer Highway and State Route (SR) 532, per City construction standards, to address undersized pipes.

RH2 Engineering, Inc., (RH2) hydraulic modeling performed as part of this General Sewer Plan (GSP) update identified the following deficiencies and recommended improvements in this vicinity.

Deficiency No. 1: Approximately 1,511 lf of existing 10-inch-diameter sewer main (model conduits P-795, P-796, P-744, P-746, P-748, and P-800) in 72nd Avenue NW, from 267th Street NW to 262nd Street NW, is over capacity under existing conditions.

Improvement No. 1: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the alignment to 15-inch diameter (with the exception of the northernmost 309 lf, model conduit P-795, which can be upsized to 12-inch diameter) in accordance with the City's construction standards. However, considering the criticality of this alignment, 18-inch-diameter sewer main should be considered for the entire alignment to provide capacity for additional flow rates beyond the 20-year planning period.

Deficiency No. 2: Approximately 358 lf of existing 12-inch-diameter sewer main (model conduits P-1750, P-1751, and P-1752) in front of Twin City Elementary School is projected to be over capacity by 2044.

Improvement No. 2: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the alignment to 15-inch diameter in accordance with the City's construction standards. However, considering the criticality of this alignment, 18-inch-diameter sewer main should be considered for the entire alignment to provide capacity for additional flow rates beyond the 20-year planning period.

CIP SM2: Twin City Mile Project – 271st Camano Street to 94th Main Replacement

Estimated Cost: $1,900,000 (City cost estimate)

Proposed Years: 2025 through 2027

Description: The City plans to replace existing gravity sewer main in 94th Drive NW from the Main Lift Station to 271st Street NW, in 271st Street NW from 94th Drive NW to 99th Avenue NW, and in 270th Street NW from 270th Street NW to 99th Avenue NW per City construction standards.

RH2 hydraulic modeling performed as part of this GSP update indicates that these alignments should have sufficient existing hydraulic capacity to convey projected 2044 flows. To provide additional capacity for flow rates beyond the 20-year planning period, it is recommended that:

- Model conduit P-102 (94th Drive NW, between the Main Lift Station and 271st Street NW) be upsized from 20-inch to 24-inch diameter; and
- Model conduits P-1283 and P-1284 (271st Street NW between 99th Avenue NW and the intersection with 270th Street NW) be upsized to 12-inch diameter.

CIP SM3: Cedarhome Dr Sewer Main Replacement

Estimated Cost: $1,285,000 (City cost estimate)

Proposed Years: 2025

Description: The City plans to replace approximately 1,080 lf of existing gravity sewer main along Cedarhome Drive and 84th Avenue NW with 24/12-inch-diameter pipe (Phase I) and replace approximately 660 lf of existing gravity sewer main along Cedarhome Drive between Pioneer Highway and 84th Avenue NW with 24-inch-diameter pipe (Phase II) per City construction standards.

RH2 hydraulic modeling performed as part of this GSP update identified the following deficiencies and recommended improvements in this vicinity.

Deficiency No. 1: Approximately 220 lf of existing 12-inch-diameter sewer main in Triangle Drive (model conduits P-749 and P-1392) is over capacity under existing conditions.

Improvement No. 1: Upsize alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, the alignment should be upsized to 18-inch diameter in accordance with the City's construction standards. However, considering the criticality of this alignment, 24-inch-diameter sewer main should be considered to provide capacity for additional flow rates beyond the 20-year planning period.

Deficiency No. 2: Approximately 440 lf of existing 18-inch-diameter sewer main in Cedarhome Drive, west of Triangle Drive (model conduit P-1389), is projected to be over capacity by 2044.

Improvement No. 2: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, the alignment should be upsized to 21-inch diameter in accordance with the City's construction standards. However, considering the criticality of this alignment, 24-inch-diameter sewer main should be considered to provide capacity for additional flow rates beyond the 20-year planning period.

CIP SM4: 68th Sewer Main Replacement

Estimated Cost: $1,000,000 (City cost estimate)

Proposed Years: 2025

Description: The City plans to replace approximately 1,500 lf of sewer main in 68th Avenue NW between 284th Street NW and the Cedarhome Lift Station with 15-inch-diameter pipe per City construction standards.

RH2 hydraulic modeling performed as part of this GSP update identified the following deficiencies and recommended improvements in this vicinity.

Deficiency No. 1: Approximately 595 lf of existing 8-inch-diameter sewer main (model conduits P-632, P-733, P-736, and P-737) in the vicinity of the decommissioned Cedarhome Lift Station, is over capacity under existing conditions.

Improvement No. 1: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize model conduits P-733 and P-736 to 10-inch diameter and model conduits P-737 and P-632 to 12-inch diameter, in accordance with the City's construction standards. However, considering the criticality of this alignment, 15-inch-diameter sewer main should be considered for model conduits P-733, P-736, and P-737 (approximately 491 lf) to provide capacity for additional flow rates beyond the 20-year planning period.

Deficiency No. 2: Approximately 258 lf of existing 8-inch-diameter sewer main (model conduit P-730) in 68th Avenue NW north of 279th Street NW is projected to be over capacity by 2034.

Improvement No. 2: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the alignment to 10-inch diameter in accordance with the City's construction standards. However, considering the criticality of this alignment, 12-inch-diameter sewer main should be considered to provide capacity for additional flow rates beyond the 20-year planning period.

Deficiency No. 3: Approximately 308 lf of existing 8-inch-diameter sewer main (model conduit P-732) in 68th Avenue NW between 279th Street NW and 278th Street NW is projected to be over capacity by 2044.

Improvement No. 3: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the alignment to 10-inch diameter in accordance with the City's construction standards. However, considering the criticality of this alignment, 12-inch-diameter sewer main should be considered to provide capacity for additional flow rates beyond the 20-year planning period.

CIP SM5: SR 532 and Pioneer Hwy Sewer Crossing

Estimated Cost: $800,000 (City cost estimate)

Proposed Years: 2025

Deficiency: Approximately 355 lf of existing 10-inch-diameter sewer main along Pioneer Highway between 267th Street NW and SR 532 (model conduits P-840 and P-842) is over capacity under existing conditions.

Improvement: Upsize the alignment to 18-inch diameter to provide sufficient capacity for projected future flow rates in accordance with the City's construction standards.

CIP SM6: 99th/272nd Pl Main Replacement

Estimated Cost: $775,000 (City cost estimate)

Proposed Years: 2028 through 2029

Description: The City plans to replace approximately 780 lf of existing gravity sewer main in 99th Avenue NW between 271st Street and 272nd Place NW, and in 272nd Street NW between 99th Avenue NW and 100th Avenue NW, with 12-inch-diameter pipe. Approximately 460 lf of sewer main along 272nd Place NW toward Heritage Park also is proposed for replacement due to root intrusion.

CIP SM7: 274th Sewer Main Replacement

Estimated Cost: $700,000 (City cost estimate)

Proposed Years: 2025

Description: The City plans to replace approximately 980 lf of existing gravity main in Cedarhome Drive and 274th Street NW, east of 83rd Drive NW, with 15-inch-diameter gravity pipe.

RH2 hydraulic modeling performed as part of this GSP update identified the following deficiencies and proposed improvements in this vicinity.

Deficiency: Approximately 997 lf of existing 8-inch-diameter sewer main (model conduits P-50, P-52, P-54, P-56, P-58, P-60, P-62, and P-64) in Cedarhome Drive and 274th Street NW, east of the intersection of Cedarhome Drive and 83rd Drive NW, is over capacity under existing conditions.

Improvement: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the entire alignment to 10-inch diameter (except for the upstream 18 lf, model conduit P-50, which should be upsized to 12-inch diameter) in accordance with the City's construction standards. However, considering the criticality of this alignment, 12-inch-diameter sewer main should be considered for the entire alignment to provide capacity for additional flow rates beyond the 20-year planning period.

CIP SM8: Pioneer Highway and SR532 Sewer Main

Estimated Cost: $600,000 (City cost estimate)

Proposed Years: 2025

Description: The City plans to upsize approximately 1,000 lf of existing pipe in Pioneer Highway south of 77th Avenue NW (Taylor's Landing) to 15 inches to mitigate existing capacity issues.

RH2 hydraulic modeling performed as part of this GSP update identified the following deficiencies and proposed improvements in this vicinity.

Deficiency: Approximately 778 lf of existing 12-inch-diameter sewer main along Pioneer Highway in the vicinity of Taylor's Landing (model conduits P-1431, P-822, and P-820) is over capacity under existing conditions. This project is adjacent to CIP SM11.

Improvement: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the alignment to 15-inch diameter in accordance with the City's construction standards. However, considering the criticality of this alignment, 18-inch-diameter sewer main should be considered to provide capacity for additional flow rates beyond the 20-year planning period.

CIP SM9: Cedarhome Collection System

Estimated Cost: $275,000 (City cost estimate)

Proposed Years: 2025

Description: In order to eliminate the Cedarhome Lift Station, a connection will need to be made to Church Creek Estates. This will be completed after all other downstream improvements have been completed.

CIP SM10: 272nd St/76th Dr Main Replacement

Estimated Cost: $150,000 (City cost estimate)

Proposed Years: 2025 through 2027

Deficiency: The sewer collection system along 272nd Street NW between 79th Drive NW and 76th Drive NW, and along 76th Drive NW between 272nd Street NW and 276th Street NW, has structural and infiltration and inflow (I/I) issues.

Improvement: Replace up to approximately 2,220 lf of existing 8-inch and 12-inch gravity pipe with new gravity sewer pipe in accordance with the City's construction standards along 272nd Street NW between 79th Drive NW and 76th Drive NW and along 76th Drive NW between 272nd Street NW and 276th Street NW.

The City plans to focus on I/I improvements and replace mains only if necessary. Improvements will be coordinated with the planned transportation improvements on 272nd Street NW between Pioneer Highway and 72nd Avenue NW.

CIP SM11: Pioneer Highway (Taylor's Landing Vicinity) Gravity Main Replacement — Future

Estimated Cost: $900,000

Proposed Years: 2031 through 2032

Deficiency: Approximately 316 lf of existing 15-inch-diameter sewer main (model conduits P-1659 and P-1536) and approximately 130 lf of existing 12-inch-diameter sewer main (model conduits P-1440 and P-1446) in Pioneer Highway, in the vicinity of Taylor's Landing, is projected to be over capacity by 2034. This project is adjacent to CIP SM8.

Improvement: Upsize the alignment to provide sufficient capacity for projected future flow rates. To provide sufficient capacity for 2044 flow rates, upsize the existing 12-inch-diameter sewer main to 15-inch diameter and upsize the existing 15-inch-diameter sewer main to 18-inch diameter in accordance with the City's construction standards. However, considering the criticality of these alignments, 18-inch-diameter sewer main should be considered for the entire alignment to provide capacity for additional flow rates beyond the 20-year planning period.

CIP SM12: 70th Avenue NW (South of 278th Street NW) Gravity Main Replacement

Estimated Cost: $300,000

Proposed Years: 2033 through 2034

Deficiency: Approximately 131 lf of existing 8-inch-diameter sewer main (model conduit P-1619) in 70th Avenue NW, south of 278th Street NW, is over capacity under existing conditions.

Improvement: Survey the alignment to verify pipe inverts and confirm if the modeled capacity deficiency actually exists. If so, upsize the alignment to 12-inch diameter in accordance with the City's construction standards.

CIP SM13: Sewer Drainage Basin 1 Pipe Replacement Program

Estimated Cost: $1,400,000 ($100,000 per year)

Proposed Years: 2031 through 2044

Deficiency: Much of the gravity sewer pipe in Sewer Drainage Basin 1 is aging, constructed of legacy or non-standard materials, and in poor overall condition. This basin also is believed to contribute a significant amount of I/I to the system, as described in **Chapter 4**.

Improvement: Replace poor condition sewer mains in Sewer Drainage Basin 1 as budgets allow. Consider cured-in-place pipe lining and other trenchless construction methods where feasible to save costs.

Lift Station Improvements

CIP LS1: Pioneer Hills Lift Station Upgrades

Estimated Cost: $350,000 (City cost estimate)

Proposed Years: 2025

Description: The City plans to upgrade the Pioneer Hills Lift Station. Improvements will include two new pumps with a new control system, full integration to the supervisory control and data acquisition (SCADA) system, and the addition of a backup power source. A new metal roof also is needed for the building.

CIP LS2: Decommission Church Creek Lift Station

Estimated Cost: $80,000 (City cost estimate)

Proposed Years: 2025 through 2026

Description: The City plans to decommission the Church Creek Lift Station, which has been bypassed by a new gravity sewer pipeline and is no longer required.

CIP LS3: Taylor's Landing Lift Station Upgrades

Estimated Cost: $200,000

Proposed Years: 2031

Description: The coatings in the Taylor's Landing Lift Station wet well are peeling and should be reapplied. Additionally, there is no flow meter at this site. The City plans to recoat the Taylor's Landing Lift Station wet well and install a flow meter.

CIP LS4: Copper Lift Station Upgrades

Estimated Cost: $100,000

Proposed Years: 2031

Description: The Copper Lift Station needs SCADA upgrades to collect flow meter data and has a tree growing dangerously close to the building's exhaust that poses a fire hazard. This project includes improvements to address these deficiencies.

CIP LS5: Decommission Cedarhome Lift Station

Estimated Cost: $80,000

Proposed Years: 2031

Description: The Cedarhome Lift Station has been bypassed by a new gravity pipeline and will be decommissioned when no longer required.

Miscellaneous Collection System Projects

CIP M1: General Sewer Plan Update

Estimated Cost: $450,000

Proposed Years: 2032 through 2034

Description: The City will update its GSP every 10 years. In addition, the City will perform a review of the GSP at the 5-year mark and adjust the projections and improvements as necessary.

CIP M2: Sewer Rate Study

Estimated Cost: $45,000 (City cost estimate)

Proposed Year: 2029

Description: The City plans to periodically evaluate sewer rates and update them as necessary.

CIP M3: Sewer Project Inventory

Estimated Cost: $225,000 (City cost estimate)

Proposed Year: 2025

Description: The City plans to build up an inventory of spare parts for the sewer utility, such as pump rebuild kits, spare motors, seals, etc.

CIP M4: GIS Equipment and Set-Up (Sewer)

Estimated Cost: $200,000 (City cost estimate)

Proposed Year: 2025 through 2026

Description: The City Council authorized the development of GIS, including mapping layers of City streets, zoning, and many assets, including water, sewer, and drainage system components. The cost of this CIP is allocated between all three of the utilities.

CIP M5: I/I Study

Estimated Cost: $125,000 (City cost estimate)

Proposed Year: 2028

Description: The City plans to conduct an I/I study to evaluate the sewer collection system and confirm results. These results help to guide future CIP projects and are often part of National Pollutant Discharge Elimination System Permit requirements.

Wastewater Treatment Plant Improvements

CIP F1: Miscellaneous Improvements

Estimated Cost: $1,400,000 ($100,000 per year)

Proposed Years: 2031 through 2044

Deficiency: The City has identified equipment at the WWTP that needs repairs and/or replacement, but the individual items do not rise to the level of their own CIP projects. However, these items are also large enough that the cost may not be fully covered by the City's annual operations and maintenance budget.

Improvement: Replace and repair various equipment at the WWTP as identified by the City.

CIP F2: Headworks Screen Replacement

Estimated Cost: $1,365,000

Proposed Years: 2027 through 2028

Deficiency: The WWTP uses screens in the headworks building for preliminary treatment of influent wastewater. This includes a mechanical screen with a built-in washer-compactor system

for screenings and a manual bar screen in a backup channel. The screens and washer-compactor will exceed their 20-year design life during the planning period and must be replaced.

Improvement: Replace the existing screens with two mechanical screens with built-in washer-compactors for screenings. Minimal structural and mechanical modifications are expected to integrate the new screens. Electrical improvements and the replacement of critical electrical and control equipment will be required to accommodate the proposed equipment.

CIP F3: Existing Secondary Clarifier Nos. 1 and 2 Replacements

Estimated Cost: $2,332,000

Proposed Years: 2029 through 2030

Deficiency: The WWTP uses an activated sludge system for secondary treatment that separates treated secondary effluent from the activated sludge using two 65-foot-diameter clarifiers. These clarifiers use rotating mechanisms to settle sludge at the bottom and remove scum from the liquid surface. Both secondary clarifier mechanisms are original to the 2004 WWTP construction and are reaching the end of their useful lives. The submerged portion of the mechanisms require condition assessments to determine if replacement or recoating is required.

Improvement: For budgetary purposes, this CIP item assumes that condition assessments indicate the need to fully replace both clarifier mechanisms. The project includes the replacement of both clarifier mechanisms with new carbon steel models (field-coated), recoating the troughs and launders, and refurbishing the effluent weir. These improvements can be phased such that one clarifier is improved at a time.

CIP F4: UV System Replacement and Expansion

Estimated Cost: $907,000

Proposed Years: 2029 through 2030

Deficiency: The WWTP uses an ultraviolet (UV) disinfection system to disinfect secondary effluent before it is discharged to the outfall. The existing UV system is reaching the end of its useful life, and its peak capacity is insufficient for the peak hour flow projected for the end of the planning period. The UV system must be replaced with a model with sufficient capacity for the planning period projections.

Improvement: Replace the UV system with a larger peak capacity system. Some structural and mechanical modifications are expected to integrate the new UV system. Electrical improvements are expected, including increasing the power feeder size as necessary and providing instrumentation for full integration. These improvements can be phased such that one reactor channel is upgraded at a time.

CIP F5: Generator Replacement

Estimated Cost: $1,211,000

Proposed Years: 2029 through 2030

Deficiency: The WWTP uses a diesel-powered generator housed in the operations building for standby power. Due to the age and observed unreliability of the existing generator, a load analysis and new generator are required.

Improvement: This project involves replacing the indoor generator with a similar unit to be located in the same building. Other upgrades to the ventilation systems, exhaust, and power distribution equipment will be required.

CIP F6: Telemetry Improvements

Estimated Cost: $104,000

Proposed Years: 2027

Deficiency: The existing WWTP telemetry system is supported and functioning properly; however, only a small computer screen is currently used to monitor the entire WWTP. An adequate screen to monitor the SCADA system for the entire WWTP is recommended.

Improvement: Install a larger human-machine interface screen to show a general overview of the entire WWTP to assist in day-to-day operations.

CIP F7: Biosolids Removal and Utilization

Estimated Cost: $3,400,000 (City cost estimate)

Proposed Years: 2025 and 2030

Deficiency: The City's WWTP produces biological sludge. This sludge is stabilized in two 1.25-acre ponds using an aerobic and facultative digestion process that reduces the mass and stabilizes the sludge so that it can be beneficially reused or disposed of as a solid waste. The stored biosolids in the City's sludge stabilization ponds will need to be removed at least one more time before CIP F9 is implemented.

Improvement: Remove and land apply the biosolids contained in both of the City's sludge stabilization ponds.

CIP F8: Grit Removal Unit and Classifier Installation

Estimated Cost: $2,044,000

Proposed Years: 2027 through 2028

Deficiency: The WWTP does not use a grit removal system. Instead, grit is manually removed from the secondary treatment system during semi-annual maintenance. A grit removal system prevents grit from accumulating downstream in the WWTP and reduces wear on equipment. Additionally, upgrades proposed in CIP F9 and CIP F10 introduce new equipment to the WWTP that can be negatively impacted by grit accumulation. Implementation of this item should occur simultaneously with CIP F10 to avoid the negative effects of grit on the proposed equipment.

Improvement: Install a grit removal unit adjacent to the headworks building as called for in the 2004 plans. This will include a classifier and a hopper inside the headworks building, a concrete chamber for the grit unit, and concrete slabs with metal structures to house the equipment. Some

structural and mechanical modifications to the screening channels will be necessary to implement the grit unit. Electrical improvements are required to accommodate the proposed equipment, including providing a power feeder as necessary and control wiring as required for full integration.

CIP F9: Solids Handling System Upgrades

Estimated Cost: $13,067,000

Proposed Years: 2025 through 2029

Deficiency: The WWTP uses sludge stabilization ponds to store and stabilize excess biological sludge produced during secondary treatment. The design capacity of the system is exceeded during the planning period based on the flow and load projections provided in **Chapter 4** of this GSP, and potential failure of aging components in the system represents a risk to the WWTP. A new solids handling strategy is recommended in **Chapter 8** of this GSP.

Improvement: This project involves reclamation of the sludge stabilization ponds and construction of a new solids handling system on the reclaimed land as the solids handling strategy for the WWTP. Construction of the new solids handling system would include the addition of dedicated waste activated sludge (WAS) pumping, aerobic digesters, a digester control building, thickening, dewatering, and conveyance. This entails major civil, structural, mechanical, and electrical improvements to construct and integrate the new system. Construction can be phased such that sludge stabilization pond no. 1 remains in use for WAS produced by the WWTP as construction occurs.

CIP F10: Activated Sludge Process – Capacity and Nutrient Enhancements

Estimated Cost: $13,767,000

Proposed Years: 2025 through 2029

Deficiency: The WWTP treats wastewater using an activated sludge process consisting of two oxidation ditches with anoxic selector basins and two secondary clarifiers. The design capacity of the system is exceeded during the planning period based on the projections in **Chapter 4** of this GSP. Nitrogen removal requirements that did not exist during the 2004 design further limit the capacity of the system. Modifications to the activated sludge process to address these deficiencies are recommended in **Chapter 8** of this GSP.

Improvement: This project involves removing equipment and structures from the existing oxidation ditches and transitioning them to partitioned plug flow reactors. Construction of the plug flow reactors would include the addition of partition walls, mixers, pumped mixed liquor recycle, blowers and diffused aeration, and surface wasting devices. This entails major civil, structural, mechanical, and electrical improvements to construct and integrate the new process. Construction can be phased such that one oxidation ditch remains in use to treat influent wastewater as construction occurs on the other.

ESTIMATING COSTS OF IMPROVEMENTS

Estimating Costs for Collection System Improvements

Some cost estimates for collection system improvement projects were provided by the City. For other projects, the costs for the proposed improvements were estimated based on costs of similar, recently constructed sewer projects in the City and around the Puget Sound area and are presented in 2024 dollars.

The cost estimates include the estimated construction cost of the improvement and indirect costs estimated at 35 percent of the construction cost for engineering preliminary design, final design, construction management services, permitting, and legal and administrative services. The construction costs are based on the estimated cost of all construction-related improvements, such as materials and labor for installation, services, manholes, connections to the existing system, trench restoration, asphalt surface restoration, and other work for a complete installation. The construction cost estimates include a 30-percent contingency and sales tax of 9.3 percent. The project costs presented in the CIP are capital cost estimates and do not represent life-cycle cost estimates.

Estimating Costs for WWTP Improvements

Project costs for the proposed improvements to the WWTP were estimated based on a breakdown of the civil, structural, mechanical, and electrical tasks anticipated for each project (except CIP F1 and CIP F7). All cost estimates were made in 2024 dollars. Cost estimates for civil tasks were considered only for CIP F9 and CIP F10 and were estimated based on unit costs from recent projects in the region scaled to the volumes and areas associated with the site work for these projects. Cost estimates for structural tasks were developed based on unit prices from recent projects, the approximate volumes of concrete to be removed and/or added, and the approximate areas of new buildings and metal structures. Cost estimates for mechanical tasks were developed based on recent budget proposals for proposed equipment, and approximations of the costs associated with demolition of previous equipment and ancillary work to integrate the new equipment. Cost estimates for electrical tasks were based on the costs of similar, recent projects in the region and the types and amounts of electrical upgrades to accommodate the proposed equipment associated with each project.

Cost estimates for civil, structural, mechanical, and electrical tasks include the anticipated cost of labor and overhead/profit. Mobilization and demobilization costs were estimated for each project as 10 percent of the sum of costs for civil, structural, mechanical, and electrical tasks. Those five costs for each project were summed to a construction cost subtotal. Total project cost estimates with contingency were calculated for each project by adding the local sales tax of 9.3 percent, indirect costs of 20 to 25 percent and a contingency of 20 to 30 percent to the construction cost subtotals.

CIP F1 did not use the cost estimation method described previously since it is not designated for specific projects. It was developed as a lump sum cost of $100,000 per year for the 20-year planning period. The cost estimate for CIP F7 was provided by the City.

PRIORITIZING IMPROVEMENTS

System improvements were prioritized by the City based on the perceived need for the improvement to be completed prior to projects with fewer deficiencies or less risk of damage due to failure of the system.

Future projects that are not identified as part of the City's CIP may become necessary. Such projects may be required to remedy an emergency situation or address unforeseen problems. Due to budgetary constraints, the completion of such projects may require modifications to the recommended CIP. The City retains the flexibility to reschedule, expand, or reduce the projects included in the CIP and to add new projects to the CIP, as best determined by the City Council, when new information becomes available for review and analysis.

SCHEDULE OF IMPROVEMENTS

The results of prioritizing the improvements were used to assist in establishing an implementation schedule that can be used by the City for preparing its 10-year CIP. The implementation schedule for the proposed improvements is shown in **Table 10-1**.

Future Project Cost Adjustments

All cost estimates shown in the tables are presented in year 2024 dollars. Therefore, it is recommended that future costs be adjusted to account for the effects of inflation and changing construction market conditions at the actual time of project implementation. Future costs can be estimated using the Engineering News Record Construction Cost Index for the Seattle area or by applying an estimated rate of inflation that reflects the current and anticipated future market conditions.

Table 10-1

Proposed Capital Improvements Plan Implementation Schedule

CIP No.	Description	Estimated Total Project Cost (2024 $)	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035-2044
	Sewer Main Improvements												
SM1	72nd Ave Sewer Main Replacement	$ 1,925,000	$1,925K										
SM2	Twin City Mile Project - 271st Camano Street to 94th Main Replacement	$ 1,900,000	$200K	$850K	$850K								
SM3	Cedarhome Dr Sewer Main Replacement	$ 1,285,000	$1,285K										
SM4	68th Sewer Main Replacement	$ 1,000,000	$1,000K										
SM5	SR 532 and Pioneer Highway Sewer Crossing	$ 800,000	$800K										
SM6	99th/272nd Pl Main Replacement	$ 775,000				$110K	$665K						
SM7	274th Sewer Main Replacement	$ 700,000	$700K										
SM8	Pioneer Highway and SR532 Sewer Main	$ 600,000	$600K										
SM9	Cedarhome Collection System	$ 275,000	$275K										
SM10	272nd St/76th Dr Main Replacement	$ 150,000	$150K										
SM11	Pioneer Highway (Taylor's Landing Vicinity) Gravity Main Replacement - Future	$ 900,000							$450K	$450K			
SM12	70th Avenue NW (South of 278th Street NW) Gravity Main Replacement	$ 300,000									$150K	$150K	
SM13	Sewer Drainage Basin 1 Pipe Replacement Program	$ 1,400,000							$100K	$100K	$100K	$100K	$1,000K
	Lift Station Improvements												
LS1	Pioneer Hills Lift Station Upgrades	$ 350,000	$350K										
LS2	Decommission Church Creek Lift Station	$ 80,000	$40K	$40K									
LS3	Taylor's Landing Lift Station Upgrades	$ 200,000							$200K				
LS4	Copper Lift Station Upgrades	$ 100,000							$100K				
LS5	Decommission Cedarhome Lift Station	$ 80,000							$80K				
	Miscellaneous Collection System Improvements												
M1	General Sewer Plan Update	$ 450,000								$150K	$150K	$150K	
M2	Sewer Rate Study	$ 45,000					$45K						
M3	Sewer Project Inventory	$ 225,000	$225K										
M4	GIS Equipment and Setup (Sewer)	$ 200,000	$100K	$100K									
M5	Inflow and Infiltration Study	$ 125,000				$125K							
	Wastewater Treatment Plant Improvements												
F1	Miscellaneous Improvements	$ 1,400,000							$100K	$100K	$100K	$100K	$1,000K
F2	Headworks Screen Replacement	$ 1,365,000			$228K	$1,137K							
F3	Existing Secondary Clarifier Nos. 1 and 2 Improvements	$ 2,332,000					$390K	$1,942K					
F4	UV System Replacement and Expansion	$ 907,000					$182K	$725K					
F5	Generator Replacement	$ 1,211,000					$202K	$1,009K					
F6	Telemetry Improvements	$ 104,000			$104K								
F7	Biosolids Removal and Utilization	$ 3,400,000	$1,400K					$2,000K					
F8	Grit Removal Unit and Classifier Installation	$ 2,044,000			$409K	$1,635K							
F9	Solids Handling System Upgrades	$ 13,067,000	$1,100K	$1,597K	$6,597K	$8,770K	$8,770K						
F10	Activated Sludge Process - Capacity and Nutrient Enhancements	$ 13,767,000											
Total Estimated Cost of Improvements		**$ 53,462,000**	**$10,150K**	**$2,587K**	**$8,188K**	**$11,777K**	**$10,254K**	**$5,676K**	**$1,030K**	**$800K**	**$500K**	**$500K**	**$2,000K**

11 | FINANCIAL PLAN

INTRODUCTION

This chapter was prepared by FCS, a Bowman Company, to provide a financial program that allows the City of Stanwood (City) sewer utility to remain financially viable during the planning period. This financial viability analysis considers the historical financial condition, current and identified future financial and policy obligations, operation and maintenance needs, and the financial impacts of the capital projects identified in the General Sewer Plan (GSP). Furthermore, this chapter provides a review of the sewer utility's current rate structure with respect to rate adequacy and customer affordability.

PAST FINANCIAL PERFORMANCE

This section includes an historical summary of financial performance as reported by the City, including fund resources and uses arising from cash transactions.

Comparative Financial Statements

The City legally owns and operates a sewer utility. The City's utility operates on a cash basis; therefore, annual balance sheets and income statements are not prepared. **Table 11-1** shows a summary of sewer fund resources and uses arising from cash transactions for the 6-year period of 2018 through 2023. Noteworthy findings and trends for the historical performance and condition of the City's sewer utility are then discussed.

Table 11-1

Summary of Historical Fund Resources and Uses Arising from Cash Transactions

	2018	2019	2020	2021	2022	2023
Beginning Cash and Investments						
Beginning Cash and Investments	$ -	$ -	$ 5,338,431	$ 5,171,833	$ 8,119,856	$ 7,417,547
Reserved	476,990	484,225	-	-	-	-
Unreserved	4,133,842	4,836,993	-	-	-	-
Net Adjustments	28,627	2,453	-	-	-	-
Revenues						
Taxes	$ -	$ -	$ -	$ -	$ -	$ -
Licenses and Permits	-	-	-	-	-	-
Intergovernmental Revenues	100	-	-	-	-	57,392
Charges for Goods and Services	2,131,724	2,214,435	2,348,538	2,689,165	3,017,303	3,198,837
Fines and Penalties	13,215	11,420	2,522	16	19,169	15,772
Miscellaneous Revenues	401,203	456,443	452,790	436,548	185,047	259,002
Total Operating Revenues:	$ 2,546,242	$ 2,682,298	$ 2,803,850	$ 3,125,729	$ 3,221,519	$ 3,531,003
Expenditures						
General Government	$ -	$ -	$ -	$ -	$ -	$ -
Public Safety	-	-	-	-	-	-
Utilities	1,043,980	1,042,969	1,196,533	1,330,856	1,562,096	1,855,384
Transportation	-	-	-	-	-	-
Natural and Economic Environment	-	-	-	-	-	-
Social Services	-	-	-	-	-	-
Culture and Recreation	-	-	-	-	-	-
Total Operating Expenses:	$ 1,043,980	$ 1,042,969	$ 1,196,533	$ 1,330,856	$ 1,562,096	$ 1,855,384
Excess (Deficiency) Revenues over Expenditures:	**$ 1,502,262**	**$ 1,639,329**	**$ 1,607,317**	**$ 1,794,873**	**$ 1,659,423**	**$ 1,675,619**
Other Increases in Fund Resources						
Debt Proceeds	$ -	$ -	$ -	$ 4,569,635	$ -	$ -
Transfers-In	3,077	-	-	-	163,135	-
Special or Extraordinary Items	-	-	-	-	-	-
Other Resources	80,000	33,140	-	-	47,338	32,842
Total Other Increases in Fund Resources	$ 83,077	$ 33,140	$ -	$ 4,569,635	$ 210,473	$ 32,842
Other Decreases in Fund Resources						
Capital Expenditures	$ 326,818	$ 1,079,028	$ 944,435	$ 2,572,481	$ 1,752,860	$ 1,288,074
Debt Service	576,762	576,227	575,692	844,004	819,346	856,982
Transfers-Out	-	-	221,000	-	-	-
Special or Extraordinary Items	-	-	-	-	-	-
Other Uses	-	2,453	32,786	-	-	45,463
Total Other Decreases in Fund Resources	$ 903,580	$ 1,657,708	$ 1,773,913	$ 3,416,485	$ 2,572,206	$ 2,190,519
Increase (Decrease) in Cash and Investments:	**$ 681,759**	**$ 14,761**	**$ (166,596)**	**$ 2,948,023**	**$ (702,310)**	**$ (482,058)**
Ending Cash and Investments						
Nonspendable	$ -	$ -	$ -	$ -	$ -	$ -
Restricted	-	-	500,035	-	45,463	32,842
Committed	-	-	-	-	-	-
Assigned	-	-	4,671,798	8,119,856	7,372,084	6,902,646
Unassigned	-	-	-	-	-	-
Reserved	484,225	492,711	-	-	-	-
Unreserved	4,836,993	4,845,720	-	-	-	-
Total Ending Cash and Investment	**$ 5,321,218**	**$ 5,338,431**	**$ 5,171,833**	**$ 8,119,856**	**$ 7,417,547**	**$ 6,935,488**

Findings and Trends

- The City's sewer charges for services increased from $2.1M in 2018 to $3.2M in 2023. The average annual compounding increase was 8.46 percent per year, with a cumulative increase of 50.06 percent from 2018 to 2023. Operating expenditures increased by approximately $0.8M over the 6 years for an average annual compounding increase of 12.19 percent. While the percentage growth in operating expenditures outpaced growth in revenues, total revenues were approximately 2.0 times the operating expenses allowing net income (revenues less expenditures) to grow from $1.5M in 2018 to $1.7M in 2023.
- The Operations and Maintenance (O&M) Coverage Ratio (total operating revenue divided by total operating expenses) was 243.90 percent in 2018. Due to the increase in operating expenditures, this ratio fell to 190.31 percent in 2023. A ratio of 100 percent or greater shows that operating revenue will successfully cover operating expenses, and the utility has remained above this ratio for the past 6 years.
- Net Operating Income as a percent of Operating Revenue was 59.00 percent in 2018 and decreased to a low of 47.45 percent in 2023. Similar to the O&M Coverage Ratio, these trends help to show how successfully operating revenue actually covered operating expenses, with higher positive numbers being the best and negative numbers showing need for improvement. In addition, these trends demonstrate the ability of the utility to invest in capital, whether through direct cash transfers or the issuance and servicing of debt.
- The Debt Service Coverage Ratio measures the amount of cash flow available to meet principal and interest payments. Typically, revenue bond debt service coverage requires a minimum factor of 1.25 during the life of the loans. This ratio is calculated by dividing cash or net operating income (operating revenues less operating expenses) by annual revenue bond debt service. The City's annual reports did not separate the debt service between revenue bond debt and junior lien debt; therefore, the coverage ratios were calculated on total debt, which is a more conservative comparison. The total debt service coverage ratio for all outstanding debt ended 2018 at 2.60, decreasing to 1.96 by 2023 as the City took on more debt. The fact that this ratio has sustained levels higher than the minimum target of 1.25 indicates a stable capacity for new debt and will likely result in favorable terms when entering the bond market.

FINANCIAL PLAN

The sewer utility is responsible for generating sufficient revenue to meet all of its costs. The primary source of funding is derived from ongoing bi-monthly service charges, with additional revenue coming from miscellaneous non-rate revenues and interest earnings. The City controls the level of user charges and, with City Council approval, can adjust user charges as needed to meet financial objectives.

The financial plan can only confirm financial feasibility if it considers the total system costs of providing sewer services, both operating and capital. To meet these objectives, the following elements have been completed.

1. **Capital Funding Plan**. Identifies the total Capital Improvement Plan (CIP) obligations of the planning period. The plan defines a strategy for funding the CIP, including an analysis of

available resources from rate revenues, existing reserves, connection charge revenues, debt financing, and any special resources that may be readily available (e.g., grants, developer contributions, etc.). The capital funding plan impacts the financial plan through the use of debt financing (resulting in annual debt service) and the assumed rate revenue made available for capital funding.

2. **Financial Forecast**. Identifies future annual non-capital costs associated with the operation, maintenance, and administration of the sewer system. Included in the financial plan is a reserve analysis that forecasts cash flow and fund balance activity, along with testing for satisfaction of actual or recommended minimum fund balance policies. The financial plan ultimately evaluates the sufficiency of utility revenues in meeting all obligations, including cash uses such as operating expenses, debt service, capital outlays, and reserve contributions, as well as any coverage requirements associated with long-term debt. The plan also identifies the future adjustments required to fully fund all utility obligations in the planning period.

Capital Funding Plan

To properly evaluate future capital funding needs, capital costs were escalated by 5.00 percent annually to the year of planned spending. The CIP developed for this GSP identifies $60.9M in escalated project costs over the 10-year planning horizon from 2025 to 2034. The 20-year period, through 2044, includes $63.3M in total escalated project costs. In addition to the capital improvement program identified in this GSP, the City directed the study to add $3.5M in vehicle replacement program expenditures, increasing the 10-year CIP to $62.4M and 20-year CIP to $66.8M.

A summary of the 20-year CIP is shown in **Table 11-2**. As shown, each year has varied capital cost obligations depending on construction schedules and infrastructure planning needs.

Table 11-2

Budget and 10-Year and 20-Year CIPs

Year	2024 $	Escalated $
2025	$ 10,280,000	$ 10,787,500
2026	2,720,900	2,986,068
2027	8,325,917	9,616,551
2028	11,919,055	14,457,072
2029	10,400,316	13,233,307
2030	5,826,706	7,757,088
2031	1,085,227	1,463,830
2032	709,884	972,484
2033	414,680	552,512
2034	419,621	576,844
Total	**$ 52,102,304**	**$ 62,403,256**
2035-2044	3,152,844	4,410,642
Total	**$ 55,255,149**	**$ 66,813,898**

Table 11-3 provides more detail for the 10-year CIP.

Table 11-3
10-Year CIP

	Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	Total
Proposed Capital Imprvements Plan Implementation Schedule Table 7-1												
Sewer Main Improvements												
SM1	72nd Ave Sewer Main Replacement	$ 2,021,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,021,250
SM2	Twin City Mile Project-271st Camano Street to 94th Main Replacement	210,000	937,125	983,981	-	-	-	-	-	-	-	2,131,106
SM3	Cedarhome Dr Sewer Main Replacement	1,349,250	-	-	-	-	-	-	-	-	-	1,349,250
SM4	68th Sewer Main Replacement	1,050,000	-	-	-	-	-	-	-	-	-	1,050,000
SM5	SR532 and Pioneer Hwy Sewer Crossing	840,000	-	-	-	-	-	-	-	-	-	840,000
SM6	99th/272nd Pl Main Replacement	-	-	-	133,706	848,727	-	-	-	-	-	982,433
SM7	274th Sewer Main Replacement	735,000	-	-	-	-	-	-	-	-	-	735,000
SM8	Pioneer Hwy and SR532 Sewer Main	630,000	-	-	-	-	-	-	-	-	-	630,000
SM9	Cedarhome Collection System	288,750	-	-	-	-	-	-	-	-	-	288,750
SM10	272nd St/76th Dr Main Replacement	157,500	-	-	-	-	-	-	-	-	-	157,500
SM11	Pioneer Highway (Taylor's Landing Vicinity) Gravity Main Replacement	-	-	-	-	-	-	633,195	664,855	-	-	1,298,050
Lift Station Improvements		-	-	-	-	-	-	-	-	-	-	-
LS1	Pioneer Hills Lift Station Upgrade	367,500	-	-	-	-	-	-	-	-	-	367,500
LS2	Decommission Church Creek Lift Station	42,000	44,100	-	-	-	-	-	-	-	-	86,100
LS3	Taylor's Landing Lift Station Upgrades	-	-	-	-	-	-	281,420	-	-	-	281,420
LS4	Copper Lift Station Upgrades	-	-	-	-	-	-	140,710	-	-	-	140,710
LS5	Decommission Cedarhome Lift Station	-	-	-	-	-	-	112,568	-	-	-	112,568
Miscellaneous Collection System Improvements		-	-	-	-	-	-	-	-	-	-	-
M1	General Sewer Plan Update	-	-	-	-	-	-	-	-	232,699	244,334	477,033
M2	Sewer Rate Study	-	-	-	-	57,433	-	-	-	-	-	57,433
M3	Sewer Project Inventory	236,250	-	-	-	-	-	-	-	-	-	236,250
M4	GIS Equipment and Set-Up (Sewer)	105,000	110,250	-	-	-	-	-	-	-	-	215,250
M5	Inflow and Infiltration Study	-	-	-	151,938	-	-	-	-	-	-	151,938
Wastewater Treatment Plant Improvements		-	-	-	-	-	-	-	-	-	-	-
F1	Miscellaneous Improvements	-	-	-	-	-	-	140,710	147,746	155,133	162,889	606,478
F2	Headworks Screen Replacement	-	-	263,939	1,382,031	-	-	-	-	-	-	1,645,969
F3	Existing Secondary Clarifier No.1/2 Improvements	-	-	-	-	497,750	2,602,466	-	-	-	-	3,100,216
F4	UV System Replacement and Expansion	-	-	-	-	232,283	971,569	-	-	-	-	1,203,853
F5	Generator Replacement	-	-	-	-	257,809	1,352,157	-	-	-	-	1,609,965
F7	Biosolids Removal and Utilization	1,470,000	-	120,393	-	-	2,680,191	-	-	-	-	4,270,584
F8	Grit Removal Unit and Classifier Installation	-	-	-	1,987,353	-	-	-	-	-	-	1,987,353
F9	Solids Handling System Upgrades	-	-	473,469	-	-	-	-	-	-	-	473,469
F10	Activated Sludge Process - Capacity and Nutrient Enhancements	1,155,000	1,760,693	7,636,852	10,659,990	11,192,989	-	-	-	-	-	32,405,524
		-	-	-	-	-	-	-	-	-	-	-
-	Vehicle Replacement	130,000	133,900	137,917	142,055	146,316	150,706	155,227	159,884	164,680	169,621	1,490,304
	Total Escalated	**$10,787,500**	**$ 2,986,068**	**$ 9,616,551**	**$14,457,072**	**$13,233,307**	**$ 7,757,088**	**$ 1,463,830**	**$ 972,484**	**$ 552,512**	**$ 576,844**	**$62,403,256**

PRELIMINARY

AVAILABLE FUNDING ASSISTANCE AND FINANCING RESOURCES

City Resources

Resources appropriate for funding capital needs include accumulated cash in the construction fund, rate revenues designated for capital spending purposes, and capital-related charges such as plant investment fee (PIF) revenue. The first two resources will be discussed in the **Fiscal Policies** section of the **Financial Forecast**. Capital-related charges are discussed in the following section.

Plant Investment Fees

A connection charge such as the City's PIF refers to a one-time charge imposed on new customers as a condition of connecting to the sewer system. The purpose of the PIF is two-fold: 1) to promote equity between new and existing customers; and 2) to provide a source of revenue to fund capital projects necessary for meeting growth. This revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects. In the absence of a connection charge, growth-related capital costs would be borne in large part by existing customers. In 2025, the City will charge all new customers a PIF of $7,719 per meter capacity equivalent (MCE). MCEs are defined by the City and represent the maximum safe operating flow capacity in gallons per minute, relative to the base meter size.

Local Facilities Charges

While a connection charge is the manner in which new customers pay their share of system investment costs, local facilities charge funding is used to pay the costs of local facilities that connect each property to the system's infrastructure. Local facilities funding is often overlooked in rate forecasting because it is funded upfront by either connecting customers and developers, or through an assessment to properties, but never from rates.

A number of mechanisms can be considered toward funding local facilities. One of the following scenarios typically occurs: a) the utility charges a connection fee based on the cost of the local facilities (under the same authority as the facilities assessment fee); b) a developer funds an extension of the system to its development and turns those facilities over to the utility (contributed capital); or c) a local assessment is set up called a Utility Local Improvement District (ULID/LID) or a Local Utility District, which collects tax revenue from benefited properties.

A local facilities charge (LFC) is a variation of the connection charge. It is a city-imposed charge to recover the cost related to service extension to local properties. Often called a front-footage charge and imposed on the basis of footage of the main "fronting" a particular property, it is usually implemented as a reimbursement mechanism to a city for the cost of a local facility that directly serves a property. It is a form of a connection charge and thus can accumulate up to 10 years of interest. It typically applies in instances when no developer-installed facilities are needed through developer extension due to the prior existence of available mains already serving the developing property.

The developer extension is a requirement that a developer install on-site and sometimes off-site improvements as a condition of extending service. These are in addition to the connection charge

required and must be built to City standards. Part of the agreement between the City and the developer planning to extend service might include a latecomer agreement (also called payback agreements), resulting in a latecomer charge to new connections for the developer extension.

Latecomer charges are a variation of developer extensions, whereby new customers connecting to a developer-installed improvement make a payment to the City based on their share of the developer's cost. The City passes this charge on to the developer who installed the facilities. As part of the developer extension process, this defines the allocation of costs and records latecomer obligations on the title of affected properties. No interest is allowed, and the reimbursement agreement cannot exceed 20 years in duration.

ULID/LID is another mechanism for funding infrastructure that assesses benefited properties based on the special benefit received by the construction of specific facilities. Most often used for local facilities, some ULIDs also recover related plant investment costs. Substantial legal and procedural requirements can make this a relatively expensive process, and there are mechanisms by which a ULID can be rejected.

Outside Resources

This section outlines various grant, loan, and bond opportunities available to the City through federal and state agencies to fund the CIP identified in the GSP.

Grants and Low Cost Loans

Historically, federal and state grant programs were available to local utilities for capital funding assistance. However, these assistance programs have been mostly eliminated, substantially reduced in scope and amount, or replaced by loan programs. Remaining grant programs are generally lightly funded and heavily subscribed. Nonetheless, the benefit of low interest loans makes the effort of applying worthwhile.

The State of Washington's Department of Commerce maintains a document currently entitled "Funding Programs for Drinking Water and Wastewater Projects; Updated 9-17-2024," which contains details on government programs, eligibility requirements, and contact information, should the City wish to inquire about program offerings and eligibility requirements.

Bond Financing

General Obligation Bonds – General Obligation (G.O.) bonds are bonds secured by the full faith and credit of the issuing agency, committing all available tax and revenue resources to debt repayment. With this high level of commitment, G.O. bonds have relatively low interest rates and few financial restrictions. However, the authority to issue G.O. bonds is restricted in terms of the amount and use of the funds, as defined by Washington constitution and statute. Specifically, the amount of debt that can be issued is linked to assessed valuation.

Revised Code of Washington (RCW) 39.36.020 states:

> (2)(a)(ii) Counties, cities, and towns are limited to an indebtedness amount not exceeding one and one half percent of the value of the taxable property in such counties, cities, or

towns without the assent of three-fifths of the voters therein voting at an election held for that purpose.

(b) In cases requiring such assent counties, cities, towns, and public hospital districts are limited to a total indebtedness of two and one-half percent of the value of the taxable property therein.

While bonding capacity can limit the availability of G.O. bonds for utility purposes, these can sometimes play a valuable role in project financing. A utility rate savings may be realized through two avenues: the lower interest rate and related bond costs, and the extension of repayment obligation to all tax-paying properties (not just developed properties) through the authorization of an ad valorem property tax levy.

Revenue Bonds – Revenue bonds are commonly used to fund utility capital improvements. The debt is secured by the revenues of the issuing utility. With this limited commitment, revenue bonds typically bear higher interest rates than G.O. bonds and require security conditions related to the maintenance of dedicated reserves (a bond reserve) and financial performance (added bond debt service coverage). The City agrees to satisfy these requirements by resolution as a condition of bond sale.

Revenue bonds can be issued in Washington without a public vote. There is no bonding limit, except perhaps the practical limit of the utility's ability to generate sufficient revenue to repay the debt and provide coverage. In some cases, poor credit might make issuing revenue bonds problematic.

Capital Financing Strategy

An ideal capital financing strategy would include the use of grants and low-cost loans when debt issuance is required. However, these resources are very limited and competitive in nature and do not provide a reliable source of funding for planning purposes. It is recommended that the City pursue these funding avenues but assume revenue bond financing to meet the needs which cannot be met by available cash resources. The capital financing strategy developed to fund the CIP identified in this GSP assumes the following funding resources:

- Accumulated cash reserves.
- Transfers of excess cash (over minimum balance targets) from the Operating Fund.
- Plant investment fee revenue.
- Interest earned on Capital Fund balances.
- Contributions in aid of construction such as grants and/or developer donations.
- Low interest loan financing.
- Revenue bond financing.

The cash resources described above are anticipated to fund 17.01 percent of the 10-year CIP and 18.30 percent of the 20-year CIP. The remaining funding is assumed to be from new debt obligations of $36.4M in the next 10-year planning period as well as PIF revenue and CIAC/grant funding. **Table 11-4** presents the 10-year and 20-year capital financing strategy.

Table 11-4

10-Year and 20-Year Capital Financing Strategy

Year	Capital (Escalated)	PIF & Hook Up Fees	Low Interest Loans	CIAC / Grants	Revenue Bonds	Cash / Reserves	Total Financing
2025	$ 10,787,500	$ 105,500	$ 1,000,000	$ 5,785,500	$ -	$ 3,896,500	$ 10,787,500
2026	2,986,068	128,100	-	-	2,724,068	133,900	2,986,068
2027	9,616,551	1,197,324	-	3,000,000	1,775,933	3,643,294	9,616,551
2028	14,457,072	688,064	-	133,706	13,493,247	142,055	14,457,072
2029	13,233,307	477,505	-	848,727	10,606,753	1,300,322	13,233,307
2030	7,757,088	108,066	-	-	6,800,000	849,022	7,757,088
2031	1,463,830	675,408	-	633,195	-	155,227	1,463,830
2032	972,484	147,746	-	664,855	-	159,884	972,484
2033	552,512	387,832	-	-	-	164,680	552,512
2034	576,844	407,224	-	-	-	169,621	576,844
Total	**$ 62,403,256**	**$ 4,322,769**	**$ 1,000,000**	**$ 11,065,983**	**$ 35,400,000**	**$ 10,614,504**	**$ 62,403,256**
2035-2044	4,410,642	2,800,610	-	-	-	1,610,032	4,410,642
Total	**$ 66,813,898**	**$ 7,123,379**	**$ 1,000,000**	**$ 11,065,983**	**$ 35,400,000**	**$ 12,224,536**	**$ 66,813,898**

FINANCIAL FORECAST

The financial forecast, or revenue requirement analysis, forecasts the amount of annual revenue that needs to be generated by user rates. The analysis incorporates operating revenues, O&M expenses, debt service payments, rate-funded capital needs, and any other identified revenues or expenses related to operations. The objective of the financial forecast is to evaluate the sufficiency of the current level of rates. In addition to annual operating costs, the revenue needs also include debt covenant requirements and specific fiscal policies and financial goals of the City.

For this analysis, two revenue sufficiency tests have been developed to reflect the financial goals and constraints of the City: cash needs must be met; and debt coverage requirements must be realized. In order to operate successfully with respect to these goals, both tests of revenue sufficiency must be met.

Cash Test – The cash flow test identifies all known cash requirements for the City in each year of the planning period. Typically, these include O&M expenses, debt service payments, rate-funded system reinvestment funding or directly funded capital outlays, and any additions to specified reserve balances. The total annual cash needs of the City are then compared to projected cash revenues using the current rate structure. Any projected revenue shortfalls are identified, and the rate increases necessary to make up the shortfalls are established.

Coverage Test – The coverage test is based on a commitment made by the City when issuing revenue bonds and some other forms of long-term debt. For the purposes of this analysis, revenue bond debt is assumed for any needed debt issuance starting in 2026, outside of the City's internally planned low interest loan assumptions for 2025. As a security condition of issuance, the City would be required per covenant to agree that the revenue bond debt would have a higher priority for payment (a senior lien) compared to most other expenditures; the only outlays with a higher lien are O&M expenses. Debt service coverage is expressed as a multiplier of the annual revenue bond debt service payment. For example, a 1.00 coverage factor would imply that no additional cushion is required. A 1.25 coverage factor means revenue must be sufficient to pay O&M expenses, annual revenue bond debt service payments, and an additional 25.0 percent of annual revenue bond debt

service payments. The excess cash flow derived from the added coverage, if any, can be used for any purpose, including funding capital projects. Based on discussions with the City, for planning purposes, a 1.50 coverage minimum on revenue bond debt service was assessed as part of the analysis. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues.

Current Financial Structure

The City maintains a fund structure and implements financial policies that target management of a financially viable and fiscally responsible sewer system.

Fiscal Policies

A brief summary of the key financial policies employed by the City, as well as those recommended and incorporated in the financial program, are discussed as follows.

Operating Reserve – Operating reserves are designed to provide a liquidity cushion to ensure that adequate cash working capital will be maintained to deal with significant cash balance fluctuations, such as seasonal fluctuations in billings and receipts, unanticipated cash expenses, or lower than expected revenue collections. Like other types of reserves, operating reserves also serve another purpose: they help smooth rate increases over time. Target funding levels for an operating reserve are generally expressed as a certain number of days of O&M expenses, with the minimum requirement varying with the expected revenue volatility. Industry practice for utility operating reserves ranges from 30 days (8.3 percent) to 120 days (33.3 percent) of O&M expenses, with the lower end more appropriate for utilities with stable revenue streams and the higher end more appropriate for utilities with significant seasonal or consumption-based fluctuations. The City's current goal is to maintain a minimum balance in the Operating Fund equal to 150 days of O&M expenses (approximately 41.7 percent). This goal is assumed for this analysis.

Capital Reserve – A capital contingency reserve is an amount of cash set aside in case of an emergency should a piece of equipment or a portion of the utility's infrastructure fail unexpectedly. The reserve also could be used for other unanticipated capital needs, including capital project cost overruns. Industry practices range from maintaining a balance equal to 1.0 to 2.0 percent of fixed assets, an amount equal to a 5-year rolling average of CIP costs, or an amount determined sufficient to fund equipment failure (other than catastrophic failure). The final target level should balance industry practices with the risk level of the City. The City's current goal is to maintain a minimum balance in the Capital Reserve equal to 1.0 percent of fixed assets.

System Reinvestment – System reinvestment funding promotes system integrity through ongoing repair and replacement of system infrastructure. Ideally, a detailed asset management plan would guide the level of rate funded system reinvestment; however, in absence of this level of effort, annual depreciation expense is commonly used as a measure of the decline in asset value associated with routine use of the system. Particularly for utilities that do not already have an explicit system reinvestment policy in place, implementing a funding level based on full depreciation expense could significantly impact rates. An alternative benchmark is annual depreciation expense net of debt principal payments on outstanding debt. This approach recognizes that customers are still paying for certain assets through the debt component of their

rate and intends to avoid simultaneously charging customers for an asset and its future replacement. The specific benchmark used to set system reinvestment funding targets is a matter of policy that must balance various objectives, including managing rate impacts, keeping long-term costs down, and promoting "generational equity" (i.e., not excessively burdening current customers with paying for facilities that will serve a larger group of customers in the future).

The City's current policy goal is to annually fund an amount of system reinvestment equal to depreciation less debt principal repayments. In order to mitigate near term rate pressures, the study assumed this target could be gradually phased-in over the 20-year period.

Debt Management – It is prudent to consider policies related to debt management as part of a broader utility financial policy structure. Debt management policies should be evaluated and formalized, including the level of acceptable outstanding debt, debt repayment, bond coverage, and total debt coverage targets. The sewer utility has one outstanding revenue bond, one Public Works Trust Fund loan (PWTF), and one Department of Ecology loan.

Based on the City's existing coverage target, this financial plan targets minimum revenue bond coverage of 1.50. Targeting a higher than required coverage factor helps the City maintain its credit rating and may provide lower interest.

Financial Forecast

The financial forecast is primarily based upon the City's budgets for 2025 and 2026 and takes into consideration other key factors and assumptions needed to develop a complete portrait of the City's annual sewer utility financial obligations. The following is a list of the key revenue and expense factors and assumptions used to develop the financial forecast.

- **Growth** – Rate revenue is escalated utilizing future growth assumptions provided by the City, ranging from 0.3 to 7.5 percent annually based on the forecasted sewer flow projections and near term new home construction planned in the City. A uniform 2.4 percent average annual growth rate was used starting in 2031.
- **Revenue** – The City has two general revenue sources: 1) sewer service charges (rate revenue); and 2) miscellaneous (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. For the purpose of this financial forecast, rate revenues are tied to actual customer statistics for 2021 and 2022 and are forecasted to increase with growth starting in 2023. Non-rate revenues are forecast to increase with general cost inflation or growth with the exception of interest earnings which are calculated based on projected balances and assumed investment rates.
- **Plant Investment Fees Revenue** – Plant investment fees are held consistent for all years of this analysis. The analysis assumes the 2025 adopted charges of $7,719 per MCE are applied to the projected new connections to forecast the future revenue. Notable increases in additional MCEs are expected in 2025 onwards. Plant investment fee revenues are forecast to generate an average of approximately $540,000 annually from 2025 through 2034. This equates to an average of 93 new MCEs per year. Plant investment fee revenue is directed towards annual capital needs.

- **Expenses** – O&M expense projections are based on the City's 2025 and 2026 budgets with general cost inflation increases of 3.0 percent, labor cost inflation of 4.0 percent and benefit cost inflation increases of 6.0 percent per year thereafter.
- **Taxes** – Taxes are calculated based on forecasted revenues and prevailing tax rates. Taxes are assessed utilizing a 3.852 percent state excise tax rate applicable to the collection share of rate revenue, approximately 20.2 percent, and 1.75 percent business and occupation tax rate applicable to the treatment and transmission share of rate revenue, approximately 79.8 percent, non-rate revenues and plant investment fees revenues. In addition, the City assesses a utility tax on the wastewater rate revenues of 6.0 percent.
- **Existing Debt** – The wastewater utility has three outstanding debt issues: one revenue bond, one PWTF loan, and one Department of Ecology loan. Total annual existing debt service obligations begin 2025 at $371,000, decreasing to $150,000 by 2034 as both loans are repaid.
- **Future Debt** – The capital financial strategy developed for this GSP forecasts the need for $36.4M in new debt proceeds in four separate instances throughout the 10-year forecast period. Based on discussion with the City, the analysis assumes one of the new debt issuances will utilize low interest loan financing. The remaining debt issuances will be through revenue bond financing. New annual debt service obligations are forecasted to begin in 2025 at $205,000, increasing to $2.4M by 2034.
- **Transfers to Capital** – Operating fund balance above the minimum requirement is assumed to be available to fund capital projects and projected to be transferred to the Capital Fund each year, if needed. In total, the utility is forecast to fund $8.9M in capital projects from excess operating fund cash within the 10-year forecast period.

Although the financial plan is completed through 2044, the rate strategy focuses on the shorter-term planning period of 2025 through 2034. It is recommended that the City revisit the proposed rates every 3 to 4 years to ensure that the rate projections developed remain adequate. Any significant changes should be incorporated into the financial plan and future rates should be adjusted as needed.

Table 11-5 provides a summary of the annual revenue requirements based on the forecast of revenues, expenditures, fund balances, and fiscal policies.

Table 11-5

Budget Year and 10-Year Financial Forecast

Revenue Requirement	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenues										
Rate Revenues Under Existing Rates	$ 3,691,481	$ 4,006,886	$ 4,183,877	$ 4,411,939	$ 4,635,085	$ 4,716,067	$ 4,829,776	$ 4,946,226	$ 5,065,485	$ 5,187,619
Non-Rate Revenues	54,948	91,948	51,124	53,959	56,744	58,286	59,947	61,809	63,635	65,521
Total Revenues	**$ 3,746,429**	**$ 4,098,833**	**$ 4,235,002**	**$ 4,465,897**	**$ 4,691,829**	**$ 4,774,353**	**$ 4,889,722**	**$ 5,008,035**	**$ 5,129,120**	**$ 5,253,139**
Expenses										
Cash Operating Expenses	$ 2,741,619	$ 2,800,858	$ 2,923,604	$ 3,037,397	$ 3,140,462	$ 3,246,799	$ 3,375,116	$ 3,496,749	$ 3,623,252	$ 3,754,840
Existing Debt Service	370,681	356,666	239,580	241,230	239,800	240,900	241,670	151,360	150,728	150,013
New Debt Service	205,189	423,258	423,258	1,591,134	1,686,694	1,931,062	2,442,837	2,442,837	2,442,837	2,442,837
Total Expenses	**$ 3,317,489**	**$ 3,580,781**	**$ 3,586,441**	**$ 4,869,761**	**$ 5,066,956**	**$ 5,418,760**	**$ 6,059,623**	**$ 6,090,946**	**$ 6,216,817**	**$ 6,347,690**
Net Surplus (Deficiency)	**$ 428,940**	**$ 518,052**	**$ 648,560**	**$ (403,864)**	**$ (375,127)**	**$ (644,408)**	**$ (1,169,901)**	**$ (1,082,910)**	**$ (1,087,697)**	**$ (1,094,550)**
Annual Rate Adjustment	**0.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**	**6.00%**	**3.00%**	**3.00%**	**3.00%**	**3.00%**
Cumulative Annual Rate Adjustment	**0.00%**	**6.00%**	**12.36%**	**19.10%**	**26.25%**	**33.82%**	**37.84%**	**41.97%**	**46.23%**	**50.62%**
Rate Revenues After Rate Increase	$ 3,691,481	$ 4,227,264	$ 4,678,830	$ 5,229,903	$ 5,824,085	$ 6,281,391	$ 6,641,071	$ 7,005,230	$ 7,389,357	$ 7,794,547
Additional Taxes from Rate Increase	-	4,791	10,760	17,783	25,849	34,030	39,378	44,763	50,521	56,675
Net Cash Flow After Rate Increase	**$ 428,940**	**$ 733,640**	**$ 1,132,753**	**$ 396,318**	**$ 788,025**	**$ 886,887**	**$ 602,017**	**$ 931,330**	**$ 1,185,654**	**$ 1,455,703**
Coverage After Rate Increases	7.50	4.31	5.40	1.97	2.05	1.55	1.59	1.75	1.87	1.99

The financial forecast indicates that at existing rate levels the utility will become deficient in 2028 by approximately $0.4M as growth in expenses outpaces growth in revenues and new debt is issued to meet capital needs. The deficiency is projected to increase up to approximately $1.1M by 2031 as the utility begins to incur additional new debt to help fund the capital improvement plan and keep up with inflationary pressures from operating and maintenance expenses. To address the deficiencies and identified capital program, a 6.00 percent annual rate increase is projected through 2030. Thereafter, annual inflationary increases of 3.00 percent are projected each year. The higher increases starting in 2026 may be conservative utilizing revenue bond financing, assuming no external funding sources such as grants or low interest loans will be available. Historically, the City has been successful in acquiring a combination of grants and low interest loans and should revisit the rate strategy as better information becomes available.

City Funds and Reserves

Table 11-6 shows a summary of the projected Operating Fund and Capital Fund ending balances through 2034 based on the rate forecasts presented above. The Operating Fund is maintained at a minimum of 150 days, or 41.7 percent, of O&M expenses, and the Capital Fund balance continues to meet or exceed the minimum target of 1.0 percent of fixed assets in every year of the forecast.

Table 11-6

Ending Cash Balance Summary

Ending Fund Balances	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Operating Fund	$ 1,140,758	$ 1,165,144	$ 1,216,205	$ 1,263,510	$ 1,306,347	$ 1,350,618	$ 1,404,032	$ 1,454,659	$ 1,507,314	$ 1,562,087
Capital Fund	2,018,202	4,740,289	635,478	11,746,008	898,802	1,068,077	1,745,126	3,314,345	4,946,479	6,879,584
Total	**$ 3,158,961**	**$ 5,905,433**	**$ 1,851,682**	**$ 13,009,518**	**$ 2,205,149**	**$ 2,418,695**	**$ 3,149,158**	**$ 4,769,004**	**$ 6,453,793**	**$ 8,441,670**
Combined Target	*$ 1,633,394*	*$ 1,687,640*	*$ 1,834,866*	*$ 2,026,742*	*$ 2,201,913*	*$ 2,323,754*	*$ 2,391,807*	*$ 2,452,158*	*$ 2,510,339*	*$ 2,570,880*

CURRENT AND PROJECTED RATES

Current Rates

The existing wastewater rates consists of a monthly fixed charge and a commodity charge per hundred cubic feet (ccf) billed to customers on a bi-monthly basis. Fixed charges vary by class of service and apply on a per account basis, with the exception of duplex, multi-family, and nursing home/child care accounts, where the charges apply on a per unit basis. Commodity charges also vary by class of service, increasing with the assumed higher concentration of influent for larger commercial classes of service. The commodity charge is only assessed if a customer exceeds their monthly allowance of 6 ccf. A low income senior and low income disabled citizen discount of 70.0 percent is available. Inactive customers pay a rate that is 50.0 percent of the regular City rate based on class of service.

Table 11-7 provides the existing wastewater rate schedule.

Table 11-7

Existing Schedule of Rates

Base Charge (per acc. per month)	2025
Residential	
Individually Metered	$ 62.51
Master Metered (per unit)	62.51
Commercial	
Light Commercial	$ 62.51
Heavy Commercial	71.05
General Industrial	79.61
Commodity Charge (per ccf)	**2025**
Residential	
Individually Metered	$ 8.73
Master Metered	8.73
Commercial	
Light Commercial	$ 8.73
Heavy Commercial	10.16
General Industrial	11.58

Notes:

1. A 50% reduction applies to inactive customers

2. Nursing homes / child care accounts are billed per unit

3. Commodity charge applies to all usage above 6ccf per month

Projected Rates

The financial forecast discussed above indicates the need for annual rate adjustments in order to satisfy all forecasted financial obligations. The forecast projects 6.00 percent annual increases through 2030. Additional annual inflationary increases are forecasted from 2031 onwards. **Table 11-8** shows the projected rates with increases applied uniformly to the wastewater fixed and commodity charges for all classes of service, where applicable.

Table 11-8

Proposed Schedule of Rates

Base Charge (per acc. per month)	Existing	2026	2027	2028	2029	2030	2031	2032	2033	2034
Residential										
Individually Metered	$ 62.51	$ 66.26	$ 70.24	$ 74.45	$ 78.92	$ 83.66	$ 86.17	$ 88.76	$ 91.42	$ 94.16
Master Metered (per unit)	62.51	66.26	70.24	74.45	78.92	83.66	86.17	88.76	91.42	94.16
Commercial										
Light Commercial	$ 62.51	$ 66.26	$ 70.24	$ 74.45	$ 78.92	$ 83.66	$ 86.17	$ 88.76	$ 91.42	$ 94.16
Heavy Commercial	71.05	75.31	79.83	84.62	89.70	95.08	97.93	100.87	103.90	107.02
General Industrial	79.61	84.39	89.45	94.82	100.51	106.54	109.74	113.03	116.42	119.91
Commodity Charge (per ccf)	**Existing**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**
Residential										
Individually Metered	$ 8.73	$ 9.25	$ 9.81	$ 10.40	$ 11.02	$ 11.68	$ 12.03	$ 12.39	$ 12.76	$ 13.14
Master Metered	8.73	9.25	9.81	10.40	11.02	11.68	12.03	12.39	12.76	13.14
Commercial										
Light Commercial	$ 8.73	$ 9.25	$ 9.81	$ 10.40	$ 11.02	$ 11.68	$ 12.03	$ 12.39	$ 12.76	$ 13.14
Heavy Commercial	10.16	10.77	11.42	12.11	12.84	13.61	14.02	14.44	14.87	15.32
General Industrial	11.58	12.27	13.01	13.79	14.62	15.50	15.97	16.45	16.94	17.45

Notes *:*

1. A 50% reduction applies to inactive customers

2. Nursing homes / child care accounts are billed per unit

3. Commodity charge applies to all usage above 6ccf per month

AFFORDABILITY

The Washington State Department of Health and the Department of Commerce Public Works Board use an affordability index to prioritize low cost loan awards depending on whether rates exceed 2.50 percent of the median household income for the service area. The average median household income for the City was $87,477 between 2019 and 2023, expressed in 2023 dollars, according to the U.S. Census Bureau. The 2023 value is escalated based on the actual rate of inflation in 2024 of 3.55 percent, based on the Consumer Price Index All Urban Consumers for the Seattle/Tacoma/Bellevue area, and an assumed 3.00 percent annual inflation rate thereafter**.** **Table 11-9** presents the City's monthly wastewater bill projected to 2034 and tested against the 2.50 percent monthly affordability threshold.

Table 11-9

Community Affordability Test

Year	Inflation	Median HH Income	2.5% Monthly Threshold	Projected Monthly Bill	% of Median HH Income
2023		$ 87,477	$ 182.24	$ 57.83	0.79%
2024	3.55%	90,579	188.71	59.11	0.78%
2025	3.00%	93,297	194.37	62.51	0.80%
2026	3.00%	96,096	200.20	62.66	0.78%
2027	3.00%	98,978	206.21	66.42	0.81%
2028	3.00%	101,948	212.39	70.41	0.83%
2029	3.00%	105,006	218.76	74.63	0.85%
2030	3.00%	108,156	225.33	79.11	0.88%
2031	3.00%	111,401	232.09	81.48	0.88%
2032	3.00%	114,743	239.05	83.92	0.88%
2033	3.00%	118,185	246.22	86.44	0.88%
2034	3.00%	121,731	253.61	89.03	0.88%

Note *:*

1. Assumes 6ccf of monthly usage

Applying the 2.50 percent monthly affordability test, the City's rates are forecasted to remain within the indicated affordability range through 2034.

CONCLUSION

The results of this analysis indicate that, at existing rate levels, the utility will enter an operating deficiency beginning in 2028. The forecast projects 6.00 percent annual rate increases through 2030. In order to address the remaining projected deficiencies, an annual inflationary increase is projected from 2031 onwards. The higher increases starting in 2026 may be conservative utilizing revenue bond financing, assuming no external funding sources such as grants or low interest loans will be available. Historically, the City has been successful in acquiring a combination of grants and low interest loans and should revisit the rate strategy as better information becomes available. It is recommended that the City regularly review and update the key underlying assumptions that compose the multi-year financial plan to ensure that adequate revenues are collected to meet the City's total financial obligations.

Appendix A
Wastewater Permits

Issuance Date: September 23, 2016
Effective Date: November 1, 2016
Expiration Date: October 31, 2021

National Pollutant Discharge Elimination System
Waste Discharge Permit No. WA0020290

State of Washington
DEPARTMENT OF ECOLOGY
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1342 et seq.

CITY OF STANWOOD WASTEWATER TREATMENT PLANT
10220 270th Street NW
Stanwood, WA 98292

is authorized to discharge in accordance with the Special and General Conditions that follow.

Plant Location: 26279 98th Avenue NW Stanwood, WA 98292	Receiving Water: Old Stillaguamish River
Treatment Type: Oxidation Ditch (Extended Aeration) – Activated Sludge System	

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Washington State Department of Ecology

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Summary of Permit Report Submittals

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	First Submittal Date
S3.A	Discharge Monitoring Report (DMR)	Monthly	December 15, 2016
S3.A	Discharge Monitoring Report (DMR)	Quarterly	April 15, 2017 (Nutrients and cyanide)
S3.A	Discharge Monitoring Report (DMR)	Annual	January 15, 2018
S3.F	Reporting Permit Violations	As necessary	
S4.B	Plans for Maintaining Adequate Capacity	As necessary	
S4.D	Notification of New or Altered Sources	As necessary	
S4.E	Infiltration and Inflow Evaluation	1/permit cycle	January 31, 2019
S5.F	Bypass Notification	As necessary	
S5.G	Operations and Maintenance Manual Update or a Review Confirmation Letter	1/permit cycle	April 30, 2018
S6.E	Industrial User Survey	1/permit cycle	April 30, 2021
S8	Outfall Evaluation	1/permit cycle	April 30, 2021
S9	Acute Toxicity: Compliance Testing and Monitoring Reports Submittal	2/permit cycle	April 30, 2021
S10	Chronic Toxicity: Compliance Testing and Monitoring Reports Submittal	2/permit cycle	April 30, 2021
S11	Application for Permit Renewal	1/permit cycle	April 30, 2021
G1	Notice of Change in Authorization	As necessary	
G4	Reporting Planned Changes	As necessary	
G5	Engineering Report for Construction or Modification Activities	As necessary	
G7	Notice of Permit Transfer	As necessary	
G10	Duty to Provide Information	As necessary	
G20	Compliance Schedules	As necessary	
G21	Contract Submittal	As necessary	

Special Conditions

S1. Discharge limits

S1.A. Effluent limits

All discharges and activities authorized by this permit must comply with the terms and conditions of this permit. The discharge of any of the following pollutants more frequently than, or at a level in excess of, that identified and authorized by this permit violates the terms and conditions of this permit.

Beginning on the effective date of this permit, the Permittee may discharge treated domestic wastewater to the Old Stillaguamish River at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall 001 Latitude: 48.235781° Longitude: -122.357501°		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Biochemical Oxygen Demand (5-day) (BOD_5)	30 milligrams/liter (mg/L) 376 pounds/day (lbs/day) 85% removal of influent BOD_5	45 mg/L 563 lbs/day
Total Suspended Solids (TSS)	30 mg/L 376 lbs/day 85% removal of influent TSS	45 mg/L 563 lbs/day
Parameter	**Daily Minimum**	**Daily Maximum**
pH [c]	6.0 standard units	9.0 standard units
Parameter	**Monthly Geometric Mean**	**Weekly Geometric Mean**
Fecal Coliform Bacteria [d]	200/100 milliliter (mL)	400/100 mL

[a]	Average monthly effluent limit means the highest allowable average of daily discharges over a calendar month. To calculate the discharge value to compare to the limit, you add the value of each daily discharge measured during a calendar month and divide this sum by the total number of daily discharges measured. See footnote c for fecal coliform calculations.
[b]	Average weekly discharge limit means the highest allowable average of daily discharges over a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges' measured during that week. See footnote c for fecal coliform calculations.
[c]	Indicates the range of permitted values. Do not average pH values.
[d]	Ecology provides directions to calculate the monthly and the weekly geometric mean in publication No. 04-10-020, Information Manual for Treatment Plant Operators available at: http://www.ecy.wa.gov/pubs/0410020.pdf

S1.B. Mixing zone authorization

Mixing zone for Outfall 001

The following paragraphs define the maximum boundaries of the mixing zones. Figure 1 illustrates the approximate relationship and sizes of the chronic and acute mixing zones around the diffuser:

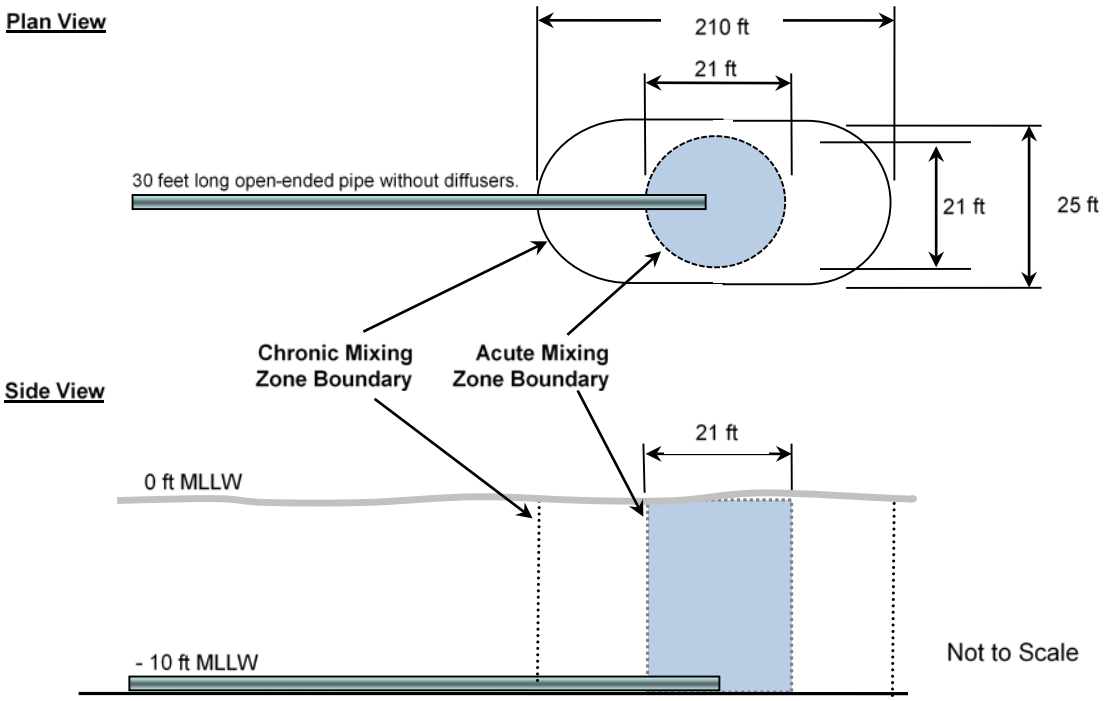

Figure 1. Outfall Mixing Zones

Chronic mixing zone

The allowable chronic mixing zone is 210 feet (64 meters) by 25 feet (7.62 meters). The mixing zone extends from the bottom to the top of the water column. The concentration of pollutants at the edge of the chronic zone must meet chronic aquatic life criteria and human health criteria.

Acute mixing zone

The acute mixing zone is a circle with radius of 10.5 feet (3.2 meters) measured from the center of the discharge port. The mixing zone extends from the bottom to the top of the water column. The concentration of pollutants at the edge of the acute zone must meet acute aquatic life criteria.

Available Dilution (dilution factor)	
Acute Aquatic Life Criteria	8
Chronic Aquatic Life Criteria	36
Human Health Criteria - Carcinogen	36
Human Health Criteria - Non-carcinogen	36

S2. Monitoring requirements

S2.A. Monitoring schedule

The Permittee must monitor in accordance with the following schedule and the requirements specified in Appendix A.

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
(1) Wastewater influent			
Wastewater Influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant.			
Flow	MGD	Continuous [a]	Metered/recorded
BOD_5	mg/L	2/week	24-hr composite [b]
BOD_5	lbs/day	2/week	Calculated [c]
TSS	mg/L	2/week	24-hr composite
TSS	lbs/day	2/week	Calculated
(2) Final wastewater effluent			
Final Wastewater Effluent means wastewater exiting the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process. The Permittee may take effluent samples for the BOD_5 analysis before or after the disinfection process. If taken after, the Permittee must dechlorinate and reseed the sample.			
Flow	MGD	Continuous	Metered/recorded
BOD_5	mg/L	2/week	24-hr composite
BOD_5	lbs/day	2/week	Calculated
BOD_5	% removal [d]	1/month	Calculated
TSS	mg/L	2/week	24-hr composite
TSS	lbs/day	2/week	Calculated
TSS	% removal	1/month	Calculated
Fecal Coliform [e]	# /100 mL	2/week	Grab [f]
pH [g]	Standard Units	Daily	Grab
(3) Whole effluent toxicity testing – final wastewater effluent			
Acute Toxicity Testing	See condition S9 for testing requirements	January 2020 and July 2020	24-hr composite
Chronic Toxicity Testing	See condition S10 for testing requirements	January 2020 and July 2020	24-hr composite
Additional requirements specified in Special Condition S9 and S10.			
(4) Effluent characterization – final wastewater effluent			
Total Ammonia	mg/L as N	Quarterly [h]	24-hr composite
Nitrate + Nitrite Nitrogen	mg/L as N	Quarterly	24-hr composite
Total Kjeldahl Nitrogen (TKN)	mg/L as N	Quarterly	24-hr composite
Total Phosphorus	mg/L as P	Quarterly	24-hr composite
Soluble Reactive Phosphorus	mg/L as P	Quarterly	24-hr composite
Cyanide	micrograms/liter (µg/L)	Quarterly	Grab
(5) Permit renewal application requirements – final wastewater effluent			
The Permittee must record and report the wastewater treatment plant flow discharged on the day it collects the sample for priority pollutant testing with the discharge monitoring report.			
Temperature	Degrees Celsius (°C)	1/Year in July [i]	Measurement
Dissolved Oxygen	mg/L	Once per year	Grab

Parameter	Units & Speciation	Minimum Sampling Frequency	Sample Type
Oil and Grease	mg/L	Once per year	Grab
Total Dissolved Solids	mg/L	Once per year	Grab
Total Hardness	mg/L	Once per year	Grab
Total Phenolic Compounds	µg/L	Once per year	Grab
Priority Pollutants (PP) – Total Metals	µg/L; nanograms(ng/L) for mercury	Once per year	24-hr composite Grab for mercury
PP – Volatile Organic Compounds	µg/L	Once per year	Grab
PP – Acid-extractable Compounds	µg/L	Once per year	24-hr composite
PP – Base-neutral Compounds	µg/L	Once per year	24-hr composite

a	Continuous means uninterrupted except for brief lengths of time for calibration, power failure, or unanticipated equipment repair or maintenance. The time interval for the associated data logger must be no greater than 30 minutes.
b	24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
c	Calculated means figured concurrently with the respective sample, using the following formula: Concentration (in mg/L) X Flow (in MGD) X Conversion Factor (8.34) = lbs/day
d	% removal = $\frac{\text{Influent concentration (mg/L)} - \text{Effluent concentration (mg/L)}}{\text{Influent concentration (mg/L)}} \times 100$ Calculate the percent (%) removal of BOD_5 and TSS using the above equation.
e	Report a numerical value for fecal coliforms following the procedures in Ecology's *Information Manual for Wastewater Treatment Plant Operators*, Publication Number 04-10-020 available at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html . Do not report a result as too numerous to count (TNTC).
f	Grab means an individual sample collected over a fifteen (15) minute, or less, period.
g	Report the daily pH and the minimum and maximum for the monitoring period.
h	Quarterly sampling periods are January through March, April through June, July through September, and October through December. The Permittee must begin quarterly monitoring for the quarter beginning on 1/1/2017 and submit results by 4/15/2017. The Permittee must begin priority pollutants monitoring for the quarter beginning on 7/1/2017 and submit results by 10/15/2017.
i	Temperature grab sampling must occur when the effluent is at or near its daily maximum temperature, which usually occurs in the late afternoon.

S2.B. Sampling and analytical procedures

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters. The Permittee must conduct representative sampling of any unusual discharge or discharge condition, including bypasses, upsets, and maintenance-related conditions that may affect effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 (or as applicable in 40 CFR subchapters N [Parts 400–471] or O [Parts 501-503]) unless otherwise specified in this permit . Ecology may only specify alternative methods for parameters without permit limits and for those parameters without an EPA approved test method in 40 CFR Part 136.

S2.C. Flow measurement, field measurement, and continuous monitoring devices

The Permittee must:

1. Select and use appropriate flow measurement, field measurement, and continuous monitoring devices and methods consistent with accepted scientific practices.
2. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard, the manufacturer's recommendation, and approved O&M manual procedures for the device and the wastestream.
3. Calibrate continuous monitoring instruments weekly unless it can demonstrate a longer period is sufficient based on monitoring records. The Permittee:
    a. May calibrate apparatus for continuous monitoring of dissolved oxygen by air calibration.
    b. Must calibrate continuous pH measurement instruments using a grab sample analyzed in the lab with a pH meter calibrated with standard buffers and analyzed within 15 minutes of sampling.
4. Use field measurement devices as directed by the manufacturer and do not use reagents beyond their expiration dates.
5. Establish a calibration frequency for each device or instrument in the O&M manual that conforms to the frequency recommended by the manufacturer.
6. Calibrate flow-monitoring devices at a minimum frequency of at least one calibration per year.
7. Maintain calibration records for at least three years.

S2.D. Laboratory accreditation

The Permittee must ensure that all monitoring data required by Ecology for permit specified parameters is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories*. Flow, temperature, settleable solids, conductivity, pH, and internal process control parameters are exempt from this requirement. The Permittee must obtain accreditation for conductivity and pH if it must receive accreditation or registration for other parameters.

S3. Reporting and recording requirements

The Permittee must monitor and report in accordance with the following conditions. Falsification of information submitted to Ecology is a violation of the terms and conditions of this permit.

S3.A. Discharge monitoring reports

The first monitoring period begins on the effective date of the permit (unless otherwise specified). The Permittee must:

1. Summarize, report, and submit monitoring data obtained during each monitoring period on the electronic discharge monitoring report (DMR) form provided by Ecology within the Water Quality Permitting Portal. Include data for each of the parameters tabulated in Special Condition S2 and as required by the form. Report a value for each day sampling occurred (unless specifically exempted in the permit) and for the summary values (when applicable) included on the electronic form.

2. Enter the "No Discharge" reporting code for an entire DMR, for a specific monitoring point, or for a specific parameter as appropriate, if the Permittee did not discharge wastewater or a specific pollutant during a given monitoring period.

3. Report single analytical values below detection as "less than the detection level (DL)" by entering < followed by the numeric value of the detection level (e.g. < 2.0) on the DMR. If the method used did not meet the minimum DL and quantitation level (QL) identified in the permit, report the actual QL and DL in the comments or in the location provided.

4. **Not** report zero for bacteria monitoring. Report as required by the laboratory method.

5. Calculate and report an arithmetic average value for each day for bacteria if multiple samples were taken in one day.

6. Calculate the geometric mean values for bacteria (unless otherwise specified in the permit) using:

    a. The reported numeric value for all bacteria samples measured above the detection value except when it took multiple samples in one day. If the Permittee takes multiple samples in one day it must use the arithmetic average for the day in the geometric mean calculation.

    b. The detection value for those samples measured below detection.

7. Report the test method used for analysis in the comments if the laboratory used an alternative method not specified in the permit and as allowed in Appendix A.

8. Calculate average values and calculated total values (unless otherwise specified in the permit) using:

    a. The reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value.

    b. One-half the detection value (for values reported below detection) if the lab detected the parameter in another sample from the same monitoring point for the reporting period.

    c. Zero (for values reported below detection) if the lab did not detect the parameter in another sample for the reporting period.

9. Report single-sample grouped parameters (for example priority pollutants, PAHs, pulp and paper chlorophenolics, TTOs) on the WQWebDMR form and include: sample date, concentration detected, detection limit (DL) (as necessary), and laboratory quantitation level (QL) (as necessary). The Permittee must also submit an electronic PDF copy of the laboratory report using WQWebDMR.

   The contract laboratory reports must also include information on the chain of custody, QA/QC results, and documentation of accreditation for the parameter.

10. Ensure that DMRs are electronically submitted no later than the dates specified below, unless otherwise specified in this permit.

11. Submit DMRs for parameters with the monitoring frequencies specified in S2 (monthly, quarterly, annual, etc.) at the reporting schedule identified below. The Permittee must:

    a. Submit **monthly** DMRs by the 15th day of the following month. The first submittal is December 15, 2016.

    b. Submit **quarterly DMRs,** unless otherwise specified in the permit, by the 15th day of the month following the monitoring period. Quarterly sampling periods are January through March, April through June, July through September, and October through December. The Permittee must submit the first quarterly DMR on April 15, 2017 for the quarter beginning on January 1, 2017.

    c. Submit **annual DMRs**, unless otherwise specified in the permit, by January 15 for the previous calendar year. The annual sampling period is the calendar year. The Permittee must submit the first annual DMR on January 15, 2018, for the 2017 calendar year.

    d. Submit permit renewal application monitoring data required in Special Condition S2.A(4)) annually in WQWebDMR by January 15th of the year following the monitoring period.

S3.B. Permit submittals and schedules

The Permittee must use the Water Quality Permitting Portal – Permit Submittals application (unless otherwise specified in the permit) to submit all other written permit-required reports by the date specified in the permit.

When another permit condition requires submittal of a paper (hard-copy) report, the Permittee must ensure that it is postmarked or received by Ecology no later than the dates specified by this permit. Send these paper reports to Ecology at:

Water Quality Permit Coordinator
Department of Ecology
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

S3.C. Records retention

The Permittee must retain records of all monitoring information for a minimum of three (3) years. Such information must include all calibration and maintenance records and all original recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit. The Permittee must extend this period of retention during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

S3.D. Recording of results

For each measurement or sample taken, the Permittee must record the following information:

1. The date, exact place, method, and time of sampling or measurement.
2. The individual who performed the sampling or measurement.
3. The dates the analyses were performed.
4. The individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

S3.E. Additional monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by Special Condition S2 of this permit, then the Permittee must include the results of such monitoring in the calculation and reporting of the data submitted in the Permittee's DMR unless otherwise specified by Special Condition S2.

S3.F. Reporting permit violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

1. Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem.
2. If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

a. Immediate reporting

The Permittee must **immediately** report to Ecology and the Department of Health, Shellfish Program, and the Snohomish Health District (at the numbers listed below), all:

- Failures of the disinfection system.
- Collection system overflows.
- Plant bypasses discharging to marine surface waters.
- Any other failures of the sewage system (pipe breaks, etc.)

Northwest Regional Office	425-649-7000
Department of Health, Shellfish Program	360-236-3330 (business hours) 360-789-8962 (after business hours)
Snohomish Health District	425-339-5250 (business hours) 425-339-5295 (after business hours)

b. Twenty-four-hour reporting

The Permittee must report the following occurrences of noncompliance by telephone, to Ecology at the telephone numbers listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

1. Any noncompliance that may endanger health or the environment, unless previously reported under immediate reporting requirements.
2. Any unanticipated bypass that causes an exceedance of an effluent limit in the permit (See Part S5.F, "Bypass Procedures").
3. Any upset that causes an exceedance of an effluent limit in the permit (See G.15, "Upset").
4. Any violation of a maximum daily or instantaneous maximum discharge limit for any of the pollutants in Section S1.A of this permit.
5. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limit in the permit.

c. Report within five days

The Permittee must also submit a written report within five days of the time that the Permittee becomes aware of any reportable event under subparts a or b, above. The report must contain:

1. A description of the noncompliance and its cause.
2. The period of noncompliance, including exact dates and times.
3. The estimated time the Permittee expects the noncompliance to continue if not yet corrected.
4. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.
5. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

d. Waiver of written reports

Ecology may waive the written report required in subpart c, above, on a case-by-case basis upon request if the Permittee has submitted a timely oral report.

e. All other permit violation reporting

The Permittee must report all permit violations, which do not require immediate or within 24 hours reporting, when it submits monitoring reports for S3.A ("Reporting"). The reports must contain the information listed in subpart c, above. Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply.

S3.G. Other reporting

a. Spills of oil or hazardous materials

The Permittee must report a spill of oil or hazardous materials in accordance with the requirements of RCW 90.56.280 and chapter 173-303-145. You can obtain further instructions at the following website: http://www.ecy.wa.gov/programs/spills/other/reportaspill.htm .

b. Failure to submit relevant or correct facts

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application, or in any report to Ecology, it must submit such facts or information promptly.

S3.H. Maintaining a copy of this permit

The Permittee must keep a copy of this permit at the facility and make it available upon request to Ecology inspectors.

S4. Facility loading

S4.A. Design criteria

The flows or waste loads for the permitted facility must not exceed the following design criteria:

Maximum Month Design Flow (MMDF)	1.5 MGD
BOD_5 Influent Loading for Maximum Month	4,100 lb/day
TSS Influent Loading for Maximum Month	4,100 lb/day

S4.B. Plans for maintaining adequate capacity

a. Conditions triggering plan submittal

The Permittee must submit a plan and a schedule for continuing to maintain capacity to Ecology when:

1. The actual flow or waste load reaches 85 percent of any one of the design criteria in S4.A for three consecutive months.
2. The projected plant flow or loading would reach design capacity within five years.

b. Plan and schedule content

The plan and schedule must identify the actions necessary to maintain adequate capacity for the expected population growth and to meet the limits and requirements of the permit. The Permittee must consider the following topics and actions in its plan.

1. Analysis of the present design and proposed process modifications
2. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system
3. Limits on future sewer extensions or connections or additional waste loads
4. Modification or expansion of facilities
5. Reduction of industrial or commercial flows or waste loads

Engineering documents associated with the plan must meet the requirements of WAC 173-240-060, "Engineering Report," and be approved by Ecology prior to any construction.

S4.C. Duty to mitigate

The Permittee must take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

S4.D. Notification of new or altered sources

1. The Permittee must submit written notice to Ecology whenever any new discharge or a substantial change in volume or character of an existing discharge into the wastewater treatment plant is proposed which:
   a. Would interfere with the operation of, or exceed the design capacity of, any portion of the wastewater treatment plant.
   b. Is not part of an approved general sewer plan or approved plans and specifications.
   c. Is subject to pretreatment standards under 40 CFR Part 403 and Section 307(b) of the Clean Water Act.
2. This notice must include an evaluation of the wastewater treatment plant's ability to adequately transport and treat the added flow and/or waste load, the quality and volume of effluent to be discharged to the treatment plant, and the anticipated impact on the Permittee's effluent [40 CFR 122.42(b)].

S4.E. Infiltration and inflow evaluation

1. The Permittee must conduct an infiltration and inflow evaluation. Refer to the U.S. EPA publication, I/I Analysis and Project Certification, available as Publication No. 97-03 at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html
2. The Permittee may use monitoring records to assess measurable infiltration and inflow.

3. The Permittee must prepare a report summarizing any measurable infiltration and inflow along with the following:
    a. Summary of the I/I analyses and routine inspections conducted in the last five years.
    b. A list of collection system repairs completed in the last five years.
    c. Identification of collection system areas where leaks are known or suspected.
    d. A schedule for conducting collection system inspections to locate leaks not already identified.
    e. A tentative schedule for future collection system repairs.
4. The Permittee must submit a report summarizing the results of the evaluation and any recommendations for corrective actions by January 31, 2019.

S5. Operation and maintenance

The Permittee must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances), which are installed to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes keeping a daily operation logbook (paper or electronic), adequate laboratory controls, and appropriate quality assurance procedures. This provision of the permit requires the Permittee to operate backup or auxiliary facilities or similar systems only when the operation is necessary to achieve compliance with the conditions of this permit.

S5.A. Certified operator

This permitted facility must be operated by an operator certified by the state of Washington for at least a Class III plant. This operator must be in responsible charge of the day-to-day operation of the wastewater treatment plant. An operator certified for at least a Class II plant must be in charge during all regularly scheduled shifts. The Permittee must notify Ecology when the operator in charge at the facility changes. It must provide the new operator's name and certification level and provide the name of the operator leaving the facility.

S5.B. Operation and maintenance program

The Permittee must:

1. Institute an adequate operation and maintenance program for the entire sewage system.
2. Keep maintenance records on all major electrical and mechanical components of the treatment plant, as well as the sewage system and pumping stations. Such records must clearly specify the frequency and type of maintenance recommended by the manufacturer and must show the frequency and type of maintenance performed.
3. Make maintenance records available for inspection at all times.

S5.C. Short-term reduction

The Permittee must schedule any facility maintenance, which might require interruption of wastewater treatment and degrade effluent quality, during non-critical water quality periods and carry this maintenance out according to the approved O&M manual or as otherwise approved by Ecology.

If a Permittee contemplates a reduction in the level of treatment that would cause a violation of permit discharge limits on a short-term basis for any reason, and such reduction cannot be avoided, the Permittee must:

1. Give written notification to Ecology, if possible, thirty (30) days prior to such activities.
2. Detail the reasons for, length of time of, and the potential effects of the reduced level of treatment.

This notification does not relieve the Permittee of its obligations under this permit.

S5.D. Electrical power failure

The Permittee must ensure that adequate safeguards prevent the discharge of untreated wastes or wastes not treated in accordance with the requirements of this permit during electrical power failure at the treatment plant and/or sewage lift stations. Adequate safeguards include, but are not limited to, alternate power sources, standby generator(s), or retention of inadequately treated wastes.

The Permittee must maintain Reliability Class II (EPA 430-99-74-001) at the wastewater treatment plant. Reliability Class II requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions. Vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be operable to full levels of treatment, but must be sufficient to maintain the biota.

S5.E. Prevent connection of inflow

The Permittee must strictly enforce its sewer ordinances and not allow the connection of inflow (roof drains, foundation drains, etc.) to the sanitary sewer system.

S5.F. Bypass procedures

A bypass is the intentional diversion of waste streams from any portion of a treatment facility. This permit prohibits all bypasses except when the bypass is for essential maintenance, as authorized in special condition S5.F.1, or is approved by Ecology as an anticipated bypass following the procedures in S5.F.2.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions

This permit allows bypasses for essential maintenance of the treatment system when necessary to ensure efficient operation of the system. The Permittee may bypass the treatment system for essential maintenance only if doing so does not cause violations of effluent limits. The Permittee is not required to

notify Ecology when bypassing for essential maintenance. However the Permittee must comply with the monitoring requirements specified in special condition S2.B.

2. Anticipated bypasses for non-essential maintenance

Ecology may approve an anticipated bypass under the conditions listed below. This permit prohibits any anticipated bypass that is not approved through the following process.

a. If a bypass is for non-essential maintenance, the Permittee must notify Ecology, if possible, at least ten (10) days before the planned date of bypass. The notice must contain:

- A description of the bypass and the reason the bypass is necessary.
- An analysis of all known alternatives which would eliminate, reduce, or mitigate the potential impacts from the proposed bypass.
- A cost-effectiveness analysis of alternatives.
- The minimum and maximum duration of bypass under each alternative.
- A recommendation as to the preferred alternative for conducting the bypass.
- The projected date of bypass initiation.
- A statement of compliance with SEPA.
- A request for modification of water quality standards as provided for in WAC 173-201A-410, if an exceedance of any water quality standard is anticipated.
- Details of the steps taken or planned to reduce, eliminate, and prevent recurrence of the bypass.

b. For probable construction bypasses, the Permittee must notify Ecology of the need to bypass as early in the planning process as possible. The Permittee must consider the analysis required above during the project planning and design process. The project-specific engineering report as well as the plans and specifications must include details of probable construction bypasses to the extent practical. In cases where the Permittee determines the probable need to bypass early, the Permittee must continue to analyze conditions up to and including the construction period in an effort to minimize or eliminate the bypass.

c. Ecology will determine if the Permittee has met the conditions of special condition S5.F.2 a and b and consider the following prior to issuing a determination letter, an administrative order, or a permit modification as appropriate for an anticipated bypass:

- If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.

- If the bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.
- If feasible alternatives to the bypass exist, such as:
  - The use of auxiliary treatment facilities.
  - Retention of untreated wastes.
  - Stopping production.
  - Maintenance during normal periods of equipment downtime, but not if the Permittee should have installed adequate backup equipment in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance.
  - Transport of untreated wastes to another treatment facility

S5.G. Operations and maintenance (O&M) manual

a. O&M manual submittal and requirements

The Permittee must:

1. Update the operations and maintenance (O&M) manual to meet the requirements of 173-240-080 WAC and submit it to Ecology for approval by April 30, 2018.
2. Submit revised sections of the O&M manual to Ecology for review and approval whenever the permittee significantly changes or upgrades treatment processes or equipment. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).
3. Keep the approved O&M manual at the permitted facility.
4. Follow the instructions and procedures of this manual.

b. O&M manual components

In addition to the requirements of WAC 173-240-080(1) through (5), the O&M manual must be consistent with the guidance in Table G1-3 in the *Criteria for Sewage Works Design* (Orange Book), 2008. The O&M manual must include:

1. Emergency procedures for cleanup in the event of wastewater system upset or failure.
2. A review of system components which if failed could pollute surface water or could impact human health. Provide a procedure for a routine schedule of checking the function of these components.
3. Wastewater system maintenance procedures that contribute to the generation of process wastewater.

4. Reporting protocols for submitting reports to Ecology to comply with the reporting requirements in the discharge permit.
5. Any directions to maintenance staff when cleaning or maintaining other equipment or performing other tasks which are necessary to protect the operation of the wastewater system (for example, defining maximum allowable discharge rate for draining a tank, blocking all floor drains before beginning the overhaul of a stationary engine).
6. The treatment plant process control monitoring schedule.
7. Minimum staffing adequate to operate and maintain the treatment processes and carry out compliance monitoring required by the permit.

S6. Pretreatment

S6.A. General requirements

The Permittee must work with Ecology to ensure that all commercial and industrial users of the publicly owned treatment works (POTW) comply with the pretreatment regulations in 40 CFR Part 403 and any additional regulations that the Environmental Protection Agency (U.S. EPA) may promulgate under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

S6.B. Duty to enforce discharge prohibitions

1. Under federal regulations (40 CFR 403.5(a) and (b)), the Permittee must not authorize or knowingly allow the discharge of any pollutants into its POTW which may be reasonably expected to cause pass through or interference, or which otherwise violate general or specific discharge prohibitions contained in 40 CFR Part 403.5 or WAC 173-216-060.
2. The Permittee must not authorize or knowingly allow the introduction of any of the following into their treatment works:
    a. Pollutants which create a fire or explosion hazard in the POTW (including, but not limited to waste streams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21).
    b. Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, or greater than 11.0 standard units, unless the works are specifically designed to accommodate such discharges.
    c. Solid or viscous pollutants in amounts that could cause obstruction to the flow in sewers or otherwise interfere with the operation of the POTW.
    d. Any pollutant, including oxygen-demanding pollutants, (BOD_5, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the POTW.
    e. Petroleum oil, non-biodegradable cutting oil, or products of mineral origin in amounts that will cause interference or pass through.

f. Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity which may cause acute worker health and safety problems.

g. Heat in amounts that will inhibit biological activity in the POTW resulting in interference but in no case heat in such quantities such that the temperature at the POTW headworks exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless Ecology, upon request of the Permittee, approves, in writing, alternate temperature limits.

h. Any trucked or hauled pollutants, except at discharge points designated by the Permittee.

i. Wastewaters prohibited to be discharged to the POTW by the Dangerous Waste Regulations (chapter 173-303 WAC), unless authorized under the Domestic Sewage Exclusion (WAC 173-303-071).

3. The Permittee must also not allow the following discharges to the POTW unless approved in writing by Ecology:

   a. Noncontact cooling water in significant volumes.

   b. Stormwater and other direct inflow sources.

   c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment, or would not be afforded a significant degree of treatment by the system.

4. The Permittee must notify Ecology if any industrial user violates the prohibitions listed in this section (S6.B), and initiate enforcement action to promptly curtail any such discharge.

S6.C. Wastewater discharge permit required

The Permittee must:

1. Establish a process for authorizing non-domestic wastewater discharges that ensures all SIUs in all tributary areas meet the applicable state waste discharge permit (SWDP) requirements in accordance with chapter 90.48 RCW and chapter 173-216 WAC.

2. Immediately notify Ecology of any proposed discharge of wastewater from a source, which may be a significant industrial user (SIU) [see fact sheet definitions or refer to 40 CFR 403.3(v)(i)(ii)].

3. Require all SIUs to obtain a SWDP from Ecology prior to accepting their non-domestic wastewater, or require proof that Ecology has determined they do not require a permit.

4. Require the documentation as described in S6.C.3 at the earliest practicable date as a condition of continuing to accept non-domestic wastewater discharges from a previously undiscovered, currently discharging and unpermitted SIU.

5. Require sources of non-domestic wastewater, which do not qualify as SIUs but merit a degree of oversight, to apply for a SWDP and provide it a copy of the application and any Ecology responses.
6. Keep all records documenting that its users have met the requirements of S6.C.

S6.D. Identification and reporting of existing, new, and proposed industrial users

1. The Permittee must take continuous, routine measures to identify all existing, new, and proposed SIUs and potential significant industrial users (PSIUs) discharging or proposing to discharge to the Permittee's sewer system (see *Appendix C* of the fact sheet for definitions).
2. Within 30 days of becoming aware of an unpermitted existing, new, or proposed industrial user who may be a significant industrial user (SIU), the Permittee must notify such user by registered mail that, if classified as an SIU, they must apply to Ecology and obtain a State Waste Discharge Permit. The Permittee must send a copy of this notification letter to Ecology within this same 30-day period.
3. The Permittee must also notify all Potential SIUs (PSIUs), as they are identified, that if their classification should change to an SIU, they must apply to Ecology for a State Waste Discharge Permit within 30 days of such change.

S6.E. Industrial user survey

The Permittee must complete an industrial user survey listing all SIUs and potential significant industrial users (PSIUs) discharging to the POTW. The Permittee must submit the survey to Ecology by April 30, 2021. At a minimum, the Permittee must develop the list of SIUs and PSIUs by means of a telephone book search, a water utility billing records search, and a physical reconnaissance of the service area.

Information on PSIUs must include, at a minimum, the business name, telephone number, address, description of the industrial process(s), and the known wastewater volumes and characteristics. The list must include SIUs and PSIUs located in all areas that contribute flow to the facility covered under this permit, including users connected to collection systems owned and operated by sewer districts or municipalities that have treatment service agreements with the Permittee.

S7. Solid wastes

S7.A. Solid waste handling

The Permittee must handle and dispose of all solid waste material in such a manner as to prevent its entry into state ground or surface water.

S7.B. Leachate

The Permittee must not allow leachate from its solid waste material to enter state waters without providing all known, available, and reasonable methods of treatment, nor allow such leachate to cause violations of the State Surface Water

Quality Standards, Chapter 173-201A WAC, or the State Ground Water Quality Standards, Chapter 173-200 WAC. The Permittee must apply for a permit or permit modification as may be required for such discharges to state ground or surface waters.

S8. Outfall evaluation

The Permittee must inspect the submerged portion of the outfall line to document its integrity and continued function. If conditions allow for a photographic verification, the Permittee must include such verification in the report. If damage is found, the report must include a plan for completing repairs. The Permittee must submit the inspection report to Ecology through the Water Quality Permitting Portal – Permit Submittals application by April 30, 2021. The Permittee must submit hard-copies of any video files to Ecology as required by Permit Condition S3.B. The Portal does not support submittal of video files.

The inspector must, at a minimum:

- Assess the physical condition of the outfall pipe and associated couplings.
- Determine the extent of sediment accumulation in the pipe opening.
- Ensure pipe is free of obstructions and is allowing uniform flow.
- Assess physical condition of the submarine line.
- Assess physical condition of anchors used to secure the submarine line.

S9. Acute toxicity

S9.A. Testing when there is no permit limit for acute toxicity

The Permittee must:

1. Conduct acute toxicity testing on final effluent once in the last summer and once in the last winter prior to submission of the application for permit renewal (April 30, 2021).
2. Conduct acute toxicity testing on a series of at least five concentrations of effluent, including 100% effluent and a control.
3. Use each of the following species and protocols for each acute toxicity test:

Acute Toxicity Tests	Species	Method
Fathead minnow 96-hour static-renewal test	*Pimephales promelas*	EPA-821-R-02-012
Daphnid 48-hour static test	*Ceriodaphnia dubia, Daphnia pulex,* or *Daphnia magna*	EPA-821-R-02-012

4. Submit the results to Ecology with the permit renewal application.

S9.B. Sampling and reporting requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must

contain toxicity data, bench sheets, and reference toxicant results for test methods. In addition, the Permittee must submit toxicity test data in electronic format (CETIS export file preferred) for entry into Ecology's database.

2. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.
3. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
4. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Subsection C and the Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
5. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Section A or pristine natural water of sufficient quality for good control performance.
6. The Permittee must conduct whole effluent toxicity tests on an unmodified sample of final effluent.
7. The Permittee may choose to conduct a full dilution series test during compliance testing in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the acute critical effluent concentration (ACEC). The ACEC equals 12.5% effluent.
8. All whole effluent toxicity tests, effluent screening tests, and rapid screening tests that involve hypothesis testing must comply with the acute statistical power standard of 29% as defined in WAC 173-205-020. If the test does not meet the power standard, the Permittee must repeat the test on a fresh sample with an increased number of replicates to increase the power.

S10. Chronic toxicity

S10.A. Testing when there is no permit limit for chronic toxicity

The Permittee must:

1. Conduct chronic toxicity testing on final effluent once in the last winter and once in the last summer prior to submission of the application for permit renewal (April 30, 2021).

2. Conduct chronic toxicity testing on a series of at least five concentrations of effluent and a control. This series of dilutions must include the acute critical effluent concentration (ACEC). The ACEC equals 12.5% effluent. The series of dilutions should also contain the CCEC of 2.8 % effluent.
3. Compare the ACEC to the control using hypothesis testing at the 0.05 level of significance as described in Appendix H, EPA/600/4-89/001.
4. Submit the results to Ecology with the permit renewal application.
5. Perform chronic toxicity tests with all of the following species and the most recent version of the following protocols:

Saltwater Chronic Test	Species	Method
Topsmelt survival and growth	*Atherinops affinis*	EPA/600/R-95/136
Mysid shrimp survival and growth	*Americamysis bahia* (formerly *Mysidopsis bahia*)	EPA-821-R-02-014

S10.B. Sampling and reporting requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain toxicity data, bench sheets, and reference toxicant results for test methods. In addition, the Permittee must submit toxicity test data in electronic format (CETIS export file preferred) for entry into Ecology's database.
2. The Permittee must collect 24-hour composite effluent samples for toxicity testing. The Permittee must cool the samples to 0 - 6 degrees Celsius during collection and send them to the lab immediately upon completion. The lab must begin the toxicity testing as soon as possible but no later than 36 hours after sampling was completed.
3. The laboratory must conduct water quality measurements on all samples and test solutions for toxicity testing, as specified in the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*.
4. All toxicity tests must meet quality assurance criteria and test conditions specified in the most recent versions of the EPA methods listed in Section C and the Ecology Publication no. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. If Ecology determines any test results to be invalid or anomalous, the Permittee must repeat the testing with freshly collected effluent.
5. The laboratory must use control water and dilution water meeting the requirements of the EPA methods listed in Subsection C or pristine natural water of sufficient quality for good control performance.
6. The Permittee must conduct whole effluent toxicity tests on an unmodified sample of final effluent.

7. The Permittee may choose to conduct a full dilution series test during compliance testing in order to determine dose response. In this case, the series must have a minimum of five effluent concentrations and a control. The series of concentrations must include the CCEC and the ACEC. The CCEC and the ACEC may either substitute for the effluent concentrations that are closest to them in the dilution series or be extra effluent concentrations. The CCEC equals 2.8% effluent. The ACEC equals 12.5% effluent.
8. All whole effluent toxicity tests that involve hypothesis testing must comply with the chronic statistical power standard of 39% as defined in WAC 173-205-020. If the test does not meet the power standard, the Permittee must repeat the test on a fresh sample with an increased number of replicates to increase the power.

S11. Application for permit renewal or modification for facility changes

The Permittee must submit an application for renewal of this permit by April 30, 2021. The Permittee must submit a paper copy and an electronic copy (preferably as a PDF).

The Permittee must also submit a new application or addendum at least one hundred eighty (180) days prior to commencement of discharges, resulting from the activities listed below, which may result in permit violations. These activities include any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility.

General Conditions

G1. Signatory requirements

1. All applications, reports, or information submitted to Ecology must be signed and certified.

   a. In the case of corporations, by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

      - A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation, or

      - The manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long-term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

   b. In the case of a partnership, by a general partner.

   c. In the case of sole proprietorship, by the proprietor.

   d. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

   Applications for permits for domestic wastewater facilities that are either owned or operated by, or under contract to, a public entity shall be submitted by the public entity.

2. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to Ecology.

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph G1.2, above, is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G1.2, above, must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section must make the following certification:

   "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G2. Right of inspection and entry

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

1. To enter upon the premises where a discharge is located or where any records must be kept under the terms and conditions of this permit.
2. To have access to and copy, at reasonable times and at reasonable cost, any records required to be kept under the terms and conditions of this permit.
3. To inspect, at reasonable times, any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.
4. To sample or monitor, at reasonable times, any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G3. Permit actions

This permit may be modified, revoked and reissued, or terminated either at the request of any interested person (including the Permittee) or upon Ecology's initiative. However, the permit may only be modified, revoked and reissued, or terminated for the reasons specified in 40 CFR 122.62, 40 CFR 122.64 or WAC 173-220-150 according to the procedures of 40 CFR 124.5.

1. The following are causes for terminating this permit during its term, or for denying a permit renewal application:
   a. Violation of any permit term or condition.
   b. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.
   c. A material change in quantity or type of waste disposal.
   d. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations and can only be regulated to acceptable levels by permit modification or termination.

e. A change in any condition that requires either a temporary or permanent reduction, or elimination of any discharge or sludge use or disposal practice controlled by the permit.

f. Nonpayment of fees assessed pursuant to RCW 90.48.465.

g. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

2. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

a. A material change in the condition of the waters of the state.

b. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

c. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

d. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

e. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

f. Ecology has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

g. Incorporation of an approved local pretreatment program into a municipality's permit.

3. The following are causes for modification or alternatively revocation and reissuance:

a. When cause exists for termination for reasons listed in 1.a through 1.g of this section, and Ecology determines that modification or revocation and reissuance is appropriate.

b. When Ecology has received notification of a proposed transfer of the permit. A permit may also be modified to reflect a transfer after the effective date of an automatic transfer (General Condition G7) but will not be revoked and reissued after the effective date of the transfer except upon the request of the new Permittee.

G4. Reporting planned changes

The Permittee must, as soon as possible, but no later than one hundred eighty (180) days prior to the proposed changes, give notice to Ecology of planned physical alterations or additions to the permitted facility, production increases, or process modification which will result in:

1. The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b).

2. A significant change in the nature or an increase in quantity of pollutants discharged.

3. A significant change in the Permittee's sludge use or disposal practices. Following such notice, and the submittal of a new application or supplement to the existing application, along with required engineering plans and reports, this permit may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G5. Plan review required

Prior to constructing or modifying any wastewater control facilities, an engineering report and detailed plans and specifications must be submitted to Ecology for approval in accordance with chapter 173-240 WAC. Engineering reports, plans, and specifications must be submitted at least one hundred eighty (180) days prior to the planned start of construction unless a shorter time is approved by Ecology. Facilities must be constructed and operated in accordance with the approved plans.

G6. Compliance with other laws and statutes

Nothing in this permit excuses the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. Transfer of this permit

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee must notify the succeeding owner or controller of the existence of this permit by letter, a copy of which must be forwarded to Ecology.

1. Transfers by Modification

   Except as provided in paragraph (2) below, this permit may be transferred by the Permittee to a new owner or operator only if this permit has been modified or revoked and reissued under 40 CFR 122.62(b)(2), or a minor modification made under 40 CFR 122.63(d), to identify the new Permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

2. Automatic Transfers

   This permit may be automatically transferred to a new Permittee if:

   a. The Permittee notifies Ecology at least thirty (30) days in advance of the proposed transfer date.

   b. The notice includes a written agreement between the existing and new Permittees containing a specific date transfer of permit responsibility, coverage, and liability between them.

   c. Ecology does not notify the existing Permittee and the proposed new Permittee of its intent to modify or revoke and reissue this permit. A modification under this subparagraph may also be minor modification under 40 CFR 122.63. If this notice is not received, the transfer is effective on the date specified in the written agreement.

G8. Reduced production for compliance

The Permittee, in order to maintain compliance with its permit, must control production and/or all discharges upon reduction, loss, failure, or bypass of the treatment facility until the facility is restored or an alternative method of treatment is provided. This requirement applies in the situation where, among other things, the primary source of power of the treatment facility is reduced, lost, or fails.

G9. Removed substances

Collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters must not be resuspended or reintroduced to the final effluent stream for discharge to state waters.

G10. Duty to provide information

The Permittee must submit to Ecology, within a reasonable time, all information which Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology upon request, copies of records required to be kept by this permit.

G11. Other requirements of 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. Additional monitoring

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. Payment of fees

The Permittee must submit payment of fees associated with this permit as assessed by Ecology.

G14. Penalties for violating permit conditions

Any person who is found guilty of willfully violating the terms and conditions of this permit is deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit may incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation is a separate and distinct offense, and in case of a continuing violation, every day's continuance is deemed to be a separate and distinct violation.

G15. Upset

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limits if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

1. An upset occurred and that the Permittee can identify the cause(s) of the upset.
2. The permitted facility was being properly operated at the time of the upset.
3. The Permittee submitted notice of the upset as required in Special Condition S3.F.
4. The Permittee complied with any remedial measures required under S3.F of this permit.

In any enforcement action the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. Property rights

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. Duty to comply

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. Toxic pollutants

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. Penalties for tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two (2) years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than $20,000 per day of violation, or by imprisonment of not more than four (4) years, or by both.

G20. Compliance schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit must be submitted no later than fourteen (14) days following each schedule date.

G21. Service agreement review

The Permittee must submit to Ecology any proposed service agreements and proposed revisions or updates to existing agreements for the operation of any wastewater treatment facility covered by this permit. The review is to ensure consistency with chapters 90.46 and 90.48 RCW as required by RCW 70.150.040(9). In the event that Ecology does not comment within a thirty-day (30) period, the Permittee may assume consistency and proceed with the service agreement or the revised/updated service agreement.

Appendix A

LIST OF POLLUTANTS WITH ANALYTICAL METHODS, DETECTION LIMITS AND QUANTITATION LEVELS

The Permittee must use the specified analytical methods, detection limits (DLs) and quantitation levels (QLs) in the following table for permit and application required monitoring unless:

- Another permit condition specifies other methods, detection levels, or quantitation levels.
- The method used produces measurable results in the sample and EPA has listed it as an EPA-approved method in 40 CFR Part 136.

If the Permittee uses an alternative method, not specified in the permit and as allowed above, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

If the Permittee is unable to obtain the required DL and QL in its effluent due to matrix effects, the Permittee must submit a matrix-specific detection limit (MDL) and a quantitation limit (QL) to Ecology with appropriate laboratory documentation.

When the permit requires the Permittee to measure the base neutral compounds in the list of priority pollutants, it must measure all of the base neutral pollutants listed in the table below. The list includes EPA required base neutral priority pollutants and several additional polynuclear aromatic hydrocarbons (PAHs). The Water Quality Program added several PAHs to the list of base neutrals below from Ecology's Persistent Bioaccumulative Toxics (PBT) List. It only added those PBT parameters of interest to Appendix A that did not increase the overall cost of analysis unreasonably.

Ecology added this appendix to the permit in order to reduce the number of analytical "non-detects" in permit-required monitoring and to measure effluent concentrations near or below criteria values where possible at a reasonable cost.

The lists below include conventional pollutants (as defined in CWA section 502(6) and 40 CFR Part 122.), toxic or priority pollutants as defined in CWA section 307(a)(1) and listed in 40 CFR Part 122 Appendix D, 40 CFR Part 401.15 and 40 CFR Part 423 Appendix A), and nonconventionals. 40 CFR Part 122 Appendix D (Table V) also identifies toxic pollutants and hazardous substances which are required to be reported by dischargers if expected to be present. This permit Appendix A list does not include those parameters. The list also includes pulp and paper pollutants identified in 40 CFR Part 430 and the dioxin and furan congeners identified using EPA Method 1613.

CONVENTIONAL POLLUTANTS

Pollutant	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
Biochemical Oxygen Demand		SM5210-B		2 mg/L
Biochemical Oxygen Demand, Soluble		SM5210-B [3]		2 mg/L
Fecal Coliform		SM 9221E,9222	N/A	Specified in method - sample aliquot dependent
Oil and Grease (HEM) (Hexane Extractable Material)		1664 A or B	1,400	5,000
pH		SM4500-H^+ B	N/A	N/A
Total Suspended Solids		SM2540-D		5 mg/L

NONCONVENTIONAL POLLUTANTS

Pollutant & CAS No. (if available)	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] µg/L unless specified	Quantitation Level (QL)[2] µg/L unless specified
Alkalinity, Total		SM2320-B		5 mg/L as CaCO3
Aluminum, Total	7429-90-5	200.8	2.0	10
Ammonia, Total (as N)		SM4500-NH3-B and C/D/E/G/H		20
Barium Total	7440-39-3	200.8	0.5	2.0
BTEX (benzene +toluene + ethylbenzene + m,o,p xylenes)		EPA SW 846 8021/8260	1	2
Boron, Total	7440-42-8	200.8	2.0	10.0
Chemical Oxygen Demand		SM5220-D		10 mg/L
Chloride		SM4500-Cl B/C/D/E and SM4110 B		Sample and limit dependent
Chlorine, Total Residual		SM4500 Cl G		50.0
Cobalt, Total	7440-48-4	200.8	0.05	0.25
Color		SM2120 B/C/E		10 color units
Dissolved oxygen		SM4500-OC/OG		0.2 mg/L
Flow		Calibrated device		
Fluoride	16984-48-8	SM4500-F E	25	100
Hardness, Total		SM2340B		200 as CaCO3
Iron, Total	7439-89-6	200.7	12.5	50
Magnesium, Total	7439-95-4	200.7	10	50
Manganese, Total	7439-96-5	200.8	0.1	0.5
Molybdenum, Total	7439-98-7	200.8	0.1	0.5
Nitrate + Nitrite Nitrogen (as N)		SM4500-NO3- E/F/H		100
Nitrogen, Total Kjeldahl (as N)		SM4500-N_{org}B/C and SM4500NH_3-B/C/D/EF/G/H		300
NWTPH Dx [4]		Ecology NWTPH Dx	250	250
NWTPH Gx [5]		Ecology NWTPH Gx	250	250
Phosphorus, Total (as P)		SM 4500 PB followed by SM4500-PE/PF	3	10
Salinity		SM2520-B		3 practical salinity units or scale (PSU or PSS)
Settleable Solids		SM2540 -F		Sample and limit dependent
Soluble Reactive Phosphorus (as P)		SM4500-P E/F/G	3	10
Sulfate (as mg/L SO_4)		SM4110-B		0.2 mg/L
Sulfide (as mg/L S)		SM4500-S^2F/D/E/G		0.2 mg/L
Sulfite (as mg/L SO_3)		SM4500-SO3B		2 mg/L
Temperature (max. 7-day avg.)		Analog recorder or use micro-recording devices known as thermistors		0.2º C
Tin, Total	7440-31-5	200.8	0.3	1.5
Titanium, Total	7440-32-6	200.8	0.5	2.5
Total Coliform		SM 9221B, 9222B, 9223B	N/A	Specified in method - sample aliquot dependent
Total Organic Carbon		SM5310-B/C/D		1 mg/L
Total dissolved solids		SM2540 C		20 mg/L

PRIORITY POLLUTANTS	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
METALS, CYANIDE & TOTAL PHENOLS					
Antimony, Total	114	7440-36-0	200.8	0.3	1.0
Arsenic, Total	115	7440-38-2	200.8	0.1	0.5
Beryllium, Total	117	7440-41-7	200.8	0.1	0.5
Cadmium, Total	118	7440-43-9	200.8	0.05	0.25
Chromium (hex) dissolved	119	18540-29-9	SM3500-Cr C	0.3	1.2
Chromium, Total	119	7440-47-3	200.8	0.2	1.0
Copper, Total	120	7440-50-8	200.8	0.4	2.0
Lead, Total	122	7439-92-1	200.8	0.1	0.5
Mercury, Total	123	7439-97-6	1631E	0.0002	0.0005
Nickel, Total	124	7440-02-0	200.8	0.1	0.5
Selenium, Total	125	7782-49-2	200.8	1.0	1.0
Silver, Total	126	7440-22-4	200.8	0.04	0.2
Thallium, Total	127	7440-28-0	200.8	0.09	0.36
Zinc, Total	128	7440-66-6	200.8	0.5	2.5
Cyanide, Total	121	57-12-5	335.4	5	10
Cyanide, Weak Acid Dissociable	121		SM4500-CN I	5	10
Cyanide, Free Amenable to Chlorination (Available Cyanide)	121		SM4500-CN G	5	10
Phenols, Total	65		EPA 420.1		50

PRIORITY POLLUTANTS	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
ACID COMPOUNDS					
2-Chlorophenol	24	95-57-8	625	1.0	2.0
2,4-Dichlorophenol	31	120-83-2	625	0.5	1.0
2,4-Dimethylphenol	34	105-67-9	625	0.5	1.0
4,6-dinitro-o-cresol (2-methyl-4,6,-dinitrophenol)	60	534-52-1	625/1625B	1.0	2.0
2,4 dinitrophenol	59	51-28-5	625	1.0	2.0
2-Nitrophenol	57	88-75-5	625	0.5	1.0
4-Nitrophenol	58	100-02-7	625	0.5	1.0
Parachlorometa cresol (4-chloro-3-methylphenol)	22	59-50-7	625	1.0	2.0
Pentachlorophenol	64	87-86-5	625	0.5	1.0
Phenol	65	108-95-2	625	2.0	4.0
2,4,6-Trichlorophenol	21	88-06-2	625	2.0	4.0

PRIORITY POLLUTANTS	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
VOLATILE COMPOUNDS					
Acrolein	2	107-02-8	624	5	10
Acrylonitrile	3	107-13-1	624	1.0	2.0
Benzene	4	71-43-2	624	1.0	2.0

PRIORITY POLLUTANTS	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
VOLATILE COMPOUNDS					
Bromoform	47	75-25-2	624	1.0	2.0
Carbon tetrachloride	6	56-23-5	624/601 or SM6230B	1.0	2.0
Chlorobenzene	7	108-90-7	624	1.0	2.0
Chloroethane	16	75-00-3	624/601	1.0	2.0
2-Chloroethylvinyl Ether	19	110-75-8	624	1.0	2.0
Chloroform	23	67-66-3	624 or SM6210B	1.0	2.0
Dibromochloromethane (chlordibromomethane)	51	124-48-1	624	1.0	2.0
1,2-Dichlorobenzene	25	95-50-1	624	1.9	7.6
1,3-Dichlorobenzene	26	541-73-1	624	1.9	7.6
1,4-Dichlorobenzene	27	106-46-7	624	4.4	17.6
Dichlorobromomethane	48	75-27-4	624	1.0	2.0
1,1-Dichloroethane	13	75-34-3	624	1.0	2.0
1,2-Dichloroethane	10	107-06-2	624	1.0	2.0
1,1-Dichloroethylene	29	75-35-4	624	1.0	2.0
1,2-Dichloropropane	32	78-87-5	624	1.0	2.0
1,3-dichloropropene (mixed isomers)(1,2-dichloropropylene)[6]	33	542-75-6	624	1.0	2.0
Ethylbenzene	38	100-41-4	624	1.0	2.0
Methyl bromide (Bromomethane)	46	74-83-9	624/601	5.0	10.0
Methyl chloride (Chloromethane)	45	74-87-3	624	1.0	2.0
Methylene chloride	44	75-09-2	624	5.0	10.0
1,1,2,2-Tetrachloroethane	15	79-34-5	624	1.9	2.0
Tetrachloroethylene	85	127-18-4	624	1.0	2.0
Toluene	86	108-88-3	624	1.0	2.0
1,2-Trans-Dichloroethylene (Ethylene dichloride)	30	156-60-5	624	1.0	2.0
1,1,1-Trichloroethane	11	71-55-6	624	1.0	2.0
1,1,2-Trichloroethane	14	79-00-5	624	1.0	2.0
Trichloroethylene	87	79-01-6	624	1.0	2.0
Vinyl chloride	88	75-01-4	624/SM6200B	1.0	2.0

PRIORITY POLLUTANTS	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL)[2] *µg/L unless specified*
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)					
Acenaphthene	1	83-32-9	625	0.2	0.4
Acenaphthylene	77	208-96-8	625	0.3	0.6
Anthracene	78	120-12-7	625	0.3	0.6
Benzidine	5	92-87-5	625	12	24
Benzyl butyl phthalate	67	85-68-7	625	0.3	0.6
Benzo(*a*)anthracene	72	56-55-3	625	0.3	0.6
Benzo(b)fluoranthene (3,4-benzofluoranthene) [7]	74	205-99-2	610/625	0.8	1.6
Benzo(j)fluoranthene [7]		**205-82-3**	625	0.5	1.0

PRIORITY POLLUTANTS	**PP #**	**CAS Number (if available)**	**Recommended Analytical Protocol**	**Detection (DL)[1] *µg/L unless specified***	**Quantitation Level (QL) [2] *µg/L unless specified***
BASE/NEUTRAL COMPOUNDS (compounds in bold are Ecology PBTs)					
Benzo(k)fluoranthene (11,12-benzofluoranthene) [7]	75	207-08-9	610/625	0.8	1.6
Benzo(r,s,t)pentaphene		**189-55-9**	625	0.5	1.0
Benzo(*a*)pyrene	73	50-32-8	610/625	0.5	1.0
Benzo(*ghi*)Perylene	79	191-24-2	610/625	0.5	1.0
Bis(*2-chloroethoxy)*methane	43	111-91-1	625	5.3	21.2
Bis(*2-chloroethyl*)ether	18	111-44-4	611/625	0.3	1.0
Bis(*2-chloroisopropyl*)ether	42	39638-32-9	625	0.3	0.6
Bis(*2-ethylhexyl*)phthalate	66	117-81-7	625	0.1	0.5
4-Bromophenyl phenyl ether	41	101-55-3	625	0.2	0.4
2-Chloronaphthalene	20	91-58-7	625	0.3	0.6
4-Chlorophenyl phenyl ether	40	7005-72-3	625	0.3	0.5
Chrysene	76	218-01-9	610/625	0.3	0.6
Dibenzo (a,h)acridine		**226-36-8**	610M/625M	2.5	10.0
Dibenzo (a,j)acridine		**224-42-0**	610M/625M	2.5	10.0
Dibenzo(a-*h*)anthracene (1,2,5,6-dibenzanthracene)	82	53-70-3	625	0.8	1.6
Dibenzo(a,e)pyrene		192-65-4	610M/625M	2.5	10.0
Dibenzo(a,h)pyrene		189-64-0	625M	2.5	10.0
3,3-Dichlorobenzidine	28	91-94-1	605/625	0.5	1.0
Diethyl phthalate	70	84-66-2	625	1.9	7.6
Dimethyl phthalate	71	131-11-3	625	1.6	6.4
Di-n-butyl phthalate	68	84-74-2	625	0.5	1.0
2,4-dinitrotoluene	35	121-14-2	609/625	0.2	0.4
2,6-dinitrotoluene	36	606-20-2	609/625	0.2	0.4
Di-n-octyl phthalate	69	117-84-0	625	0.3	0.6
1,2-Diphenylhydrazine (*as Azobenzene*)	37	122-66-7	1625B	5.0	20
Fluoranthene	39	206-44-0	625	0.3	0.6
Fluorene	80	86-73-7	625	0.3	0.6
Hexachlorobenzene	9	118-74-1	612/625	0.3	0.6
Hexachlorobutadiene	52	87-68-3	625	0.5	1.0
Hexachlorocyclopentadiene	53	77-47-4	1625B/625	0.5	1.0
Hexachloroethane	12	67-72-1	625	0.5	1.0
Indeno(*1,2,3-cd*)Pyrene	83	193-39-5	610/625	0.5	1.0
Isophorone	54	78-59-1	625	0.5	1.0
3-Methyl cholanthrene		**56-49-5**	625	2.0	8.0
Naphthalene	55	91-20-3	625	0.3	0.6
Nitrobenzene	56	98-95-3	625	0.5	1.0
N-Nitrosodimethylamine	61	62-75-9	607/625	2.0	4.0
N-Nitrosodi-n-propylamine	63	621-64-7	607/625	0.5	1.0
N-Nitrosodiphenylamine	62	86-30-6	625	0.5	1.0
Perylene		**198-55-0**	625	1.9	7.6
Phenanthrene	81	85-01-8	625	0.3	0.6
Pyrene	84	129-00-0	625	0.3	0.6
1,2,4-Trichlorobenzene	8	120-82-1	625	0.3	0.6

PRIORITY POLLUTANT	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL) [2] *µg/L unless specified*
DIOXIN					
2,3,7,8-Tetra-Chlorodibenzo-P-Dioxin (2,3,7,8 TCDD)	129	1746-01-6	1613B	1.3 pg/L	5 pg/L

PRIORITY POLLUTANTS	PP #	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL) [2] *µg/L unless specified*
PESTICIDES/PCBs					
Aldrin	89	309-00-2	608	0.025	0.05
alpha-BHC	102	319-84-6	608	0.025	0.05
beta-BHC	103	319-85-7	608	0.025	0.05
gamma-BHC (Lindane)	104	58-89-9	608	0.025	0.05
delta-BHC	105	319-86-8	608	0.025	0.05
Chlordane [8]	91	57-74-9	608	0.025	0.05
4,4'-DDT	92	50-29-3	608	0.025	0.05
4,4'-DDE	93	72-55-9	608	0.025	0.05
4,4' DDD	94	72-54-8	608	0.025	0.05
Dieldrin	90	60-57-1	608	0.025	0.05
alpha-Endosulfan	95	959-98-8	608	0.025	0.05
beta-Endosulfan	96	33213-65-9	608	0.025	0.05
Endosulfan Sulfate	97	1031-07-8	608	0.025	0.05
Endrin	98	72-20-8	608	0.025	0.05
Endrin Aldehyde	99	7421-93-4	608	0.025	0.05
Heptachlor	100	76-44-8	608	0.025	0.05
Heptachlor Epoxide	101	1024-57-3	608	0.025	0.05
PCB-1242 [9]	106	53469-21-9	608	0.25	0.5
PCB-1254	107	11097-69-1	608	0.25	0.5
PCB-1221	108	11104-28-2	608	0.25	0.5
PCB-1232	109	11141-16-5	608	0.25	0.5
PCB-1248	110	12672-29-6	608	0.25	0.5
PCB-1260	111	11096-82-5	608	0.13	0.5
PCB-1016 [9]	112	12674-11-2	608	0.13	0.5
Toxaphene	113	8001-35-2	608	0.24	0.5

PULP & PAPER POLLUTANTS (40CFR Part 430)

Pollutant	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] µg/L unless specified	Quantitation Level (QL)[2] µg/L unless specified
Adsorbable Organic Halides (AOX)		EPA 1650		20
2,3,7,8- Tetrachlorodibenzo-*p*-dioxin (TCDD) (this is also priority pollutant and is listed above)	1746-01-6	EPA 1613	1.3 pg/L	5 pg/L
2,3,7,8- Tetrachlorodibenzofuran (TCDF)	51207-31-9	EPA 1613	1.3 pg/L	5 pg/L
Trichlorosyringol		EPA 1653		2.5
3,4,5-Trichlorocatechol		EPA 1653		5.0
3,4,6-Trichlorocatechol		EPA 1653		5.0
3,4,5-Trichloroguaiacol		EPA 1653		2.5

PULP & PAPER POLLUTANTS (40CFR Part 430)

Pollutant	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] µg/L unless specified	Quantitation Level (QL)[2] µg/L unless specified
3,4,6-Trichloroguaiacol		EPA 1653		2.5
4,5,6-Trichloroguaiacol		EPA 1653		2.5
2,4,5-Trichlorophenol		EPA 1653		2.5
2,4,6-Trichlorophenol		EPA 1653		2.5
Tetrachlorocatechol		EPA 1653		5.0
Tetrachloroguaiacol		EPA 1653		5.0
2,3,4,6-Tetrachlorophenol		EPA 1653		2.5
Pentachlorphenol (this is also priority pollutant and is listed above)		EPA 1653		5.0

NONCONVENTIONALS – DIOXIN & FURAN CONGENERS

Pollutant	CAS Number (if available)	Recommended Analytical Protocol	Detection (DL)[1] µg/L unless specified	Quantitation Level (QL)[2] µg/L unless specified
2,3,7,8- Tetrachlorodibenzo-*p*-dioxin (TCDD) (this is a priority pollutant and is also listed above)	1746-01-6	EPA 1613	1.3 pg/L	5 pg/L
Total TCDD	41903-57-5			
2,3,7,8- Tetrachlorodibenzofuran (TCDF)	51207-31-9		1.3 pg/L	5 pg/L
Total-TCDF	55722-27-5			
1,2,3,7,8- Pentachlorodibenzo-*p*-dioxin (PeCDD)	40321-76-4			
Total-PeCDD	36088-22-9			
1,2,3,7,8- Pentachlorodibenzofuran (PeCDF)	57117-41-6			
2,3,4,7,8-PeCDF	57117-31-4			
Total-PeCDF	30402-15-4			
1,2,3,4,7,8- Hexachlorodibenzo-*p*-dioxin (HxCDD)	39227-28-6			
1,2,3,6,7,8-HxCDD	57653-85-7			
1,2,3,7,8,9-HxCDD	19408-74-3			
Total-HxCDD	34465-46-8			
1,2,3,4,7,8- Hexachlorodibenzofuran (HxCDF)	70648-26-9			
1,2,3,6,7,8-HxCDF	57117-44-9			
1,2,3,7,8,9-HxCDF	72918-21-9			
2,3,4,6,7,8-HxCDF	60851-34-5			
Total-HxCDF	55684-94-1			
1,2,3,4,6,7,8- Heptachlorodibenzo-*p*-dioxin (HpCDD)	35822-46-9			
Total-HpCDD	37871-00-4			
1,2,3,4,6,7,8- Heptachlorodibenzofuran (HpCDF)	67562-39-4			
1,2,3,4,7,8,9-HpCDF	55673-89-7			
Total-HpCDF	38998-75-3			
Octachlorodibenzo-*p*-dioxin (OCDD)	3268-87-9			
Octachlorodibenzofuran (OCDF)	39001-02-0			

1. Detection level (DL) or detection limit means the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B.
2. Quantitation Level (QL) also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer (64 FR 30417).
   ALSO GIVEN AS:
   The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency, December 2007).
3. Soluble Biochemical Oxygen Demand method note: First, filter the sample through a Millipore Nylon filter (or equivalent) - pore size of 0.45-0.50 um (prep all filters by filtering 250 ml of laboratory grade deionized water through the filter and discard). Then, analyze sample as per method 5210-B.
4. NWTPH Dx - Northwest Total Petroleum Hydrocarbons Diesel Extended Range – see http://www.ecy.wa.gov/biblio/97602.html
5. NWTPH Gx - Northwest Total Petroleum Hydrocarbons Gasoline Extended Range – see http://www.ecy.wa.gov/biblio/97602.html
6. 1, 3-dichloroproylene (mixed isomers) You may report this parameter as two separate parameters: cis-1, 3-dichlorpropropene (10061-01-5) and trans-1, 3-dichloropropene (10061-02-6).
7. Total Benzofluoranthenes - Because Benzo(b)fluoranthene, Benzo(j)fluoranthene and Benzo(k)fluoranthene co-elute you may report these three isomers as total benzofluoranthenes.
8. Chlordane – You may report alpha-chlordane (5103-71-9) and gamma-chlordane (5103-74-2) in place of chlordane (57-74-9). If you report alpha and gamma-chlordane, the DL/PQLs that apply are 0.025/0.050.
9. PCB 1016 & PCB 1242 – You may report these two PCB compounds as one parameter called PCB 1016/1242.

Fact Sheet for NPDES Permit WA0020290

City of Stanwood Wastewater Treatment Plant

Effective date: November 1, 2016

Purpose of this fact sheet

This fact sheet explains and documents the decisions the Washington State Department of Ecology (Ecology) made in drafting the proposed National Pollutant Discharge Elimination System (NPDES) permit for the City of Stanwood Wastewater Treatment Plant (WWTP).

This fact sheet complies with Section 173-220-060 of the Washington Administrative Code (WAC), which requires Ecology to prepare a draft permit and accompanying fact sheet for public evaluation before issuing an NPDES permit.

Ecology makes the draft permit and fact sheet available for public review and comment at least thirty (30) days before issuing the final permit. Copies of the fact sheet and draft permit for the City of Stanwood WWTP, NPDES permit number WA0020290, were available for public review and comment from July 28, 2016, until August 27, 2016. For more details on preparing and filing comments about these documents, please see *Appendix A - Public Involvement Information*.

The City of Stanwood reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions regarding the facility's location, history, wastewater discharges, or receiving water prior to publishing this draft fact sheet for public notice.

After the public comment period closes, Ecology will summarize substantive comments and provide responses to them. Ecology will include the summary and responses to comments in this fact sheet as *Appendix G - Response to Comments*, and publish it when issuing the final NPDES permit. Ecology generally will not revise the rest of the fact sheet. The full document will become part of the legal history contained in the facility's permit file.

Summary

The City of Stanwood (City) owns, operates, and maintains a 1.5 MGD wastewater treatment plant that provides biological treatment via two extended aerated oxidation ditches and solids removal using two secondary clarifiers. Final effluent is UV disinfected before discharging to the Old Stillaguamish River.

The plant treats domestic wastewater from residential and commercial activities, and organic industrial wastewater from North Star Cold Storage and Carlson's Trucking. North Star Cold Storage is a seafood processing company that discharges process wastewater to plant. Carlson's Trucking transports food products in tanker trucks and discharges wash water from the tanker trucks to the plant.

The proposed permit contains the same effluent limits for biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform bacteria and pH, as the previous permit issued in 2011.

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I. Introduction

The Federal Clean Water Act (FCWA, 1972, and later amendments in 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One mechanism for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES), administered by the federal Environmental Protection Agency (EPA). The EPA authorized the state of Washington to manage the NPDES permit program in our state. Our Washington State Legislature accepted the delegation and assigned the power and duty for conducting NPDES permitting and enforcement to Ecology. The Legislature defined Ecology's authority and obligations for the wastewater discharge permit program in 90.48 RCW (Revised Code of Washington).

The following regulations apply to domestic wastewater NPDES permits:

- Procedures Ecology follows for issuing NPDES permits (chapter 173-220 WAC).
- Technical criteria for discharges from municipal wastewater treatment facilities (chapter 173-221 WAC).
- Water quality criteria for surface waters (chapter 173-201A WAC).
- Water quality criteria for groundwaters (chapter 173-200 WAC).
- Whole effluent toxicity testing and limits (chapter 173-205 WAC).
- Sediment management standards (chapter 173-204 WAC).
- Submission of plans and reports for construction of wastewater facilities (chapter 173-240 WAC).

These rules require any treatment facility owner/operator to obtain an NPDES permit before discharging wastewater to state waters. They also help define the basis for limits on each discharge and for requirements imposed by the permit.

Under the NPDES permit program and in response to a complete and accepted permit application, Ecology must prepare a draft permit and accompanying fact sheet, and make them available for public review before final issuance. Ecology must also publish an announcement (public notice) telling people where they can read the draft permit, and where to send their comments, during a period of thirty days (WAC 173-220-050). (*See Appendix A - Public Involvement Information* for more detail about the public notice and comment procedures). After the public comment period ends, Ecology may make changes to the draft NPDES permit in response to comment(s). Ecology will summarize the responses to comments and any changes to the permit in *Appendix G*.

II. Background Information

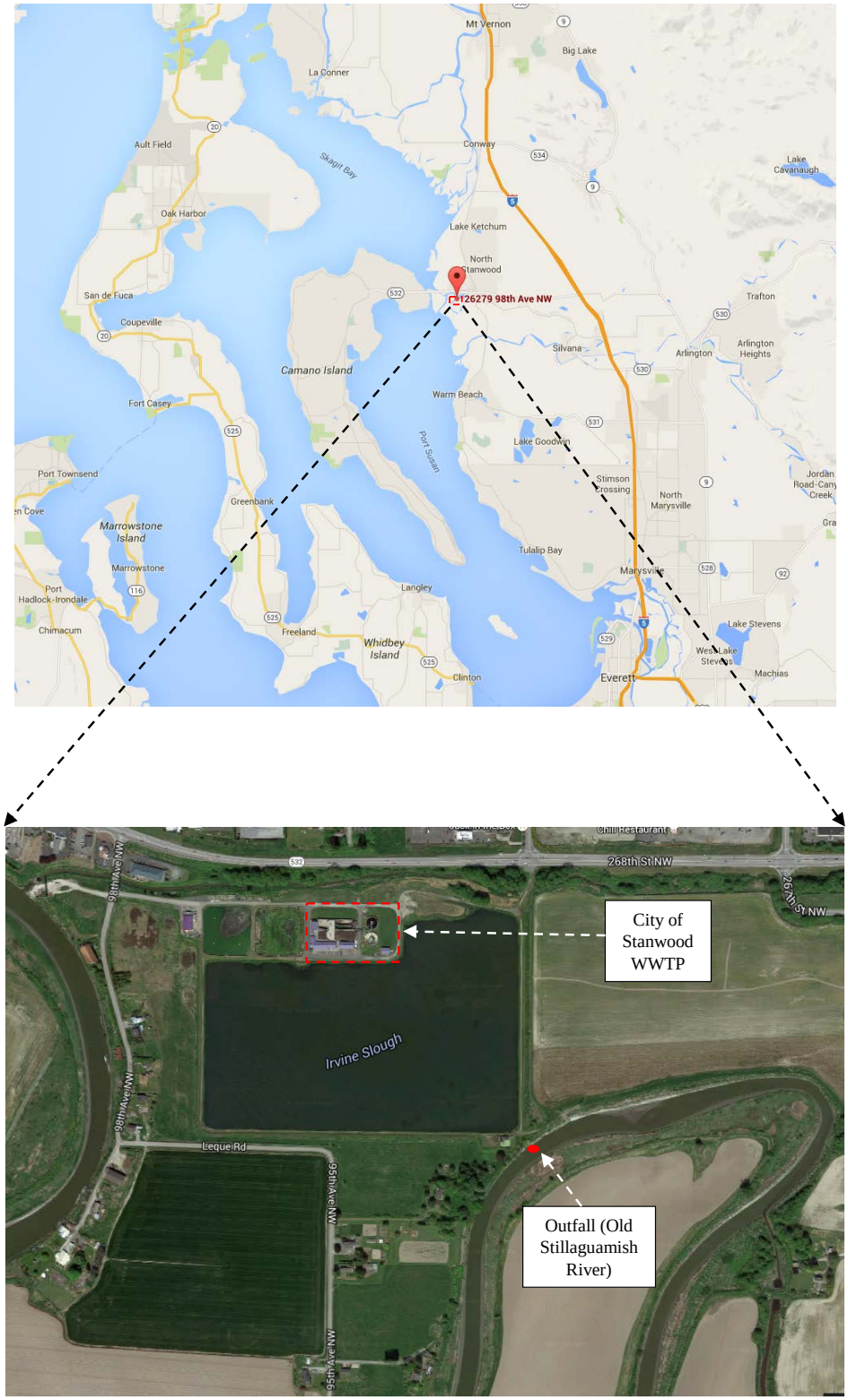
Table 1. General Facility Information

Facility Information	
Applicant	City of Stanwood
Facility Name and Address	City of Stanwood WWTP 26279 98th Avenue NW Stanwood, WA 98292
Contact at Facility	Name: Victoria Leigh Danielson Title: Wastewater Department Lead Telephone #: 360-629-9781
Responsible Official	Name: Leonard Kelley Title: Mayor Address: 10220 270th St. NW Stanwood, WA 98292 Telephone #: 360-629-2181
Type of Treatment	Oxidation Ditch – Activated Sludge System
Facility Location (NAD83/WGS84 reference datum)	Latitude: 48.241667 Longitude: -122.365556
Discharge Waterbody Name and Location (NAD83/WGS84 reference datum)	Old Stillaguamish River Latitude: 48.235781 Longitude: -122.357501

Permit Status	
Issuance Date of Previous Permit	10/25/2011
Application for Permit Renewal Submittal Date	4/28//2016
Date of Ecology Acceptance of Application	5/2/2016

Inspection Status	
Date of Last Non-sampling Inspection Date	02/23/2015

Figure 1. Facility Location Map



A. Facility description

History

The City was incorporated in 1903 and its original sewer collection system was constructed mostly of asbestos-cement pipe in 1963 to serve the downtown Stanwood area, former east Stanwood, and the City's eastern hill. The system was expanded to serve new developments on the eastern hill, including pump stations and sewer extensions that were largely constructed of polyvinyl chloride (PVC) pipe.

The City's wastewater treatment plant was completed in 1963. The original plant consisted of headworks with grit channel, comminutor, bypass bar screen, and Parshall flume; four 1.25-acre anaerobic primary lagoons and a 35-acre facultative lagoon; and an outfall to the Stillaguamish River. Since its construction the plant has undergone two major upgrades. In 1973, the plant was upgraded with the addition of effluent chlorination facilities and a propeller-type flow meter. In 2004, the City constructed a new wastewater treatment plant to increase the system's total capacity to 1.5 million gallons per day (MGD). This expansion included construction of headworks, oxidation ditches and secondary clarifiers, an ultraviolet disinfection system, and a scum system. In addition, two existing wastewater treatment lagoons were converted to sludge stabilization ponds. In 2013, the plant was upgraded with a sodium hypochlorite injection system that feeds sodium hypochlorite into the washdown water line and injects it into the return activated sludge (RAS) piping.

Collection system status

The current status of the collection system is provided in detail in the *City of Stanwood Comprehensive Sewer System Plan*, prepared by RH2 Engineers, Planners, Scientists, February 2015. The plan also discusses the improvements that will be needed to eliminate existing system deficiencies. Ecology approved the plan on June 29, 2015.

The collection sewer system consists of 7 pump stations, approximately 27 miles of sewer piping, and approximately 7,089 feet of force main. The sewer piping ranges in size from 6 to 36 inches in diameter. About 78 percent of the sewer piping within the sewer service area is 8-inch-diameter pipe.

The City has recorded a peak flow event of 293 gallons per capita per day (gpcd) in the last few years, which exceeds the United States Environmental Protection Agency (EPA) maximum of 275 gpcd for inflow. An I/I analysis will be crucial to assist the City to eliminate any excessive inflow in the collection system. Conversely, infiltration is considered to be non-excessive. A review of the City's flow during dry weather conditions indicates peaks below the EPA maximum of 120 gpcd. Further information on the EPA guidelines to determine whether inflow and infiltration is considered excessive can be found in the *"I/I Analysis and Project Certification"* published in 1985, by the EPA.

Treatment processes

At the headworks, influent wastewater flow is monitored using a magnetic flow meter in the force main from the main pump station. Raw wastewater flows through a rock trap and a 6-mm mechanical fine screen. A back up manual bar screen is used when the mechanical screen is offline for repair or maintenance.

Screened wastewater flows by gravity through a flow distribution channel and then to two extended aerated oxidation ditches for BOD removal. The oxidation ditches typically operate at a 26-day SRT. Each ditch consists of an anoxic zone and aerobic zone. The aerobic zone is continuously aerated using a mechanical aerator, and the anoxic zone is mixed for thirty minutes every hour. Historical data from 2011 to 2016 have shown that the oxidation ditches have been able to consistently achieve BOD removals greater than 90 percent.

The effluent from the oxidation ditches flows by gravity to the secondary clarifier flow splitter box and then to the two secondary clarifiers for solids removal. At the splitter box the operators can either split the flow evenly (50/50) between the two secondary clarifiers or send total flow to one clarifier only.

The secondary clarifiers' effluent flows by gravity to the UV disinfection system. The UV disinfection system consists of two banks, and each bank has 24 lamps. Upstream of the UV channels, a sluice gate is used to distribute the wastewater between the two UV banks. Downstream of the UV system, a Parshall flume is used for effluent flow measurement. Disinfected wastewater is discharged into the Old Stillaguamish River.

A 35-acre lagoon located downstream of the disinfection system is used for emergency storage of treated effluent from the secondary treatment system and to protect the South Skagit Bay shellfish growing area. The plant effluent is diverted to the emergency storage lagoon when the effluent turbidity exceeds 35 NTU, or when the UV disinfection preset dosage falls below 36 milliJoules/cm^2.

The plant possesses two automated effluent discharge gates controlled by a SCADA system. These gates are used to automatically divert the UV disinfection effluent to the 35-acre lagoon when the disinfection system fails or the turbidity is higher than the preset values. Water stored in the lagoon is routed back to the headworks for treatment.

Discharge outfall

Secondary treated and disinfected effluent from the City of Stanwood WWTP is discharged into the Old Stillaguamish River at river mile 4.1. The discharge outfall consists of a 24-inch diameter open-ended, coated corrugated metal pipe. The discharge outfall is approximately 30 feet offshore when the tide is at mean sea level, and approximately 10 feet below mean lower low water level (MLLW).

Solid wastes/residual solids

Solids are removed at the headworks and secondary clarifier. Screenings are removed in the mechanical fine screen, discharged into a dumpster, and disposed of as solid waste at a local landfill. Additional solids are removed as settled sludge in the secondary clarifiers. The WAS is pumped to two 1.25-acre lagoons for stabilization and future utilization as biosolids under the State General Biosolids Permit (#BA-0020290). The biosolids are stabilized using an aerobic and facultative biological process.

In 2010, the City hired a contractor to remove, dewater, and haul biosolids from both sludge ponds to King County's Boulder Park Facility in Mansfield, Washington for land application. In 2014, the City contracted with Tetra Tech to evaluate cost-effective biosolids management alternatives. Nine biosolids management alternatives were developed and later narrowed down to four alternatives for further consideration

(Tetra Tech, 2014). All alternatives have been discussed in-depth in the Tetra Tech technical memorandum entitled "*Preliminary Screening of Biosolids Management Alternatives"*.

The recommended biosolids management alternative was presented in the "*Biosolids Management Engineering Report*" prepared by Tetra Tech, dated September 2015. The recommended alternative is to maintain the existing biosolids management. The City will continue to produce Class B biosolids suitable for land application using the sludge ponds for stabilization. After a sludge pond is full, every 3 to 4 years, the City will contract for sludge dredging, dewatering, and hauling for land application at Boulder Park.

Operator classifications

Washington State law requires operators of municipal wastewater treatment plants to be certified at a level appropriate for the type and size of the facility. Criteria published in Ecology's *Permit Writer's Manual* and WAC 173-230 classify the treatment system at the City of Stanwood WWTP as a Group III facility. As such, the operator in responsible charge at the facility must, at a minimum, be rated as a Group III operator. An operator certified for at least a Group II facility must be in charge of each scheduled shift at the facility.

Currently, the plant is staffed with one Group IV operator, one Group III operator, and one Group I operator. The normal operating hours are from 7:00 a.m. to 3:30 p.m. from Monday through Friday and a 24/7 on-call operator (Group III). On the weekend, the plant is staffed with the on-call operator (Group III).

B. Description of the receiving water

The City of Stanwood WWTP discharges to the Old Stillaguamish River. There are several potential point and nonpoint sources in the basin that could contribute to the Stillaguamish basin Section 303(d) listings. Wastewater treatment plants (WWTPs), dairies, and animal production facilities historically have been the focus of water quality actions in the lower basin and along the upper basin valleys to control bacteria, nutrients, and oxygen demand inputs. Point sources in the Stillaguamish basin include the WWTPs at Arlington, Indian Ridge Correctional Facility, Warm Beach Christian Conference Center, Twin City Foods, and Stanwood. Stormwater from roadway runoff and uncontrolled runoff from land adjacent to ditches and drains have been also identified as potential pollutant sources.

Ecology used ambient data from its Environmental Information Management System (EIM), which stores data of the Old Stillaguamish River TMDL and Old Stillaguamish Channel Diel Surveys studies (Study ID #s GPEL0008 and SCOF001, respectively - link: https://fortress.wa.gov/ecy/eimreporting/). Ecology also used ambient background data from the reports (1), (2) and (3) listed below. The background ammonia concentration was taken from the farthest sampling station (05TOC4-06) upstream of the City of Stanwood WWTP.

Based on the results of the salinity measurements taken during Ecology's dye study in the river in 1996 and the Chapter WAC 173-201A-260, the receiving water in the vicinity of Stanwood WWTP discharge is considered a marine estuary.

Chapter WAC 173-201A-260(3) presents special circumstances that require further instructions to determine which numeric criteria apply to a designated use category. The rule explains that a use category designation may be assigned within the freshwater use designation per Table 602 Use Designation for Fresh Waters, but the salinity conditions, in accordance with subsection 260(3)(e)(ii), require that marine water quality criteria be applied to that waterbody.

Per subsection 260(3)(e)(ii), the marine water criteria must apply at locations where the salinity values are greater than one part per thousand, except that the marine criteria for bacteria applies when the salinity is 10 part per thousand or greater. The salinity values in the Old Stillaguamish River vary from 1.9 ppt to 18.8 ppt as reported in the *Analysis of the Effect of Discharged Wastewater on the Stillaguamish River Channel – Interim Model Calibration Report*, August 2007, prepared by Ecology. The Old Stillaguamish River flow is directly affected by the tidal influence from Port Susan and Skagit Bay. The general circulation pattern in the Stillaguamish River is that during flood tide, water moves upstream from Port Susan (via South Pass) into the Old Stillaguamish River and Skagit Bay (via West Pass). Further details of the tidal influence on the Old Stillaguamish River's salinity can be found in the reports (1), and (2) listed below.

1) *(Draft) Total Maximum Daily Load Analysis of the Old Stillaguamish River Channel – Interim Model Calibration Report*, August 2007, S. A. Breithaupt and T. Khangaonkar, Battelle – Pacific Northwest Division, prepared for WA State Department of Ecology.

2) *An Analysis of the Effect of Discharged Wastewater on the Stillaguamish River at Stanwood*, July 1996, Norm Glenn, Ecology Publication Number 96-330.

3) *City of Stanwood – Wastewater Facilities Plan*, May 2000, Tetra Tech/KCM, Inc.

Table 2. Ambient Background Data

Parameter	Value Used
Temperature (highest annual 1-DADMax) Temperature (90th percentile)	23.0° C 20.5° C
pH (Maximum / Minimum)	8.8 / 5.5 standard units
Dissolved Oxygen (10th percentile)	5.1 mg/L
Total Ammonia-N	0.035 mg/L
Fecal Coliform (90th percentile)	1/100 mL
Alkalinity (90th percentile)	202 mg/L as $CaCO_3$
Salinity (90th percentile)	24 psu

C. Wastewater influent characterization

City of Stanwood WWTP monitors influent flow and waste loading to verify actual loading does not exceed approved design capacity. Table 3 summarizes facility loading, as reported on discharge monitoring reports (DMRs) from November 2011 through March 2016.

Table 3. Wastewater Influent Characterization

Parameter	Units	# of Samples	Average of Average Monthly Values	Maximum of Average Monthly Value
Flow	MGD	~500	0.59	0.93
Biochemical Oxygen Demand (BOD_5)	mg/L	~ 500	353	495
Biochemical Oxygen Demand (BOD_5)	lbs/day	~ 500	1,620	2,376
Total Suspended Solids (TSS)	mg/L	~ 500	322	457
Total Suspended Solids (TSS)	lbs/day	~ 500	1,494	2,216

D. Wastewater effluent characterization

City of Stanwood WWTP reported the concentrations of pollutants in the discharge in the permit application and in discharge monitoring reports. Table 4 summarizes effluent quality as reported in DMRs from November 2011 through March 2016 and as reported in the application.

Table 4. Wastewater Effluent Characterization

Parameter	Units	# of Samples	Average of Average Monthly Values	Maximum of Average Monthly Values
Flow	MGD	~500	0.59	1.02
Biochemical Oxygen Demand (BOD_5)	mg/L	~500	3.6	9.0
Biochemical Oxygen Demand (BOD_5)	lbs/day	~500	18.1	43.0
Total Suspended Solids (TSS)	mg/L	~500	6.0	14.0
Total Suspended Solids (TSS)	lbs/day	~500	31.3	79.0
Ammonia	mg/L	8	0.221	0.5
Nitrate + Nitrite (Nitrogen)	mg/L	8	4.32	13.8
Total Kjeldahl Nitrogen (TKN)	mg/L	8	1.99	2.67
Temperature (Winter)	°C	129	15.7	20.4
Temperature (Summer)	°C	127	20.3	23.8

Parameter	Units	# of Samples	Value
Temperature (95th Percentile)	°C	~250	23.3

	Units	# of Samples	Maximum Monthly Geometric Mean	Maximum Weekly Geometric Mean
Fecal Coliforms	#/100 mL	~500	8.1	61.0

Parameter	Units	# of Samples	Minimum Value	Maximum Value
pH	standard units	~1000	7.3	7.9

Table 5. Wastewater Effluent Characterization - Expanded

Parameter	Units	# of Samples	Average of Sample Values	Maximum of Sample Values
Phosphorus (Total)	mg/L	3	6.75	7.95
Dissolved Oxygen	mg/L	3	7.23	9.75
Oil and Grease	mg/L	3	5.1	15.3
Total Dissolved Solids (TDS)	mg/L	3	570	680
Arsenic	ug/L	3	6.0	6.0
Cadmium	ug/L	3	0.06	0.2
Chromium	ug/L	3	0.3	0.9
Copper	ug/L	3	8.0	11.0
Lead	ug/L	3	0.3	0.9
Mercury	ug/L	3	0.0009	0.0015
Nickel	ug/L	3	3.0	5.0
Selenium	ug/L	3	0.4	0.7
Thallium	ug/L	3	7.0	21.0
Zinc	ug/L	3	43.0	68.0
Total Phenolic Compounds	ug/L	3	16.3	49.0
Cyanide, Weak Acid Dissociable	ug/L	3	1.6	5.0
Chloroform	ug/L	3	0.623	1.8
Bis (2-Ethylhexyl) Phthalate	ug/L	3	7.1	19.0
Hardness (as $CaCO_3$)	mg/L	3	204.6	204.6

E. Summary of compliance with previous permit issued October 25, 2011

The previous permit placed effluent limits on BOD_5, TSS, fecal coliform, and pH.

The City of Stanwood WWTP has complied with the effluent limits and permit conditions throughout the duration of the permit issued on October 25, 2011. Ecology's records show no permit violations during the permit term. Ecology assessed compliance based on its review of the facility's information in the Ecology Permitting and Reporting Information System (PARIS), discharge monitoring reports (DMRs) and on inspections.

The following table summarizes compliance with report submittal requirements over the permit term.

Table 6. Permit Submittals

Submittal Name	Due Date	Received Date
Application for Permit Renewal	May 1, 2016	April 28, 2016

F. State environmental policy act (SEPA) compliance

State law exempts the issuance, reissuance or modification of any wastewater discharge permit from the SEPA process as long as the permit contains conditions that are no less stringent than federal and state rules and regulations (RCW 43.21C.0383). The exemption applies only to existing discharges, not to new discharges.

III. Proposed Permit Limits

Federal and state regulations require that effluent limits in an NPDES permit must be either technology- or water quality-based.

- Technology-based limits are based upon the treatment methods available to treat specific pollutants. Technology-based limits are set by the EPA and published as a regulation, or Ecology develops the limit on a case-by-case basis (40 CFR 125.3, and chapter 173-220 WAC).
- Water quality-based limits are calculated so that the effluent will comply with the Surface Water Quality Standards (chapter 173-201A WAC), Ground Water Standards (chapter 173-200 WAC), Sediment Quality Standards (chapter 173-204 WAC), or the National Toxics Rule (40 CFR 131.36).
- Ecology must apply the most stringent of these limits to each parameter of concern. These limits are described below.

The limits in this permit reflect information received in the application and from supporting reports (engineering, hydrogeology, etc.). Ecology evaluated the permit application and determined the limits needed to comply with the rules adopted by the state of Washington. Ecology does not develop effluent limits for all reported pollutants. Some pollutants are not treatable at the concentrations reported, are not controllable at the source, are not listed in regulation, and do not have a reasonable potential to cause a water quality violation.

Ecology does not usually develop limits for pollutants not reported in the permit application but may be present in the discharge. The permit does not authorize discharge of the non-reported pollutants. During the five-year permit term, the facility's effluent discharge conditions may change from those conditions reported in the permit application. The facility must notify Ecology if significant changes occur in any constituent [40 CFR 122.42(a)]. Until Ecology modifies the permit to reflect additional discharge of pollutants, a permitted facility could be violating its permit.

A. Design criteria

Under WAC 173-220-150 (1)(g), flows and waste loadings must not exceed approved design criteria. Ecology approved design criteria for this facility's treatment plant in the *City of Stanwood Wastewater Treatment Plant Upgrade and Expansion – Plans and Specifications* dated March 2002, and prepared by Tetra Tech/KCM Inc. Table 7 includes design criteria from the referenced report.

Table 7. Design Criteria for City of Stanwood WWTP

Parameter	Design Quantity
Maximum Month Design Flow (MMDF)	1.5 MGD
BOD_5 Loading for Maximum Month	4,100 lb/day
TSS Loading for Maximum Month	4,100 lb/day

B. Technology-based effluent limits

Federal and state regulations define technology-based effluent limits for domestic wastewater treatment plants. These effluent limits are given in 40 CFR Part 133 (federal) and in chapter 173-221 WAC (state). These regulations are performance standards that constitute all known, available, and reasonable methods of prevention, control, and treatment (AKART) for domestic wastewater.

Table 8 identifies technology-based limits for pH, fecal coliform, BOD_5, and TSS, as listed in chapter 173-221 WAC. Section III.F of this fact sheet describes the potential for water quality-based limits.

Table 8. Technology-based Limits

Parameter	Average Monthly Limit	Average Weekly Limit
BOD_5 (concentration)	30 mg/L	45 mg/L
BOD_5 (concentration)	In addition, the BOD_5 effluent concentration must not exceed fifteen percent (15%) of the average influent concentration.	
TSS (concentration)	30 mg/L	45 mg/L
TSS (concentration)	In addition, the TSS effluent concentration must not exceed fifteen percent (15%) of the average influent concentration.	

Parameter	Monthly Geometric Mean Limit	Weekly Geometric Mean Limit
Fecal Coliform Bacteria	200 organisms/100 mL	400 organisms/100 mL

Parameter	Daily Minimum	Daily Maximum
pH	6.0 standard units	9.0 standard units

Table 9 lists the proposed technology-based mass limits for the discharge. Technology-based mass limits are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b). Ecology calculated the monthly and weekly average mass limits for BOD_5 and Total Suspended Solids as follows:

Mass Limit = CL x DF x CF

where:

CL = Technology-based concentration limits listed in the above table

DF = Maximum Monthly Average Design flow (MGD)

CF = Conversion factor of 8.34

Table 9. Technology-based Mass Limits

Parameter	Concentration Limit (mg/L)	Mass Limit (lbs/day)
BOD_5 Monthly Average	30	376
BOD_5 Weekly Average	45	563
TSS Monthly Average	30	376
TSS Weekly Average	45	563

C. Surface water quality-based effluent limits

The Washington State surface water quality standards (chapter 173-201A WAC) are designed to protect existing water quality and preserve the beneficial uses of Washington's surface waters. Waste discharge permits must include conditions that ensure the discharge will meet the surface water quality standards (WAC 173-201A-510). Water quality-based effluent limits may be based on an individual waste load allocation or on a waste load allocation developed during a basin wide total maximum daily load study (TMDL).

Numerical criteria for the protection of aquatic life and recreation

Numerical water quality criteria are listed in the water quality standards for surface waters (chapter 173-201A WAC). They specify the maximum levels of pollutants allowed in receiving water to protect aquatic life and recreation in and on the water. Ecology uses numerical criteria along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limits, the discharge must meet the water quality-based limits.

Numerical criteria for the protection of human health

The U.S. EPA has published 91 numeric water quality criteria for the protection of human health that are applicable to dischargers in Washington State (EPA, 1992). These criteria are designed to protect humans from exposure to pollutants linked to cancer and other diseases, based on consuming fish and shellfish and drinking contaminated surface waters. The water quality standards also include radionuclide criteria to protect humans from the effects of radioactive substances.

Narrative criteria

Narrative water quality criteria (e.g., WAC 173-201A-240(1); 2006) limit the toxic, radioactive, or other deleterious material concentrations that the facility may discharge to levels below those which have the potential to:

- Adversely affect designated water uses.
- Cause acute or chronic toxicity to biota.
- Impair aesthetic values.
- Adversely affect human health.

Narrative criteria protect the specific designated uses of all fresh waters (WAC 173-201A-200, 2006) and of all marine waters (WAC 173-201A-210, 2006) in the state of Washington.

Antidegradation

Description--The purpose of Washington's Antidegradation Policy (WAC 173-201A-300-330; 2006) is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.

- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).
- Apply three tiers of protection (described below) for surface waters of the state.

Tier I ensures existing and designated uses are maintained and protected and applies to all waters and all sources of pollutions. Tier II ensures that waters of a higher quality than the criteria assigned are not degraded unless such lowering of water quality is necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities. Tier III prevents the degradation of waters formally listed as "outstanding resource waters," and applies to all sources of pollution.

A facility must prepare a Tier II analysis when all three of the following conditions are met:

- The facility is planning a new or expanded action.
- Ecology regulates or authorizes the action.
- The action has the potential to cause measurable degradation to existing water quality at the edge of a chronic mixing zone.

Facility Specific Requirements--This facility must meet Tier I requirements.

- Dischargers must maintain and protect existing and designated uses. Ecology must not allow any degradation that will interfere with, or become injurious to, existing or designated uses, except as provided for in chapter 173-201A WAC.

Ecology's analysis described in this section of the fact sheet demonstrates that the proposed permit conditions will protect existing and designated uses of the receiving water.

Mixing zones

A mixing zone is the defined area in the receiving water surrounding the discharge port(s), where wastewater mixes with receiving water. Within mixing zones the pollutant concentrations may exceed water quality numeric standards, so long as the discharge doesn't interfere with designated uses of the receiving water body (for example, recreation, water supply, and aquatic life and wildlife habitat, etc.) The pollutant concentrations outside of the mixing zones must meet water quality numeric standards.

State and federal rules allow mixing zones because the concentrations and effects of most pollutants diminish rapidly after discharge, due to dilution. Ecology defines mixing zone sizes to limit the amount of time any exposure to the end-of-pipe discharge could harm water quality, plants, or fish.

The state's water quality standards allow Ecology to authorize mixing zones for the facility's permitted wastewater discharges only if those discharges already receive all known, available, and reasonable methods of prevention, control, and treatment (AKART). Mixing zones typically require compliance with water quality criteria within a specified distance from the point of discharge and must not use more than 25% of the available width of the water body for dilution [WAC 173-201A-400 (7)(b)(ii)].

Ecology uses modeling to estimate the amount of mixing within the mixing zone. Through modeling Ecology determines the potential for violating the water quality standards at the

edge of the mixing zone and derives any necessary effluent limits. Steady-state models are the most frequently used tools for conducting mixing zone analyses. Ecology chooses values for each effluent and for receiving water variables that correspond to the time period when the most critical condition is likely to occur (see Ecology's *Permit Writer's Manual*). Each critical condition parameter, by itself, has a low probability of occurrence and the resulting dilution factor is conservative. The term "reasonable worst-case" applies to these values.

The mixing zone analysis produces a numerical value called a dilution factor (DF). A dilution factor represents the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. For example, a dilution factor of 4 means the effluent is 25% and the receiving water is 75% of the total volume of water at the boundary of the mixing zone. Ecology uses dilution factors with the water quality criteria to calculate reasonable potentials and effluent limits. Water quality standards include both aquatic life-based criteria and human health-based criteria. The former are applied at both the acute and chronic mixing zone boundaries; the latter are applied only at the chronic boundary. The concentration of pollutants at the boundaries of any of these mixing zones may not exceed the numerical criteria for that zone.

Most aquatic life *acute* criteria are based on the assumption that organisms are not exposed to that concentration for more than one hour and more often than one exposure in three years. Most aquatic life *chronic* criteria are based on the assumption that organisms are not exposed to that concentration for more than four consecutive days and more often than once in three years.

The two types of human health-based water quality criteria distinguish between those pollutants linked to non-cancer effects (non-carcinogenic) and those linked to cancer effects (carcinogenic). The human health-based water quality criteria incorporate several exposure and risk assumptions. These assumptions include:

- A 70-year lifetime of daily exposures.
- An ingestion rate for fish or shellfish measured in kg/day.
- An ingestion rate of two liters/day for drinking water.
- A one-in-one-million cancer risk for carcinogenic chemicals.

This permit authorizes a small acute mixing zone, surrounded by a chronic mixing zone around the point of discharge (WAC 173-201A-400). The water quality standards impose certain conditions before allowing the discharger a mixing zone:

1. **Ecology must specify both the allowed size and location in a permit.**

   The proposed permit specifies the size and location of the allowed mixing zone (as specified below).

2. **The facility must fully apply "all known, available, and reasonable methods of prevention, control and treatment" (AKART) to its discharge.**

   Ecology has determined that the treatment provided at City of Stanwood WWTP meets the requirements of AKART (see "Technology-based Limits").

3. Ecology must consider critical discharge conditions.

Surface water quality-based limits are derived for the water body's critical condition (the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or designated waterbody uses). The critical discharge condition is often pollutant-specific or waterbody-specific.

Critical discharge conditions are those conditions that result in reduced dilution or increased effect of the pollutant. Factors affecting dilution include the depth of water, the density stratification in the water column, the currents, and the rate of discharge. Density stratification is determined by the salinity and temperature of the receiving water. Temperatures are warmer in the surface waters in summer. Therefore, density stratification is generally greatest during the summer months. Density stratification affects how far up in the water column a freshwater plume may rise. The rate of mixing is greatest when an effluent is rising. The effluent stops rising when the mixed effluent is the same density as the surrounding water. After the effluent stops rising, the rate of mixing is much more gradual. Water depth can affect dilution when a plume might rise to the surface when there is little or no stratification. Ecology uses the water depth at mean lower low water (MLLW) for marine waters. Ecology's *Permit Writer's Manual* describes additional guidance on criteria/design conditions for determining dilution factors. The manual can be obtained from Ecology's website at: https://fortress.wa.gov/ecy/publications/SummaryPages/92109.html.

Table 10. Critical Conditions Used to Model the Discharge

Critical Condition	Value
Water depth at MLLW	10 feet
50th percentile current speeds for chronic and human health mixing zones	21.3 m/sec
Maximum average monthly effluent flow for chronic and human health non-carcinogen	1.5 MGD
Maximum daily flow for acute mixing zone	1.16 MGD
Far-field dispersion coefficient for acute condition	0.000453 $m^{2/3}$/sec
Far-field dispersion coefficient for chronic condition	0.0022 $m^{2/3}$/sec
1 DAD MAX effluent temperature	23.8 degrees C

Ecology obtained ambient data at critical conditions in the vicinity of the outfall from the *City of Stanwood – Wastewater Facilities Plan*, dated May 2000, and prepared by Tetra Tech/KCM, Inc.

4. Supporting information must clearly indicate the mixing zone would not:

- Have a reasonable potential to cause the loss of sensitive or important habitat.
- Substantially interfere with the existing or characteristic uses.
- Result in damage to the ecosystem.
- Adversely affect public health.

Ecology established Washington State water quality criteria for toxic chemicals using EPA criteria. EPA developed the criteria using toxicity tests with numerous organisms and set the criteria to generally protect the species tested and to fully protect all commercially and recreationally important species.

EPA sets acute criteria for toxic chemicals assuming organisms are exposed to the pollutant at the criteria concentration for one hour. They set chronic standards assuming organisms are exposed to the pollutant at the criteria concentration for four days. Dilution modeling under critical conditions generally shows that both acute and chronic criteria concentrations are reached within minutes of discharge.

The discharge plume does not impact drifting and non-strong swimming organisms because they cannot stay in the plume close to the outfall long enough to be affected. Strong swimming fish could maintain a position within the plume, but they can also avoid the discharge by swimming away. Mixing zones generally do not affect benthic organisms (bottom dwellers) because the buoyant plume rises in the water column. Ecology has additionally determined that the effluent will not exceed 33 degrees C for more than two seconds after discharge; and that the temperature of the water will not create lethal conditions or blockages to fish migration.

Ecology evaluates the cumulative toxicity of an effluent by testing the discharge with whole effluent toxicity (WET) testing.

Ecology reviewed the above information, the specific information on the characteristics of the discharge, the receiving water characteristics, and the discharge location. Based on this review, Ecology concluded that the discharge does not have a reasonable potential to cause the loss of sensitive or important habitat, substantially interfere with existing or characteristics uses, result in damage to the ecosystem, or adversely affect public health if the permit limits are met.

5. The discharge/receiving water mixture must not exceed water quality criteria outside the boundary of a mixing zone.

Ecology conducted a reasonable potential analysis, using procedures established by the EPA and by Ecology, for each pollutant and concluded the discharge/receiving water mixture will not violate water quality criteria outside the boundary of the mixing zone if permit limits are met.

6. The size of the mixing zone and the concentrations of the pollutants must be minimized.

At any given time, the effluent plume uses only a portion of the acute and chronic mixing zone, which minimizes the volume of water involved in mixing. Because tidal currents change direction, the plume orientation within the mixing zone changes. The plume mixes as it rises through the water column therefore much of the receiving water volume at lower depths in the mixing zone is not mixed with discharge. Similarly, because the discharge may stop rising at some depth due to density stratification, waters above that depth will not mix with the discharge. Ecology determined it is impractical to specify in the permit the actual, much more limited volume in which the dilution occurs as the plume rises and moves with the current.

Ecology minimizes the size of mixing zones by requiring dischargers to install diffusers when they are appropriate to the discharge and the specific receiving waterbody. When a diffuser is installed, the discharge is more completely mixed with the receiving water in a shorter time. Ecology also minimizes the size of the mixing zone (in the form of the dilution factor) using design criteria with a low probability of occurrence. For example,

Ecology uses the expected 95th percentile pollutant concentration, the 90th percentile background concentration, the centerline dilution factor, and the lowest flow occurring once in every ten years to perform the reasonable potential analysis.

Because of the above reasons, Ecology has effectively minimized the size of the mixing zone authorized in the proposed permit.

7. Maximum size of chronic mixing zone.

The authorized chronic mixing zone does not exceed the maximum size restriction.

8. Acute mixing zone.

- **The discharge/receiving water mixture must comply with acute criteria as near to the point of discharge as practicably attainable.**

  Ecology determined the acute criteria will be met at 10% of the distance of the chronic mixing zone.

- **The pollutant concentration, duration, and frequency of exposure to the discharge will not create a barrier to migration or translocation of indigenous organisms to a degree that has the potential to cause damage to the ecosystem.**

  As described above, the toxicity of any pollutant depends upon the exposure, the pollutant concentration, and the time the organism is exposed to that concentration. Authorizing a limited acute mixing zone for this discharge assures that it will not create a barrier to migration. The effluent from this discharge will rise as it enters the receiving water, assuring that the rising effluent will not cause translocation of indigenous organisms near the point of discharge (below the rising effluent).

- **Comply with size restrictions.**

  The mixing zone authorized for this discharge complies with the size restrictions published in chapter 173-201A WAC.

9. Overlap of mixing zones.

This mixing zone does not overlap another mixing zone.

D. Designated uses and surface water quality criteria

Applicable designated uses and surface water quality criteria are defined in chapter 173-201A WAC. In addition, the U.S. EPA set human health criteria for toxic pollutants (EPA 1992). The tables included below summarize the criteria applicable to the receiving water's designated uses.

- Aquatic life uses are designated using the following general categories. All indigenous fish and non-fish aquatic species must be protected in waters of the state.

  a. Extraordinary quality salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

  b. Excellent quality salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

c. Good quality salmonid migration and rearing; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

d. Fair quality salmonid and other fish migration.

The *Aquatic Life Uses* and the associated criteria for this receiving water are identified below.

Table 11. Marine Aquatic Life Uses and Associated Criteria

Excellent Quality	
Temperature Criteria – Highest 1D MAX	16°C (60.8°F)
Dissolved Oxygen Criteria – Lowest 1-Day Minimum	6.0 mg/L
Turbidity Criteria	• 5 NTU over background when the background is 50 NTU or less; or • A 10 percent increase in turbidity when the background turbidity is more than 50 NTU.
pH Criteria	pH must be within the range of 7.0 to 8.5 with a human-caused variation within the above range of less than 0.5 units.

- To protect shellfish harvesting, fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, and not have more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies/100 mL.
- The *recreational uses* are primary contact recreation and secondary contact recreation.

The recreational use for this receiving water is identified below.

Table 12. Recreational Uses

Recreational Use	Criteria
Primary Contact Recreation	Fecal coliform organism levels must not exceed a geometric mean value of 14 colonies/100 mL, with not more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 43 colonies /100 mL.

- The *miscellaneous marine water uses* are wildlife habitat, harvesting, commerce and navigation, boating, and aesthetics.

E. Water quality impairments

The Old Stillaguamish River (OSR) has been included on the 303(d) list for temperature, fecal coliform, and dissolved oxygen (DO) (Pelletier and Sullivan, 2006). Temperature and fecal coliform listings have already been addressed by previous total maximum daily load (TMDL) studies (Joy, 2004; Pelletier and Bilhimer, 2004), and Ecology is conducting a TMDL study of the OSR to address the listing for DO.

The monitoring data shows that dissolved oxygen, temperature and fecal coliform in the river exceeded the water quality standards at sampling locations shown in the Table 13.

Complete information on the TMDL activities in the Stillaguamish can be found at: http://www.ecy.wa.gov/programs/wq/tmdl/TMDLsbyWria/tmdl-wria05.html
The aquatic life DO criterion for the OSR is 6.0 mg/l lowest 1-day minimum. When DO is lower than this criterion due to natural conditions, then human conditions considered cumulatively may not cause the DO to decrease more than 0.2 mg/L.

Ecology conducted two diel (24-hour) surveys examining changes in DO in the OSR channel on July 28-30 and September 7-9, 2004. Ecology reported the survey results in *Old Stillaguamish River Channel Diel Surveys*, July and September 2004 (Ecology Publication Number 05-03-035). Water quality criteria violations for DO were observed during the 2004 surveys and the report suggested that future TMDL evaluations would be necessary.

Ecology contracted with Battelle-Pacific Northwest Division (Battelle) to develop a 3-dimensional hydrodynamic (water quality) model to simulate the biochemical processes that affect the nutrient balance in the OSR channel and their effect on DO. The results of this modeling study are presented in *(Draft) Total Maximum Daily Load Analysis of the Old Stillaguamish River Channel – Interim Model Calibration Report*, S. A. Breithaupt and T. Khangaonkar, 2007, Battelle – Pacific Northwest Division.

The report states that "The highly dynamic character of the Old Stillaguamish River Channel (OSRC), as driven primarily by tidal conditions and the diurnal cycle of light, produces a complex system of interacting components whose effects are difficult to separate without sufficient data and analysis". Ecology plans to develop a TMDL followed by waste load allocation (WLA) in the future.

In the absence of WLA for DO for the Stanwood WWTP, the permit proposes technology-based limits for BOD shown in Table 17 and in Condition S1.A of the proposed permit.

Table 13. Parameters Listed in the 303 (d) list for the Old Stillaguamish River

Parameter	Category	Location	Sample Measurement	Comments
Fecal Coliform	4A (approved TMDL being actively implemented)	Lat: 48.235 Long: 122.365	Ranging from geometric mean of 32 to 472	Based on Ecology and Stillaguamish Tribe data from 1996 through 2001.
Dissolved Oxygen	5 (TMDL study in progress)	31N-4E-5	In 2006, 5 of 6 samples (83.3%) showed an excursion of the criteria for this waterbody, (criterion = 8.0 mg/L).	Data from the Dept. of Ecology EIM database for the Project STILTMDL (Stillaguamish TMDL) station 05TMS3 (Main Stilly Channel near river mile 3)
Dissolved Oxygen	5 (TMDL study in progress)	32N-4E-30	In 2004, 1 of 1 sample (100.0%) showed an excursion of the criteria for this waterbody, (criterion = 8.0 mg/L).	Data from the Dept. of Ecology EIM database for the Project STILTMDL (Stillaguamish TMDL) station 05TTCF5 (Twin City Foods Drain #5)
Dissolved Oxygen	5 (TMDL study in progress)	32N-4E-32	In 2004, 4 of 4 samples (100.0%) showed an excursion of the criteria for this waterbody, (criterion = 8.0 mg/L).	Location ID [05TOC4]
Temperature	5 (TMDL has not been developed)	T 32N, R 4E, S 29	24.8°C (7-day mean of daily values)	Stillaguamish Tribe unpublished data shows a 7-day mean of daily values of 24.8°C at Florence (Station 145) in 2001.
Temperature	5 (TMDL has not been developed)	T 32N, R 4E, S 32	23.2°C (7-day mean of daily values)	Stillaguamish Tribe unpublished data shows a 7-day mean of daily values of 23.2°C at Peterson Bridge (Station 90) and 22.4°C above Hatt Slough (Station 135) in 2001.
Temperature			19.6°C	Maximum temperature of 19.6°C was measured on September 4, 1992, during Ecology's study of the impacts of Stanwood's discharge on the river.

F. Evaluation of surface water quality-based effluent limits for narrative criteria

Ecology must consider the narrative criteria described in WAC 173-201A-260 when it determines permit limits and conditions. Narrative water quality criteria limit the toxic, radioactive, or other deleterious material concentrations that the facility may discharge which have the potential to adversely affect designated uses, cause acute or chronic toxicity to biota, impair aesthetic values, or adversely affect human health.

Ecology considers narrative criteria when it evaluates the characteristics of the wastewater and when it implements all known, available, and reasonable methods of treatment and prevention (AKART) as described above in the technology-based limits section. When Ecology determines if a facility is meeting AKART it considers the pollutants in the wastewater and the adequacy of the treatment to prevent the violation of narrative criteria.

In addition, Ecology considers the toxicity of the wastewater discharge by requiring whole effluent toxicity (WET) testing when there is a reasonable potential for the discharge to contain toxics. Ecology's analysis of the need for WET testing for this discharge is described later in the fact sheet.

G. Evaluation of surface water quality-based effluent limits for numeric criteria

Pollutants in an effluent may affect the aquatic environment near the point of discharge (near-field) or at a considerable distance from the point of discharge (far-field). Toxic pollutants, for example, are near-field pollutants; their adverse effects diminish rapidly with mixing in the receiving water. Conversely, a pollutant such as biochemical oxygen demand (BOD_5) is a far-field pollutant whose adverse effect occurs away from the discharge even after dilution has occurred. Thus, the method of calculating surface water quality-based effluent limits varies with the point at which the pollutant has its maximum effect.

With technology-based controls (AKART), predicted pollutant concentrations in the discharge exceed water quality criteria. Ecology therefore authorizes a mixing zone in accordance with the geometric configuration, flow restriction, and other restrictions imposed on mixing zones by chapter 173-201A WAC.

The Outfall 001 consists of approximately 30 feet of a 24-inch diameter open-ended, coated corrugated metal pipe with a discharge depth of approximately 10 feet below mean lower low water level. Ecology obtained this information from the *City of Stanwood - Wastewater Facilities Plan*, May 2000, prepared by Tetra Tech/KCM, Inc.

Chronic Mixing Zone--WAC 173-201A-400(7)(b) specifies that mixing zones must not extend in any horizontal direction from the discharge ports for a distance greater than 200 feet plus the depth of water over the discharge ports and may not occupy more than 25% of the width of the water body as measured during MLLW. The authorized mixing zone size complies with the width restriction. The horizontal distance of the chronic mixing zone is 210 feet. The mixing zone extends from the bottom to the top of the water column.

The study report entitled *An Analysis of the Effect of Discharged Wastewater on the Stillaguamish River at Stanwood*, Norm Glenn, July 1996, Ecology Publication Number 96-330 provides further details on how the dimensions of the chronic zone were determined. Based on this publication:

(i) The width of the chronic mixing zone (perpendicular to the shoreline) is 25 feet. The mixing zone is centered over the outfall port extending 12.5 feet in both directions.

(ii) The length of the chronic mixing zone (parallel to the shoreline) is 210 feet. The mixing zone extends 105 feet in each direction, upstream and downstream, from the outfall port.

Acute Mixing Zone--WAC 173-201A-400(8)(b) specifies that in estuarine waters a zone where acute criteria may be exceeded must not extend beyond 10% of the distance established for the chronic zone. The acute mixing zone for Outfall 001 extends 10.5 feet in any direction from any discharge port.

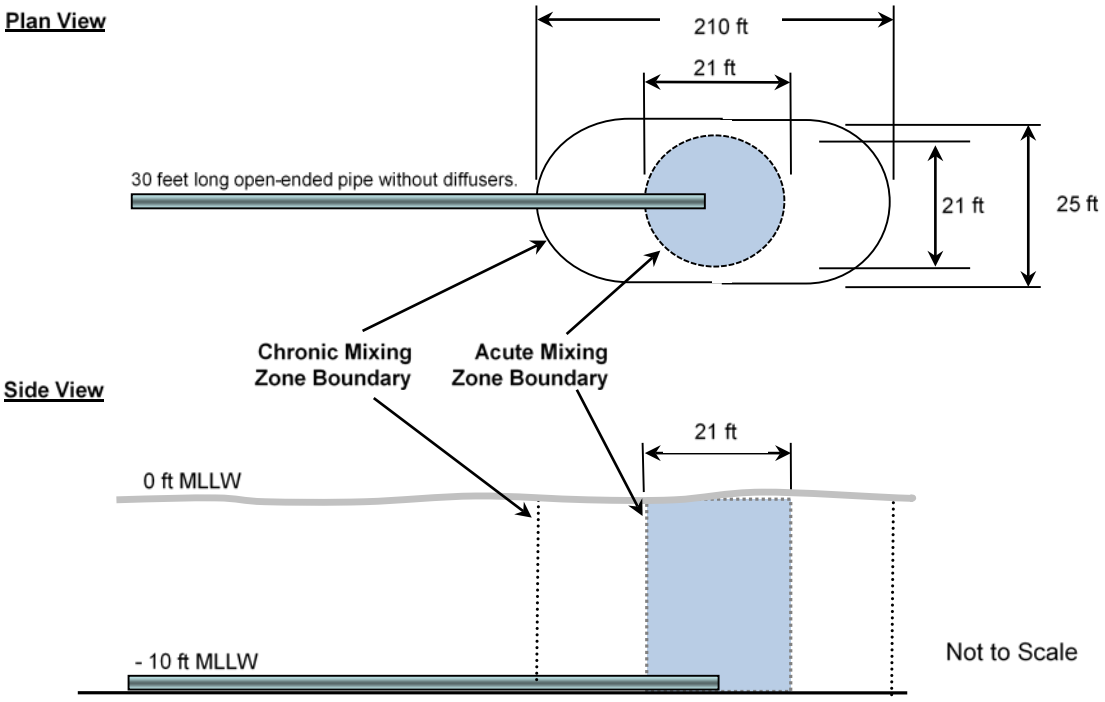
Based upon the Ecology Publication Number 96-330 aforementioned:

(i) The width of the acute mixing zone (perpendicular to the shoreline) is 21 feet. The mixing zone is centered over the outfall port extending 10.5 feet in both directions.

(ii) The length of the acute mixing zone (parallel to the shoreline) is 21 feet. The mixing zone extends 10.5 feet in each direction, upstream and downstream, from the outfall port.

The dimensions and boundaries of the mixing zones are as depicted below.

Figure 2. Outfall Mixing Zones



The City used the PLUMES model to determine dilution factors that occur within the mixing zones at the critical condition. The dilution analysis based on PLUMES model is included in the *City of Stanwood - Wastewater Facilities Plan*, May 2000, approved by Ecology on May 30, 2000. The dilution factors determined for the year 2020 continuous flow discharge conditions are shown in the following table:

Table 14. Dilution Factors (DF)

Criteria	Acute	Chronic
Aquatic Life	8	36
Human Health, Carcinogen		36
Human Health, Non-carcinogen		36

Ecology determined the impacts of dissolved oxygen deficiency, nutrients, pH, fecal coliform, ammonia, metals, other toxics, and temperature as described below, using the dilution factors in the above table. The derivation of surface water quality-based limits also takes into account the variability of pollutant concentrations in both the effluent and the receiving water.

Dissolved Oxygen--BOD_5 and Ammonia Effects--Natural decomposition of organic material in wastewater effluent impacts dissolved oxygen in the receiving water at distances far outside of the regulated mixing zone. The 5-day Biochemical Oxygen Demand (BOD_5) of an effluent sample indicates the amount of biodegradable material in the wastewater and estimates the magnitude of oxygen consumption the wastewater will generate in the receiving water. The amount of ammonia-based nitrogen in the wastewater also provides an indication of oxygen demand potential in the receiving water.

With technology-based limits, this discharge results in a small amount of biochemical oxygen demand (BOD_5) relative to the large amount of dilution in the receiving water at critical conditions. Technology-based limits will ensure that dissolved oxygen criteria are met in the receiving water.

pH--Compliance with the technology-based limits of 6.0 to 9.0 will assure compliance with the water quality standards of surface waters because of the high buffering capacity of marine water.

Fecal Coliform--Ecology modeled the numbers of fecal coliform by simple mixing analysis using the technology-based limit of 400 organisms per 100 ml, an ambient fecal coliform concentration of 1 organisms per 100mL, and a dilution factor of 36 (see Appendix D).

Under critical conditions, modeling predicts no violation of the water quality criterion for fecal coliform. Therefore, the proposed permit includes the technology-based effluent limit for fecal coliform bacteria.

Turbidity--Ecology evaluated the impact of turbidity based on the range of total suspended solids in the effluent and turbidity of the receiving water. Ecology expects no violations of the turbidity criteria outside the designated mixing zone provided the facility meets its technology-based total suspended solids permit limits.

Toxic Pollutants--Federal regulations (40 CFR 122.44) require Ecology to place limits in NPDES permits on toxic chemicals in an effluent whenever there is a reasonable potential for those chemicals to exceed the surface water quality criteria. Ecology does not exempt facilities with technology-based effluent limits from meeting the surface water quality standards.

The toxic pollutants listed in Table 15 are present in the discharge. Ecology conducted a reasonable potential analysis (See Appendix D) on these parameters to determine whether it would require effluent limits in this permit.

Table 15. Toxic Pollutants Present in the Discharge

Parameter	Units	# of Samples	Average of Sample Values	Maximum of Sample Values
Ammonia	mg/L	8	0.221	0.5
Arsenic	ug/L	3	6.0	6.0
Cadmium	ug/L	3	0.06	0.2
Chromium	ug/L	3	0.3	0.9
Copper	ug/L	3	8.0	11.0
Lead	ug/L	3	0.3	0.9
Mercury	ug/L	3	0.0009	0.0015
Nickel	ug/L	3	3.0	5.0
Selenium	ug/L	3	0.4	0.7
Thallium	ug/L	3	7.0	21.0
Zinc	ug/L	3	43.0	68.0
Total Phenolic Compounds	ug/L	3	16.3	49.0
Cyanide (WAD)	ug/L	3	1.6	5.0
Chloroform	ug/L	3	0.623	1.8
Bis (2-Ethylhexyl) Phthalate	ug/L	3	7.1	19.0

Ammonia's toxicity depends on that portion which is available in the unionized form. The amount of unionized ammonia depends on the temperature, pH, and salinity of the receiving marine water. To evaluate ammonia toxicity, Ecology used the available receiving water information described in section II.B (Description of the receiving water) and Ecology spreadsheet tools.

No valid ambient background data were available for the other pollutants listed above. Ecology used zero for background.

Ecology determined that the toxic pollutants listed in Table 15, except cyanide, pose no reasonable potential to exceed the water quality criteria at the critical condition using procedures given in EPA, 1991 (*Appendix D*) and as described above. Ecology's determination assumes that this facility meets the other effluent limits of this permit.

Ecology determined that cyanide may pose a reasonable potential to exceed the water quality criteria at the critical conditions using methods from EPA, 1991 (*Appendix D)* and as described above. However, Ecology will not establish effluent limits for this pollutant in the proposed permit because Ecology recognizes that the sampling frequency (3/permit cycle) required in the previous permit was very limited in the number of samples collected and analyzed and may not be representative for the reasonable potential analysis. To better assess any exceedance of the water quality criteria, the proposed permit will require quarterly monitoring of this priority pollutant. Ecology also recognizes that increasing the sampling frequency will generate a data set that is statistically significant and more representative of the effluent discharge characteristics.

Ecology's determination assumes that this facility meets the other effluent limits of this permit.

Temperature--The state temperature standards [WAC 173-201A-200-210 and 600-612] include multiple elements:

- Annual summer maximum threshold criteria (June 15 to September 15)
- Supplemental spawning and rearing season criteria (September 15 to June 15)
- Incremental warming restrictions
- Protections against acute effects

Ecology evaluates each criterion independently to determine reasonable potential and derive permit limits.

- Annual summer maximum and supplementary spawning/rearing criteria

  Each water body has an annual maximum temperature criterion [WAC 173-201A-200(1)(c), 210(1)(c), and Table 602]. These threshold criteria (e.g., 12, 16, 17.5, 20°C) protect specific categories of aquatic life by controlling the effect of human actions on summer temperatures.

  Some waters have an additional threshold criterion to protect the spawning and incubation of salmonids (9°C for char and 13°C for salmon and trout) [WAC 173-201A-602, Table 602]. These criteria apply during specific date-windows.

  The threshold criteria apply at the edge of the chronic mixing zone. Criteria for most fresh waters are expressed as the highest 7-Day average of daily maximum temperature (7-DADMax). The 7-DADMax temperature is the arithmetic average of seven consecutive measures of daily maximum temperatures. Criteria for marine waters and some fresh waters are expressed as the highest 1-Day annual maximum temperature (1-DMax).

- Incremental warming criteria

  The water quality standards limit the amount of warming human sources can cause under specific situations [WAC 173-201A-200(1)(c)(i)-(ii), 210(1)(c)(i)-(ii)]. The incremental warming criteria apply at the edge of the chronic mixing zone.

  At locations and times when background temperatures are cooler than the assigned threshold criterion, point sources are permitted to warm the water by only a defined increment. These increments are permitted only to the extent doing so does not cause temperatures to exceed either the annual maximum or supplemental spawning criteria.

  At locations and times when a threshold criterion is being exceeded due to natural conditions, all human sources, considered cumulatively, must not warm the water more than 0.3°C above the naturally warm condition.

  When Ecology has not yet completed a TMDL, our policy allows each point source to warm water at the edge of the chronic mixing zone by 0.3°C. This is true regardless of the background temperature and even if doing so would cause the temperature at the edge of a standard mixing zone to exceed the numeric threshold criteria. Allowing a 0.3°C warming for each point source is reasonable and protective where the dilution factor is based on 25% or less of the critical flow. This is because the fully mixed effect on temperature will only be a fraction of the 0.3°C cumulative allowance (0.075°C or less) for all human sources combined.

- Protections for temperature acute effects

  Instantaneous lethality to passing fish: The upper 99th percentile daily maximum effluent temperature must not exceed 33°C, unless a dilution analysis indicates ambient temperatures will not exceed 33°C two seconds after discharge.

  General lethality and migration blockage: Measurable (0.3°C) increases in temperature at the edge of a chronic mixing zone are not allowed when the receiving water temperature exceeds either a 1DMax of 23°C or a 7DADMax of 22°C.

  Lethality to incubating fish: Human actions must not cause a measurable (0.3°C) warming above 17.5°C at locations where eggs are incubating.

Reasonable Potential Analysis

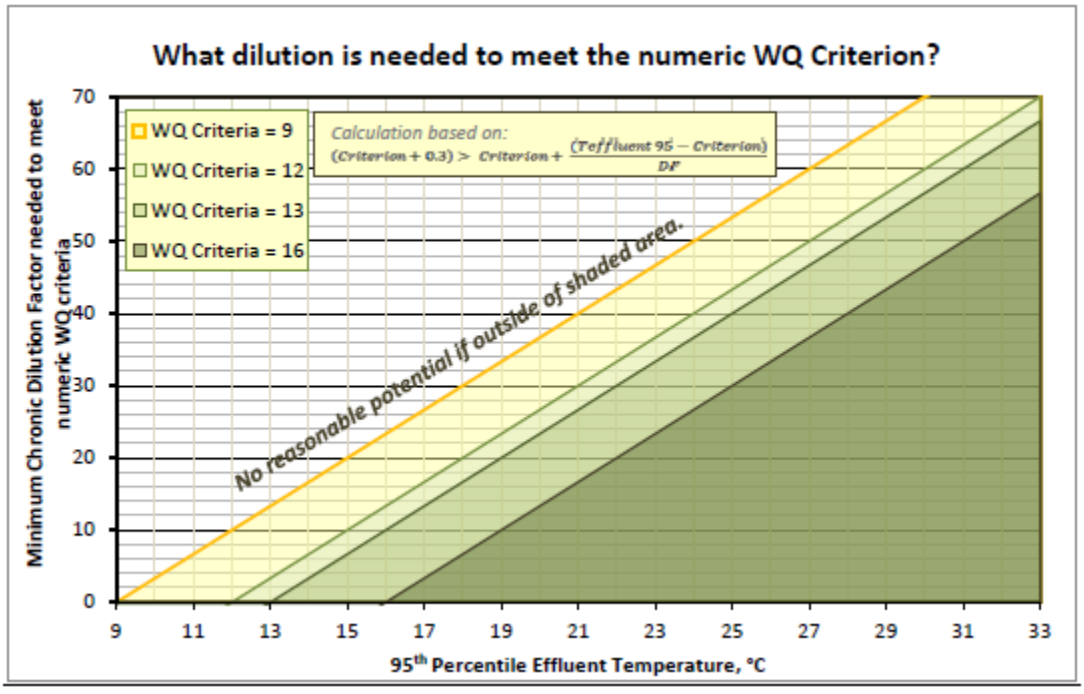
Annual summer maximum and incremental warming criteria: Ecology calculated the reasonable potential for the discharge to exceed the annual summer maximum and the incremental warming criteria at the edge of the chronic mixing zone during critical condition. No reasonable potential exists to exceed the temperature criterion where:

(Criterion + 0.3) > [Criterion + (Teffluent95 – Criterion)/DF].

(16 + 0.3) > [16 + (23.3 – 16)/36] = > 16.3 > 16.2

The figure below graphically portrays the above equation and shows the conditions when a permit limit will apply.

Figure 3. Dilution Necessary to Meet Criteria at Edge of Mixing Zone



Therefore, the proposed permit does not include a temperature limit. The permit requires additional monitoring of effluent temperatures. Ecology will reevaluate the reasonable potential during the next permit renewal.

H. Human health

Washington's water quality standards include 91 numeric human health-based criteria that Ecology must consider when writing NPDES permits. These criteria were established in 1992 by the U.S. EPA in its National Toxics Rule (40 CFR 131.36). The National Toxics Rule allows states to use mixing zones to evaluate whether discharges comply with human health criteria.

Ecology determined the effluent contains chemicals of concern for human health, based on data or information reported in priority pollutant testing that indicate regulated chemicals occur in the discharge. A list of the pollutants of concern for human health is shown in Table 16.

Table 16. Human Health Pollutants Present in the Discharge

Parameter	Units	# of Samples	Average of Sample Values	Maximum of Sample Values
Arsenic	ug/L	3	6.0	6.0
Cadmium	ug/L	3	0.06	0.2
Chromium	ug/L	3	0.3	0.9
Copper	ug/L	3	8.0	11.0
Lead	ug/L	3	0.3	0.9
Mercury	ug/L	3	0.0009	0.0015
Nickel	ug/L	3	3.0	5.0
Selenium	ug/L	3	0.4	0.7
Thallium	ug/L	3	7.0	21.0
Zinc	ug/L	3	43.0	68.0
Total Phenolic Compounds	ug/L	3	16.3	49.0
Cyanide (WAD)	ug/L	3	1.6	5.0
Chloroform	ug/L	3	0.623	1.8
Bis (2-Ethylhexyl) Phthalate	ug/L	3	7.1	19.0

Ecology evaluated the discharge's potential to violate the water quality standards as required by 40 CFR 122.44(d) by following the procedures published in the *Technical Support Document for Water Quality-Based Toxics Control* (EPA/505/2-90-001) and Ecology's *Permit Writer's Manual* to make a reasonable potential determination. The evaluation (See *Appendix D*) showed that the discharge has no reasonable potential to cause a violation of water quality standards, and effluent limits are not needed for the pollutants listed in Table 16.

I. Sediment quality

The aquatic sediment standards (chapter 173-204 WAC) protect aquatic biota and human health. Under these standards Ecology may require a facility to evaluate the potential for its discharge to cause a violation of sediment standards (WAC 173-204-400). You can obtain additional information about sediments at the Aquatic Lands Cleanup Unit website. http://www.ecy.wa.gov/programs/tcp/smu/sediment.html

Through a review of the discharger characteristics and of the effluent characteristics, and facility operations, Ecology determined that this discharge has no reasonable potential to violate the sediment management standards. Therefore, the proposed permit does not require sediment monitoring in the vicinity of the discharge outfall. If substantial changes affecting the effluent occur, the Aquatic Lands Cleanup Unit (ALCU) will reassess the sediment monitoring requirements at the facility.

J. Whole effluent toxicity

The water quality standards for surface waters forbid discharge of effluent that has the potential to cause toxic effects in the receiving waters. Many toxic pollutants cannot be measured by commonly available detection methods. However, laboratory tests can measure toxicity directly by exposing living organisms to the wastewater and measuring their responses. These tests measure the aggregate toxicity of the whole effluent, so this approach is called whole effluent toxicity (WET) testing. Some WET tests measure acute toxicity and other WET tests measure chronic toxicity.

- *Acute toxicity tests measure mortality as the significant* response to the toxicity of the effluent. Dischargers who monitor their wastewater using acute toxicity tests find early indications of any potential lethal effect of the effluent on organisms in the receiving water.
- *Chronic toxicity tests measure various sublethal toxic responses*, such as reduced growth or reproduction. Chronic toxicity tests often involve either a complete life cycle test on an organism with an extremely short life cycle, or a partial life cycle test during a critical stage of a test organism's life. Some chronic toxicity tests also measure organism survival.

Laboratories accredited by Ecology for WET testing know how to use the proper WET testing protocols, fulfill the data requirements, and submit results in the correct reporting format. Accredited laboratory staff know how to calculate an NOEC, LC50, EC50, IC25, etc. Ecology gives all accredited labs the most recent version of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria* (https://fortress.wa.gov/ecy/publications/SummaryPages/9580.html), which is referenced in the permit. Ecology recommends that each regulated facility send a copy of the acute or chronic toxicity sections(s) of its NPDES permit to the laboratory.

Acute WET testing conducted during effluent characterization showed no reasonable potential for effluent discharges to cause receiving water acute toxicity. The proposed permit will not include an acute WET limit. City of Stanwood WWTP must retest the effluent before submitting an application for permit renewal.

- If this facility makes process or material changes which, in Ecology's opinion, increase the potential for effluent toxicity, then Ecology may (in a regulatory order, by permit modification, or in the permit renewal) require the facility to conduct additional effluent characterization. City of Stanwood WWTP may demonstrate to Ecology that effluent toxicity has not increased by performing additional WET testing and/or chemical analyses after the process or material changes have been made. Ecology recommends that the Permittee check with it first to make sure that Ecology will consider the demonstration adequate to support a decision to not require an additional effluent characterization.
- If WET testing conducted for submittal with a permit application fails to meet the performance standards in WAC 173-205-020, Ecology will assume that effluent toxicity has increased.

Chronic WET testing conducted during effluent characterization showed no reasonable potential for effluent discharges to cause receiving water chronic toxicity. The proposed permit will not include a chronic WET limit. City of Stanwood WWTP must retest the effluent before submitting an application for permit renewal.

- If this facility makes process or material changes which, in Ecology's opinion, increase the potential for effluent toxicity, then Ecology may (in a regulatory order, by permit modification, or in the permit renewal) require the facility to conduct additional effluent characterization.
- If WET testing conducted for submittal with a permit application fails to meet the performance standards in WAC 173-205-020, Ecology will assume that effluent toxicity has increased. City of Stanwood WWTP may demonstrate to Ecology that effluent toxicity has not increased by performing additional WET testing after the process or material changes have been made.

K. Groundwater quality limits

The groundwater quality standards (chapter 173-200 WAC) protect beneficial uses of groundwater. Permits issued by Ecology must not allow violations of those standards (WAC 173-200-100). The City of Stanwood WWTP does not discharge wastewater to the ground. No permit limits are required to protect groundwater.

L. Comparison of effluent limits with the previous permit issued permit modified on October 25, 2011.

Table 17. Comparison of Previous and Proposed Effluent Limits

		Previous Effluent Limits: Outfall # 001		Proposed Effluent Limits: Outfall # 001	
Parameter	**Basis of Limit**	**Average Monthly**	**Average Weekly**	**Average Monthly**	**Average Weekly**
Biochemical Oxygen Demand (5-day)	Technology	30 mg/L 376 lbs/day 85% removal	45 mg/L 563 lbs/day	30 mg/L 376 lbs/day 85% removal	45 mg/L 563 lbs/day
Total Suspended Solids	Technology	30 mg/L 376 lbs/day 85% removal	45 mg/L 563 lbs/day	30 mg/L 376 lbs/day 85% removal	45 mg/L 563 lbs/day

Parameter		**Monthly Geometric Mean Limit**	**Weekly Geometric Mean Limit**	**Monthly Geometric Mean Limit**	**Weekly Geometric Mean Limit**
Fecal Coliform Bacteria	Technology	200/100 mL	400/100 mL	200/100 mL	400/100 mL

Parameter		**Limit**	**Limit**
pH	Technology	Daily minimum equal to or greater than 6.0; daily maximum less than or equal to 9.0	Daily minimum equal to or greater than 6.0; daily maximum less than or equal to 9.0

IV. Monitoring Requirements

Ecology requires monitoring, recording, and reporting (WAC 173-220-210 and 40 CFR 122.41) to verify that the treatment process is functioning correctly and that the discharge complies with the permit's effluent limits.

If a facility uses a contract laboratory to monitor wastewater, it must ensure that the laboratory uses the methods and meets or exceeds the method detection levels required by the permit. The permit describes when facilities may use alternative methods. It also describes what to do in certain situations when the laboratory encounters matrix effects. When a facility uses an alternative method as allowed by the permit, it must report the test method, detection level (DL), and quantitation level (QL) on the discharge monitoring report or in the required report.

A. Wastewater monitoring

The monitoring schedule is detailed in the proposed permit under Special Condition S.2. Specified monitoring frequencies take into account the quantity and variability of the discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring. The required monitoring frequency is consistent with agency guidance given in the current version of Ecology's *Permit Writer's Manual* (Publication Number 92-109) for activated sludge facilities with design flows less than 2.0 MGD average design flow.

Ecology has included some additional monitoring of nutrients in the proposed permit to establish a baseline for this discharger. Ecology will use this data in the future if Ecology develops TMDLs for dissolved oxygen and establishes WLAs for nutrients.

Monitoring of sludge quantity and quality is necessary to determine the appropriate uses of the sludge. Biosolids monitoring is required by the current state and local solid waste management program and also by EPA under 40 CFR 503.

B. Lab accreditation

Ecology requires that facilities must use a laboratory registered or accredited under the provisions of chapter 173-50 WAC, Accreditation of Environmental Laboratories, to prepare all monitoring data (with the exception of certain parameters). Ecology accredited the laboratory at the City of Stanwood WWTP (W512-15) for the parameters and methods listed in Table 18.

Table 18. Accredited Parameters

Parameter Name	Category	Method Name	Matrix Description
Biochemical Oxygen Demand	General Chemistry	SM 5210 B-01	Non-potable water
Total Suspended Solids	General Chemistry	SM 2540 D-97	Non-potable water
Dissolved Oxygen	General Chemistry	SM 4500-O G-01	Non-potable water
pH	General Chemistry	SM 4500-H^+ B-00	Non-potable water
Fecal coliform	Microbiology	SM 9222 D (m-FC)-97	Non-potable water

V. Other Permit Conditions

A. Reporting and record keeping

Ecology based Special Condition S3 on its authority to specify any appropriate reporting and record keeping requirements to prevent and control waste discharges (WAC 173-220-210).

B. Prevention of facility overloading

Overloading of the treatment plant is a violation of the terms and conditions of the permit. To prevent this from occurring, RCW 90.48.110 and WAC 173-220-150 require the City of Stanwood WWTP to:

- Take the actions detailed in proposed permit Special Condition S.4.
- Design and construct expansions or modifications before the treatment plant reaches existing capacity.
- Report and correct conditions that could result in new or increased discharges of pollutants.

Special Condition S.4 restricts the amount of flow.

If the City intends to apply for Ecology-administered funding for the design or construction of a facility project, the plan must meet the standard of a "Facility Plan", as defined in WAC 173-98-030. A complete "Facility Plan" includes all elements of an "Engineering Report" along with State Environmental Review Process (SERP) documentation to demonstrate compliance with 40 CFR 35.3140 and 40 CFR 35.3145, and a cost effectiveness analysis as required by WAC 173-98-730. The City should contact Ecology's regional office as early as practical before planning a project that may include Ecology-administered funding.

C. Operation and maintenance

The proposed permit contains Special Condition S.5 as authorized under RCW 90.48.110, WAC 173-220-150, chapter 173-230 WAC, and WAC 173-240-080. Ecology included it to ensure proper operation and regular maintenance of equipment, and to ensure that the City of Stanwood WWTP takes adequate safeguards so that it uses constructed facilities to their optimum potential in terms of pollutant capture and treatment.

The City has recorded a peak flow event of 293 gallons per capita per day (gpcd) in the last few years, which exceeds the United States Environmental Protection Agency (EPA) maximum of 275 gpcd for inflow. An I/I analysis will be fundamental to assist the City to eliminate any excessive inflow in the collection system. Therefore, the proposed permit requires the City of Stanwood WWTP to conduct an infiltration and inflow evaluation and submit a report summarizing the results of the evaluation and any recommendations for corrective actions. Specifically, the report must include the following information:

- Volume of the annual average and peak daily flow under worst conditions (inflow or infiltration) attributed to leaks.
- Location of each individual leaks.
- Size of each leak and/or volume of excess flow contributed by a run of sewer.
- Whether exfiltration occurs in the system's force mains and/or inverted siphons.

Three good references to aid in these tasks include:

- American Society of Civil Engineers and Water Environment Federation Manual of Practice FD-6, *Existing Sewer Evaluation and Rehabilitation*.
- U.S. Environmental Protection Agency, *Handbook for Sewer System Infrastructure Analysis and Rehabilitation*, EPA/625/6-91/030, 1991.
- Washington State Department of Transportation, *Standard Specifications for Road, Bridge, and Municipal Construction*, 2002.

Following characterization of the leaks, Ecology may require corrective actions by issuing an administrative order following review of the assessment.

D. Pretreatment

Duty to enforce discharge prohibitions

This provision prohibits the publicly owned treatment works (POTW) from authorizing or permitting an industrial discharger to discharge certain types of waste into the sanitary sewer.

- The first section of the pretreatment requirements prohibits the POTW from accepting pollutants which causes "pass-through" or "interference". This general prohibition is from 40 CFR §403.5(a). *Appendix C* of this fact sheet defines these terms.
- The second section reinforces a number of specific state and federal pretreatment prohibitions found in WAC 173-216-060 and 40 CFR §403.5(b). These reinforce that the POTW may not accept certain wastes, which:
    a. Are prohibited due to dangerous waste rules.
    b. Are explosive or flammable.
    c. Have too high or low of a pH (too corrosive, acidic or basic).
    d. May cause a blockage such as grease, sand, rocks, or viscous materials.
    e. Are hot enough to cause a problem.
    f. Are of sufficient strength or volume to interfere with treatment.
    g. Contain too much petroleum-based oils, mineral oil, or cutting fluid.
    h. Create noxious or toxic gases at any point.

40 CFR Part 403 contains the regulatory basis for these prohibitions, with the exception of the pH provisions which are based on WAC 173-216-060.

- The third section of pretreatment conditions reflects state prohibitions on the POTW accepting certain types of discharges unless the discharge has received prior written authorization from Ecology. These discharges include:
    a. Cooling water in significant volumes.
    b. Stormwater and other direct inflow sources.
    c. Wastewaters significantly affecting system hydraulic loading, which do not require treatment.

Federal and state pretreatment program requirements

Ecology administers the Pretreatment Program under the terms of the addendum to the "Memorandum of Understanding between Washington Department of Ecology and the United States Environmental Protection Agency, Region 10" (1986) and 40 CFR, part 403. Under this delegation of authority, Ecology issues wastewater discharge permits for significant industrial users (SIUs) discharging to POTWs which have not been delegated authority to issue wastewater discharge permits. Ecology must approve, condition, or deny new discharges or a significant increase in the discharge for existing significant industrial users (SIUs) [40 CFR 403.8 (f)(1)(i) and(iii)].

Industrial dischargers must obtain a permit from Ecology before discharging waste to the City of Stanwood WWTP [WAC 173-216-110(5)]. Industries discharging wastewater that is similar in character to domestic wastewater do not require a permit.

Routine identification and reporting of industrial users

The permit requires non-delegated POTWs to take "continuous, routine measures to identify all existing, new, and proposed significant industrial users (SIUs) and potential significant industrial users (PSIUs)" discharging to their sewer system. Examples of such routine measures include regular review of water and sewer billing records, business license and building permit applications, advertisements, and personal reconnaissance. System maintenance personnel should be trained on what to look for so they can identify and report new industrial dischargers in the course of performing their jobs. The POTW may not allow SIUs to discharge prior to receiving a permit, and must notify all industrial dischargers (significant or not) in writing of their responsibility to apply for a State Waste Discharge Permit. The POTW must send a copy of this notification to Ecology.

Requirements for performing an industrial user survey

This POTW has the potential to serve significant industrial or commercial users and must conduct an industrial user (IU) survey. The purpose of the IU Survey is to identify all facilities that may be subject to pretreatment standards or requirements so that Ecology can take appropriate measures to control these discharges. The POTW should identify each such user, and require them to apply for a permit before allowing their discharge to the POTW to commence. For SIUs, the POTW must require they actually are issued a permit prior to accepting their discharge. The steps the POTW must document in their IU Survey submittal include:

1. The POTW must develop a master list of businesses that may be subject to pretreatment standards and requirements and show their disposition. This list must be based on several sources of information including business licenses, and water and sewer billing records.
2. The POTW must canvas all the potential sources, having them either complete a survey form or ruling them out by confirming they only generate domestic wastewater.
3. The POTW must develop a list of the SIUs and potential SIUs in all areas served by the POTW. The list must contain sufficient information on each to allow Ecology to decide which discharges merit further controls such as a state waste discharge permit.

Ecology describes the information needed in IU Survey submittals to allow Ecology to make permitting decision in the manual "Performing an Industrial User Survey". Properly completing an Industrial User Survey helps Ecology control discharges that may otherwise harm the POTW including its collection system, processes, and receiving waters. Where surveys are incomplete, Ecology may take such enforcement as appropriate and/or require the POTW to develop a fully delegated pretreatment program.

The proposed permit requires the City of Stanwood WWTP to conduct an industrial user survey to determine the extent of compliance of all industrial users of the sanitary sewer and wastewater treatment facility with federal pretreatment regulations [40 CFR Part 403 and Sections 307(b) and 308 of the Clean Water Act)], with state regulations (chapter 90.48 RCW and chapter 173-216 WAC), and with local ordinances.

E. Solid wastes

To prevent water quality problems the facility is required in permit Special Condition S7 to store and handle all residual solids (grit, screenings, sludge, and other solid waste) in accordance with the requirements of RCW 90.48.080 and state water quality standards.

The final use and disposal of sewage sludge from this facility is regulated by U.S. EPA under 40 CFR 503, and by Ecology under chapter 70.95J RCW, chapter 173-308 WAC "Biosolids Management," and chapter 173-350 WAC "Solid Waste Handling Standards." The disposal of other solid waste is under the jurisdiction of the Snohomish County Health Department.

Requirements for monitoring sewage sludge and record keeping are included in this permit. Ecology will use this information, required under 40 CFR 503, to develop or update local limits.

F. Outfall evaluation

Ecology does not have a record of an outfall inspection being conducted in the last 10 years. Therefore, the proposed permit requires the City of Stanwood WWTP to conduct an outfall inspection and submit a report detailing the findings of that inspection (Special Condition S.8). The inspection must accomplish the following:

- Evaluate physical condition of the discharge pipe and associated couplings.
- Evaluate extent of sediment accumulations in the vicinity of the pipe opening.
- Determine whether the pipe is free from obstructions.
- Assess physical condition of the submarine line.
- Assess physical condition of anchors used to secure the submarine line.

G. General conditions

Ecology bases the standardized General Conditions on state and federal law and regulations. They are included in all individual domestic wastewater NPDES permits issued by Ecology.

VI. Permit Issuance Procedures

A. Permit modifications

Ecology may modify this permit to impose numerical limits, if necessary, to comply with water quality standards for surface waters, with sediment quality standards, or with water quality standards for groundwaters, based on new information from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

Ecology may also modify this permit to comply with new or amended state or federal regulations.

B. Proposed permit issuance

This proposed permit meets all statutory requirements for Ecology to authorize a wastewater discharge. The permit includes limits and conditions to protect human health and aquatic life, and the beneficial uses of waters of the state of Washington. Ecology proposes to issue this permit for a term of 5 years.

VII. References for Text and Appendices

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1985. *Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water*. EPA/600/6-85/002a.

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2002. *City of Stanwood - WWTP Upgrade and Expansion, Plans and Specifications*, Tetra Tech/KCM, Inc.

2000. *City of Stanwood - Wastewater Facilities Plan*, Tetra Tech/KCM, Inc.

Appendix A--Public Involvement Information

Ecology proposes to issue a permit to City of Stanwood WWTP. The permit includes wastewater discharge limits and other conditions. This fact sheet describes the facility and Ecology's reasons for requiring permit conditions.

Ecology placed a Public Notice of Draft on July 28, 2016, in the *Everett Herald* to inform the public and to invite comment on the proposed draft National Pollutant Discharge Elimination System permit and fact sheet.

The notice:

- Told where copies of the draft permit and fact sheet were available for public evaluation (a local public library, the closest regional or field office, posted on our website).
- Offered to provide the documents in an alternate format to accommodate special needs.
- Asked people to tell us how well the proposed permit would protect the receiving water.
- Invited people to suggest fairer conditions, limits, and requirements for the permit.
- Invited comments on Ecology's determination of compliance with antidegradation rules.
- Urged people to submit their comments, in writing, before the end of the comment period.
- Told how to request a public hearing about the proposed NPDES permit.
- Explained the next step(s) in the permitting process.

Ecology has published a document entitled *Frequently Asked Questions about Effective Public Commenting*, which is available on our website at https://fortress.wa.gov/ecy/publications/SummaryPages/0307023.html.

You may obtain further information from Ecology by telephone, 425-649-7201, or by writing to the address listed below.

Water Quality Permit Coordinator
Department of Ecology
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

The primary author of this permit and fact sheet is Lazaro Eleuterio.

Appendix B--Your Right to Appeal

You have a right to appeal this permit to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of the final permit. The appeal process is governed by chapter 43.21B RCW and chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2) (see glossary).

To appeal you must do the following within 30 days of the date of receipt of this permit:

- File your appeal and a copy of this permit with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this permit on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in chapter 43.21B RCW and chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel RD SW STE 301 Tumwater, WA 98501	**Pollution Control Hearings Board** PO Box 40903 Olympia, WA 98504-0903

Appendix C--Glossary

1-DMax or 1-day maximum temperature -- The highest water temperature reached on any given day. This measure can be obtained using calibrated maximum/minimum thermometers or continuous monitoring probes having sampling intervals of thirty minutes or less.

7-DADMax or 7-day average of the daily maximum temperatures -- The arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

Acute toxicity -- The lethal effect of a compound on an organism that occurs in a short time period, usually 48 to 96 hours.

AKART -- The acronym for "all known, available, and reasonable methods of prevention, control and treatment." AKART is a technology-based approach to limiting pollutants from wastewater discharges, which requires an engineering judgment and an economic judgment. AKART must be applied to all wastes and contaminants prior to entry into waters of the state in accordance with RCW 90.48.010 and 520, WAC 173-200-030(2)(c)(ii), and WAC 173-216-110(1)(a).

Alternate point of compliance -- An alternative location in the groundwater from the point of compliance where compliance with the groundwater standards is measured. It may be established in the groundwater at locations some distance from the discharge source, up to, but not exceeding the property boundary and is determined on a site specific basis following an AKART analysis. An "early warning value" must be used when an alternate point is established. An alternate point of compliance must be determined and approved in accordance with WAC 173-200-060(2).

Ambient water quality -- The existing environmental condition of the water in a receiving water body.

Ammonia -- Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

Annual average design flow (AADF) -- The average of the daily flow volumes anticipated to occur over a calendar year.

Average monthly (intermittent) discharge limit -- The average of the measured values obtained over a calendar month's time taking into account zero discharge days.

Average monthly discharge limit -- The average of the measured values obtained over a calendar month's time.

Background water quality -- The concentrations of chemical, physical, biological or radiological constituents or other characteristics in or of groundwater at a particular point in time upgradient of an activity that has not been affected by that activity [WAC 173-200-020(3)]. Background water quality for any parameter is statistically defined as the 95% upper tolerance interval with a 95% confidence based on at least eight hydraulically upgradient water quality samples. The eight samples are collected over a period of at least one year, with no more than one sample collected during any month in a single calendar year.

Best management practices (BMPs) -- Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD5 -- Determining the five-day Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by bacteria. The BOD5 is used in modeling to measure the reduction of dissolved oxygen in receiving waters after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD_5 is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass -- The intentional diversion of waste streams from any portion of a treatment facility.

Categorical pretreatment standards -- National pretreatment standards specifying quantities or concentrations of pollutants or pollutant properties, which may be discharged to a POTW by existing or new industrial users in specific industrial subcategories.

Chlorine -- A chemical used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Chronic toxicity -- The effect of a compound on an organism over a relatively long time, often 1/10 of an organism's lifespan or more. Chronic toxicity can measure survival, reproduction or growth rates, or other parameters to measure the toxic effects of a compound or combination of compounds.

Clean water act (CWA) -- The federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Compliance inspection-without sampling -- A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance inspection-with sampling -- A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations. In addition it includes as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the 85 percent removal requirement. Ecology may conduct additional sampling.

Composite sample -- A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Construction activity -- Clearing, grading, excavation, and any other activity, which disturbs the surface of the land. Such activities may include road building; construction of residential houses, office buildings, or industrial buildings; and demolition activity.

Continuous monitoring -- Uninterrupted, unless otherwise noted in the permit.

Critical condition -- The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Date of receipt -- This is defined in RCW 43.21B.001(2) as five business days after the date of mailing; or the date of actual receipt, when the actual receipt date can be proven by a preponderance of the evidence. The recipient's sworn affidavit or declaration indicating the date of receipt, which is unchallenged by the agency, constitutes sufficient evidence of actual receipt. The date of actual receipt, however, may not exceed forty-five days from the date of mailing.

Detection limit -- The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the pollutant concentration is above zero and is determined from analysis of a sample in a given matrix containing the pollutant.

Dilution factor (DF) -- A measure of the amount of mixing of effluent and receiving water that occurs at the boundary of the mixing zone. Expressed as the inverse of the percent effluent fraction, for example, a dilution factor of 10 means the effluent comprises 10% by volume and the receiving water 90%.

Distribution uniformity -- The uniformity of infiltration (or application in the case of sprinkle or trickle irrigation) throughout the field expressed as a percent relating to the average depth infiltrated in the lowest one-quarter of the area to the average depth of water infiltrated.

Early warning value -- The concentration of a pollutant set in accordance with WAC 173-200-070 that is a percentage of an enforcement limit. It may be established in the effluent, groundwater, surface water, the vadose zone or within the treatment process. This value acts as a trigger to detect and respond to increasing contaminant concentrations prior to the degradation of a beneficial use.

Enforcement limit -- The concentration assigned to a contaminant in the groundwater at the point of compliance for the purpose of regulation, [WAC 173-200-020(11)]. This limit assures that a groundwater criterion will not be exceeded and that background water quality will be protected.

Engineering report -- A document that thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report must contain the appropriate information required in WAC 173-240-060 or 173-240-130.

Fecal coliform bacteria -- Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

Grab sample -- A single sample or measurement taken at a specific time or over as short a period of time as is feasible.

Groundwater -- Water in a saturated zone or stratum beneath the surface of land or below a surface water body.

Industrial user -- A discharger of wastewater to the sanitary sewer that is not sanitary wastewater or is not equivalent to sanitary wastewater in character.

Industrial wastewater -- Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business; from the development of any natural resource; or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated stormwater and, also, leachate from solid waste facilities.

Interference -- A discharge which, alone or in conjunction with a discharge or discharges from other sources, both:

- Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and
- Therefore is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation) or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent State or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA) (including title II, more commonly referred to as the Resource Conservation and Recovery Act (RCRA), and including State regulations contained in any State sludge management plan prepared pursuant to subtitle D of the SWDA), sludge regulations appearing in 40 CFR Part 507, the Clean Air Act, the Toxic Substances Control Act, and the Marine Protection, Research and Sanctuaries Act.

Local limits -- Specific prohibitions or limits on pollutants or pollutant parameters developed by a POTW.

Major facility -- A facility discharging to surface water with an EPA rating score of > 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Maximum daily discharge limit -- The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Maximum day design flow (MDDF) -- The largest volume of flow anticipated to occur during a one-day period, expressed as a daily average.

Maximum month design flow (MMDF) -- The largest volume of flow anticipated to occur during a continuous 30-day period, expressed as a daily average.

Maximum week design flow (MWDF) -- The largest volume of flow anticipated to occur during a continuous 7-day period, expressed as a daily average.

Method detection level (MDL) -- See Detection Limit.

Minor facility -- A facility discharging to surface water with an EPA rating score of < 80 points based on such factors as flow volume, toxic pollutant potential, and public health impact.

Mixing zone -- An area that surrounds an effluent discharge within which water quality criteria may be exceeded. The permit specifies the area of the authorized mixing zone that Ecology defines following procedures outlined in state regulations (chapter 173-201A WAC).

National pollutant discharge elimination system (NPDES) -- The NPDES (Section 402 of the Clean Water Act) is the federal wastewater permitting system for discharges to navigable waters of the United States. Many states, including the state of Washington, have been delegated the authority to issue these permits. NPDES permits issued by Washington State permit writers are joint NPDES/State permits issued under both state and federal laws.

pH -- The pH of a liquid measures its acidity or alkalinity. It is the negative logarithm of the hydrogen ion concentration. A pH of 7 is defined as neutral and large variations above or below this value are considered harmful to most aquatic life.

Pass-through -- A discharge which exits the POTW into waters of the State in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation), or which is a cause of a violation of State water quality standards.

Peak hour design flow (PHDF) -- The largest volume of flow anticipated to occur during a one-hour period, expressed as a daily or hourly average.

Peak instantaneous design flow (PIDF) -- The maximum anticipated instantaneous flow.

Point of compliance -- The location in the groundwater where the enforcement limit must not be exceeded and a facility must comply with the Ground Water Quality Standards. Ecology determines this limit on a site-specific basis. Ecology locates the point of compliance in the groundwater as near and directly downgradient from the pollutant source as technically, hydrogeologically, and geographically feasible, unless it approves an alternative point of compliance.

Potential significant industrial user (PSIU) -- A potential significant industrial user is defined as an Industrial User that does not meet the criteria for a Significant Industrial User, but which discharges wastewater meeting one or more of the following criteria:

a. Exceeds 0.5 % of treatment plant design capacity criteria and discharges <25,000 gallons per day; or

b. Is a member of a group of similar industrial users which, taken together, have the potential to cause pass through or interference at the POTW (e.g. facilities which develop photographic film or paper, and car washes).

Ecology may determine that a discharger initially classified as a potential significant industrial user should be managed as a significant industrial user.

Quantitation level (QL) -- Also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) x 10^n, where n is an integer (64 FR 30417).

ALSO GIVEN AS:
The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency, December 2007).

Reasonable potential -- A reasonable potential to cause a water quality violation, or loss of sensitive and/or important habitat.

Responsible corporate officer -- A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or have gross annual sales or expenditures exceeding $25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Sample Maximum -- No sample may exceed this value.

Significant industrial user (SIU) --

1) All industrial users subject to Categorical Pretreatment Standards under 40 CFR 403.6 and 40 CFR Chapter I, Subchapter N; and

2) Any other industrial user that: discharges an average of 25,000 gallons per day or more of process wastewater to the POTW (excluding sanitary, noncontact cooling, and boiler blow-down wastewater); contributes a process wastestream that makes up 5 percent or more of the average dry weather hydraulic or organic capacity of the POTW treatment plant; or is designated as such by the Control Authority* on the basis that the industrial user has a reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement [in accordance with 40 CFR 403.8(f)(6)].

   Upon finding that the industrial user meeting the criteria in paragraph 2, above, has no reasonable potential for adversely affecting the POTW's operation or for violating any pretreatment standard or requirement, the Control Authority* may at any time, on its own initiative or in response to a petition received from an industrial user or POTW, and in accordance with 40 CFR 403.8(f)(6), determine that such industrial user is not a significant industrial user.

   *The term "Control Authority" refers to the Washington State Department of Ecology in the case of non-delegated POTWs or to the POTW in the case of delegated POTWs.

Slug discharge -- Any discharge of a non-routine, episodic nature, including but not limited to an accidental spill or a non-customary batch discharge to the POTW. This may include any pollutant released at a flow rate that may cause interference or pass through with the POTW or in any way violate the permit conditions or the POTW's regulations and local limits.

Soil scientist -- An individual who is registered as a Certified or Registered Professional Soil Scientist or as a Certified Professional Soil Specialist by the American Registry of Certified Professionals in Agronomy, Crops, and Soils or by the National Society of Consulting Scientists or who has the credentials for membership. Minimum requirements for eligibility are possession of a baccalaureate, masters, or doctorate degree from a U.S. or Canadian

institution with a minimum of 30 semester hours or 45 quarter hours professional core courses in agronomy, crops or soils, and have 5, 3, or 1 year(s), respectively, of professional experience working in the area of agronomy, crops, or soils.

Solid waste -- All putrescible and non-putrescible solid and semisolid wastes including, but not limited to, garbage, rubbish, ashes, industrial wastes, swill, sewage sludge, demolition and construction wastes, abandoned vehicles or parts thereof, contaminated soils and contaminated dredged material, and recyclable materials.

Soluble BOD_5 -- Determining the soluble fraction of Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of soluble organic material present in an effluent that is utilized by bacteria. Although the soluble BOD_5 test is not specifically described in Standard Methods, filtering the raw sample through at least a 1.2 um filter prior to running the standard BOD_5 test is sufficient to remove the particulate organic fraction.

State waters -- Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Stormwater -- That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface water body, or a constructed infiltration facility.

Technology-based effluent limit -- A permit limit based on the ability of a treatment method to reduce the pollutant.

Total coliform bacteria -- A microbiological test, which detects and enumerates the total coliform group of bacteria in water samples.

Total dissolved solids -- That portion of total solids in water or wastewater that passes through a specific filter.

Total maximum daily load (TMDL) -- A determination of the amount of pollutant that a water body can receive and still meet water quality standards.

Total suspended solids (TSS) -- Total suspended solids is the particulate material in an effluent. Large quantities of TSS discharged to a receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

Upset -- An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

Water quality-based effluent limit -- A limit imposed on the concentration of an effluent parameter to prevent the concentration of that parameter from exceeding its water quality criterion after discharge into receiving waters.

Appendix D--Technical Calculations

Several of the Excel® spreadsheet tools used to evaluate a discharger's ability to meet Washington State water quality standards can be found in the PermitCalc workbook on Ecology's webpage at: http://www.ecy.wa.gov/programs/wq/permits/guidance.html.

Simple Mixing:

Ecology uses simple mixing calculations to assess the impacts of certain conservative pollutants, such as the expected increase in fecal coliform bacteria at the edge of the chronic mixing zone boundary. Simple mixing uses a mass balance approach to proportionally distribute a pollutant load from a discharge into the authorized mixing zone. The approach assumes no decay or generation of the pollutant of concern within the mixing zone. The predicted concentration at the edge of a mixing zone (C_{mz}) is based on the following calculation:

$$C_{mz} = Ca + \frac{(Ce - Ca)}{DF}$$

where: Ce = Effluent Concentration
Ca = Ambient Concentration
DF = Dilution Factor

Reasonable Potential Analysis:

The spreadsheets Input 2 – Reasonable Potential, and LimitCalc in Ecology's PermitCalc Workbook determine reasonable potential (to violate the aquatic life and human health water quality standards) and calculate effluent limits. The process and formulas for determining reasonable potential and effluent limits in these spreadsheets are taken directly from the *Technical Support Document for Water Quality-based Toxics Control*, (EPA 505/2-90-001). The adjustment for autocorrelation is from EPA (1996a), and EPA (1996b).

Calculation of Water Quality-Based Effluent Limits:

Water quality-based effluent limits are calculated by the two-value wasteload allocation process as described on page 100 of the TSD (EPA, 1991) and shown below.

1. Calculate the acute wasteload allocation WLA_a by multiplying the acute criteria by the acute dilution factor and subtracting the background factor. Calculate the chronic wasteload allocation (WLA_c) by multiplying the chronic criteria by the chronic dilution factor and subtracting the background factor.

WLA_a = (acute criteria x DF_a) – [(background conc. x (DF_a - 1)]
WLA_c = (chronic criteria x DF_c) – [(background conc. x (DF_c -1)]
where: DF_a = Acute Dilution Factor
DF_c = Chronic Dilution Factor

2. Calculate the long term averages (LTA_a and LTA_c) which will comply with the wasteload allocations WLA_a and WLA_c.

$LTA_a = WLA_a \times e^{[0.5\sigma^2 - z\sigma]}$

where: $\sigma^2 = \ln[CV^2 + 1]$

$z = 2.326$

CV = coefficient of variation = std. dev/mean

$LTA_c = WLA_c \times e^{[0.5\sigma^2 - z\sigma]}$

where: $\sigma^2 = \ln[(CV^2 \div 4) + 1]$

$z = 2.326$

3. Use the smallest LTA of the LTA_a or LTA_c to calculate the maximum daily effluent limit and the monthly average effluent limit.

MDL = Maximum Daily Limit

$MDL = LTA \times e^{(Z\sigma - 0.5\sigma^2)}$

where: $\sigma^2 = \ln[CV^2 + 1]$

$z = 2.326$ (99th percentile occurrence)

LTA = Limiting long term average

AML = Average Monthly Limit

$AML = LTA \times e^{(Z\sigma_n - 0.5\sigma_n^2)}$

where: $\sigma^2 = \ln[(CV^2 \div n) + 1]$

n = number of samples/month

$z = 1.645$ (95^{th} % occurrence probability)

LTA = Limiting long term average

Reasonable Potential Calculations

Reasonable Potential Calculation

Facility	City of Stanwood WWTP
Water Body Type	Marine

Dilution Factors:	Acute	Chronic
Aquatic Life	8.0	36.0
Human Health Carcinogeni		36.0
Human Health Non-Carcino		36.0

Pollutant, CAS No. & NPDES Application Ref. No.		AMMONIA, Criteria as Total NH3	ARSENIC (dissolved) 7440382 2M	BIS(2-ETHYLHEXYL) PHTHALATE 117817 13B	CADMIUM - 7440439 4M Hardness dependent	CHLOROFORM 67663 11V	CHROMIUM(HEX) 18540299	COPPER - 744058 6M Hardness dependent	LEAD - 7439921 7M Dependent on hardness	MERCURY 7439976 8M	NICKEL - 7440020 9M - Dependent on hardness
Effluent Data	# of Samples (n)	8	3	3	3	3	3	3	3	3	3
	Coeff of Variation (Cv)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)	500	6	19	0.2	1.8	0.9	11	0.9	0.0015	5
	Calculated 50th percentile Effluent Conc. (when n>10)										
Receiving Water Data	90th Percentile Conc., ug/L	35	0		0		0	0	0	0	0
	Geo Mean, ug/L			0		0		0		0	0
Water Quality Criteria	Aquatic Life Criteria, ug/L — Acute	938	69	-	42	-	1100	4.8	210	1.8	74
	Aquatic Life Criteria, ug/L — Chronic	141	36	-	9.3	-	50	3.1	8.1	0.025	8.2
	WQ Criteria for Protection of Human Health, ug/L	-	-	5.9	-	470	-	-	-	0.15	4600
	Metal Criteria Translator, decimal — Acute	-	1	-	0.994	-	0.993	0.83	0.951	0.85	0.99
	Metal Criteria Translator, decimal — Chronic	-	-	-	0.994	-	0.993	0.83	0.951	-	0.99
	Carcinogen?	N	Y	Y	N	Y	N	N	N	N	N

Aquatic Life Reasonable Potential

Effluent percentile value		0.950	0.950		0.950		0.950	0.950	0.950	0.950	0.950
s	$s^2=\ln(CV^2+1)$	0.555	0.555		0.555		0.555	0.555	0.555	0.555	0.555
Pn	$Pn=(1\text{-confidence level})^{1/n}$	0.688	0.368		0.368		0.368	0.368	0.368	0.368	0.368
Multiplier		1.90	3.00		3.00		3.00	3.00	3.00	3.00	3.00
Max concentration (ug/L) at edge of…	Acute	149	2.250		0.075		0.335	3.423	0.321	0.000	1.856
	Chronic	60	0.500		0.017		0.074	0.761	0.071	0.000	0.412
Reasonable Potential? Limit Required?		**NO**	**NO**		**NO**		**NO**	**NO**	**NO**	**NO**	**NO**

Human Health Reasonable Potential

s	$s^2=\ln(CV^2+1)$			0.5545	0.5545				0.5545	0.5545
Pn	Pn=(1-confidence level)1/n			0.368	0.368				0.368	0.368
Multiplier				1.2049	1.2049				1.2049	1.2049
Dilution Factor				36	36				36	36
Max Conc. at edge of Chronic Zone, ug/L				0.6359	0.0602				5E-05	0.1673
Reasonable Potential? Limit Required?				**NO**	**NO**				**NO**	**NO**

Reasonable Potential Calculation - Page 2

Facility	City of Stanwood WWTP
Water Body Type	Marine

Dilution Factors:	Acute	Chronic
Aquatic Life	8.0	36.0
Human Health Carcinogenic		36.0
Human Health Non-Carcinogenic		36.0

Pollutant, CAS No. & NPDES Application Ref. No.		PHENOL 108952 10A	SELENIUM 7782492 10M	THALLIUM 7440280 12M	ZINC- 7440666 13M hardness dependent							
Effluent Data	# of Samples (n)	3	3	3	3							
	Coeff of Variation (Cv)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)	49	0.7	21	68							
	Calculated 50th percentile Effluent Conc. (when n>10)											
Receiving Water Data	90th Percentile Conc., ug/L		0		0							
	Geo Mean, ug/L	0	0	0								
Water Quality Criteria	Aquatic Life Criteria, ug/L Acute	-	290	-	90							
	Chronic	-	71	-	81							
	WQ Criteria for Protection of Human Health, ug/L	5E+06	4200	6.3	-							
	Metal Criteria Translator, decimal Acute	-	-	-	0.946							
	Chronic	-	-	-	0.946							
	Carcinogen?	N	N	N	N							

Aquatic Life Reasonable Potential

Effluent percentile value			0.950		0.950							
s	$s^2=\ln(CV^2+1)$		0.555		0.555							
Pn	$Pn=(1\text{-confidence level})^{1/n}$		0.368		0.368							
Multiplier			3.00		3.00							
Max concentration (ug/L) at edge of...	Acute		0.262		24.119							
	Chronic		0.058		5.360							
Reasonable Potential? Limit Required?			**NO**		**NO**							

Human Health Reasonable Potential

s	$s^2=\ln(CV^2+1)$	0.5545	0.5545	0.5545								
Pn	Pn=(1-confidence level)1/n	0.368	0.368	0.368								
Multiplier		1.2049	1.2049	1.2049								
Dilution Factor		36	36	36								
Max Conc. at edge of Chronic Zone, ug/L		1.6399	0.0234	0.7028								
Reasonable Potential? Limit Required?		**NO**	**NO**	**NO**								

Fecal Coliform Calculations

Calculation of Fecal Coliform at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	36.0
Receiving Water Fecal Coliform, #/100 ml	1
Effluent Fecal Coliform - worst case, #/100 ml	400
Surface Water Criteria, #/100 ml	*14*
OUTPUT	
Fecal Coliform at Mixing Zone Boundary, #/100 ml	**12**
Difference between mixed and ambient, #/100 ml	11

Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for fecal coliform.

Ammonia Calculations

Marine Un-ionized Ammonia Criteria Calculation

Calculation of seawater fraction of un-ionized ammonia from Hampson (1977). Un-ionized ammonia criteria for salt water are from EPA 440/5-88-004. Revised 19-Oct-

INPUT	
1. Receiving Water Temperature, deg C (90th percentile):	20.5
2. Receiving Water pH, (90th percentile):	8.8
3. Receiving Water Salinity, g/kg (10th percentile):	2.0
4. Pressure, atm (EPA criteria assumes 1 atm):	1.0
5. Unionized ammonia criteria (mg un-ionized NH_3 per liter) from EPA 440/5-88-004:	
Acute:	0.233
Chronic:	0.035
OUTPUT	
Using mixed temp and pH at mixing zone boundaries?	No
1. Molal Ionic Strength (not valid if >0.85):	0.040
2. pKa8 at 25 deg C (Whitfield model "B"):	9.250
3. Percent of Total Ammonia Present as Unionized:	20.4%
4. Total Ammonia Criteria (mg/L as NH_3):	
Acute:	1.14
Chronic:	0.17
RESULTS	
Total Ammonia Criteria (mg/L as N)	
Acute:	**0.94**
Chronic:	**0.14**

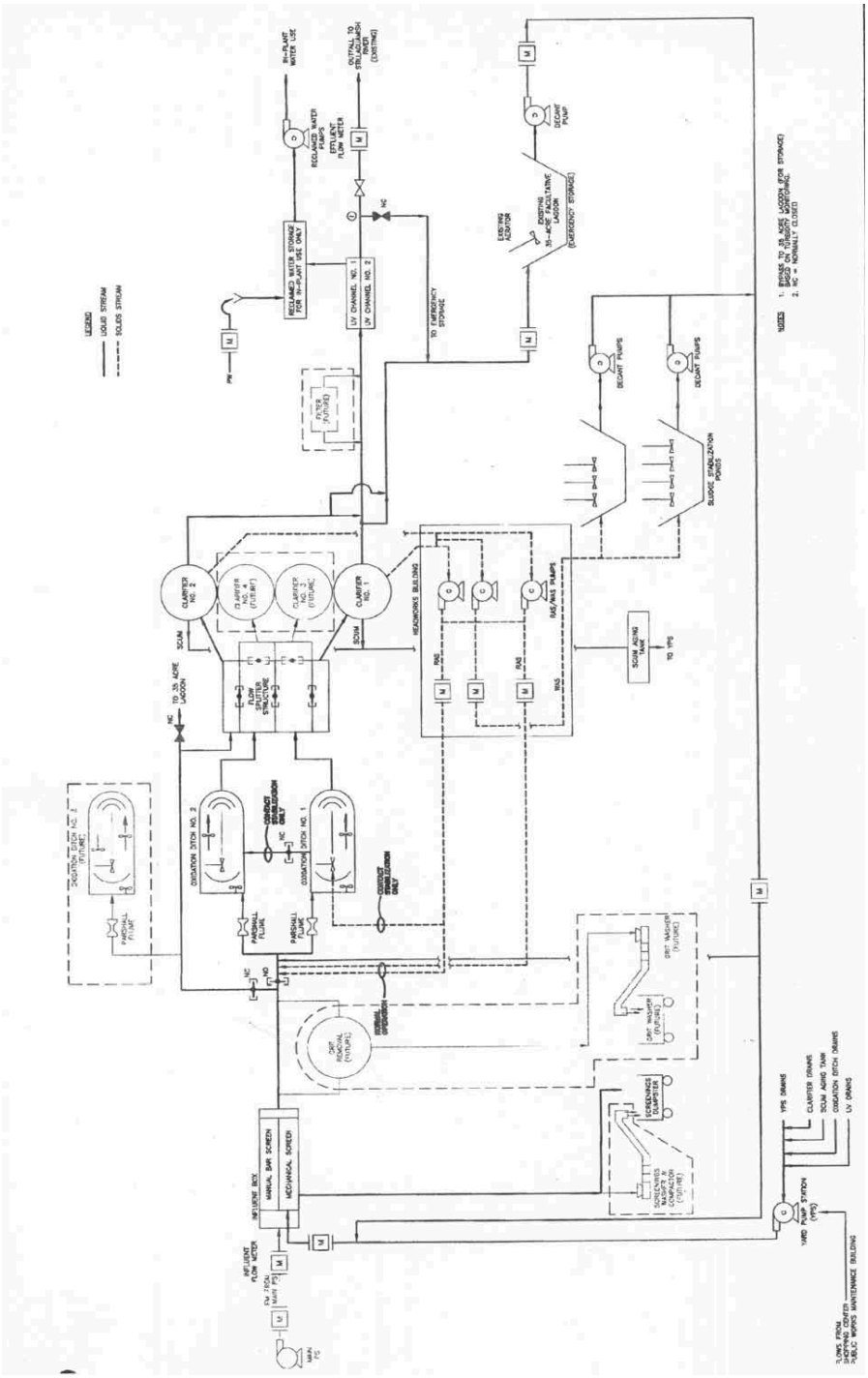
Temperature Calculations

Marine Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and Water Quality Program Guidance. All Data inputs must meet WQ guidelines. The Water Quality temperature guidance document may be found at: http://www.ecy.wa.gov/biblio/0610100.html

INPUT	May-Sep
1. Chronic Dilution Factor at Mixing Zone Boundary	36.0
2. Annual max 1DADMax Ambient Temperature (Background 90th percentile)	20.5 °C
3. 1DADMax Effluent Temperature (95th percentile)	23.3 °C
4. Aquatic Life Temperature WQ Criterion	16.0 °C
OUTPUT	
5. Temperature at Chronic Mixing Zone Boundary:	20.58 °C
6. Incremental Temperature Increase or decrease:	0.08 °C
7. Incremental Temperature Increase 12/(T-2) if T≤ crit:	---
8. Maximum Allowable Temperature at Mixing Zone Boundary:	20.80 °C
A. If ambient temp is warmer than WQ criterion	
9. Does temp fall within this warmer temp range?	YES
10. Temp increase allowed at mixing zone boundary, if required:	NO LIMIT
B. If ambient temp is cooler than WQ criterion but within 12/(T_{amb}-2) and within 0.3 °C of the criterion	
11. Does temp fall within this incremental temp. range?	---
12. Temp increase allowed at mixing zone boundary, if required:	---
C. If ambient temp is cooler than (WQ criterion-0.3) but within 12/(T_{amb}-2) of the criterion	
13. Does temp fall within this Incremental temp. range?	---
14. Temp increase allowed at mixing zone boundary, if required:	---
D. If ambient temp is cooler than (WQ criterion - 12/(T_{amb}-2))	
15. Does temp fall within this Incremental temp. range?	---
16. Temp increase allowed at mixing zone boundary, if required:	---
RESULTS	
17. Do any of the above cells show a temp increase?	**NO**
18. Temperature Limit if Required?	**NO LIMIT**

Appendix E--City of Stanwood WWTP Schematic Process Flow Diagram

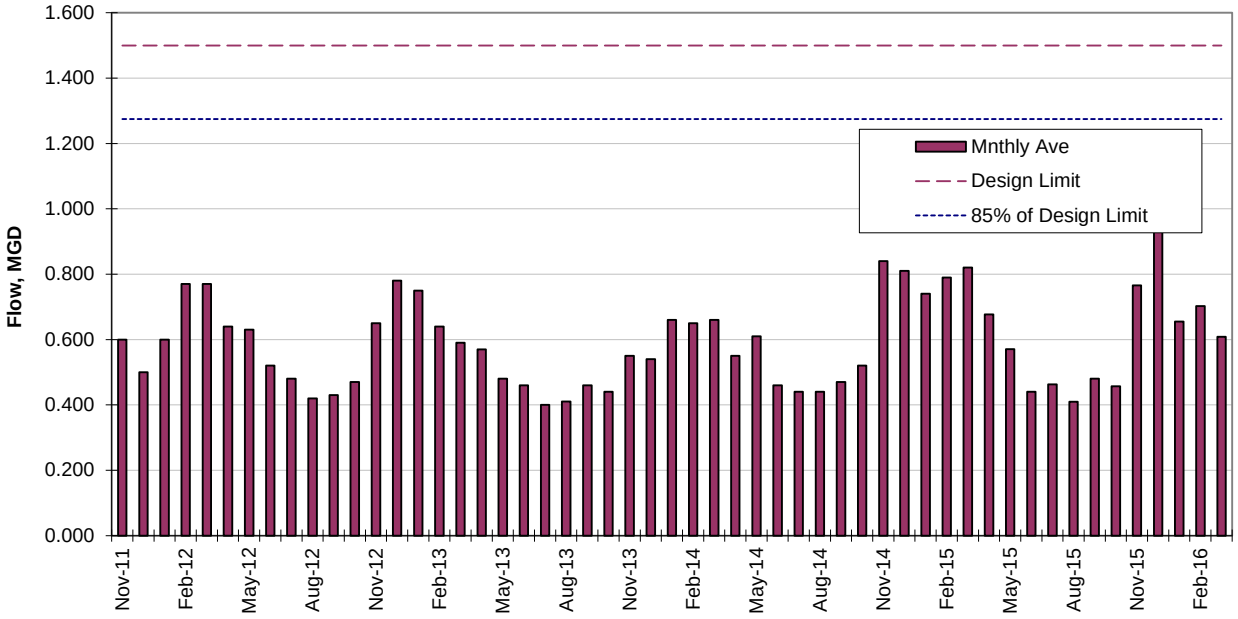


Appendix F--City of Stanwood WWTP Data (2011 – 2016)

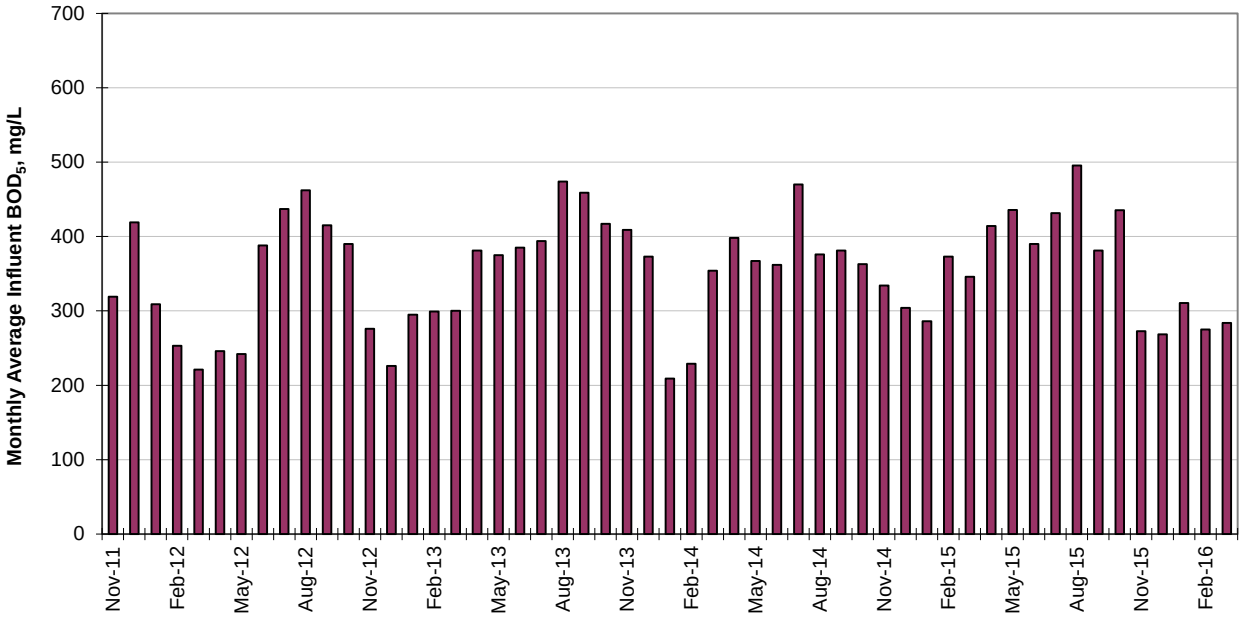
	Influent									
Date	BOD, mg/L	BOD, mg/L	BOD, ppd	BOD, ppd	TSS, mg/L	TSS, mg/L	TSS, ppd	TSS, ppd	Flow, MGD	Flow, MGD
	Mnthly Ave	Mnthly Max	Mnthly Ave	Mnthly Max	Mnthly Ave	Mnthly Max	Mnthly Ave	Mnthly Max	Mnthly Ave	Mnthly Max
1-Nov-11	319	414	1,384	1,830	234	329	1,054	1,372	0.60	1.59
1-Dec-11	419	531	1,763	2,246	303	366	1,272	1,587	0.50	0.57
1-Jan-12	309	410	1,423	1,710	283	398	1,276	1,626	0.60	1.34
1-Feb-12	253	392	1,526	1,954	208	320	1,295	1,679	0.77	1.92
1-Mar-12	221	373	1,303	1,742	209	280	1,272	1,471	0.77	1.25
1-Apr-12	246	318	1,298	1,990	250	348	1,285	1,567	0.64	0.89
1-May-12	242	466	1,162	1,632	301	591	1,435	2,070	0.63	1.24
1-Jun-12	388	450	1,587	1,764	325	383	1,330	1,675	0.52	0.81
1-Jul-12	437	753	1,722	3,077	340	518	1,336	1,944	0.48	0.71
1-Aug-12	462	613	1,633	2,096	357	448	1,246	1,607	0.42	0.45
1-Sep-12	415	600	1,493	2,152	388	607	1,396	2,177	0.43	0.45
1-Oct-12	390	519	1,540	1,861	316	485	1,264	1,739	0.47	0.75
1-Nov-12	276	397	1,354	1,722	251	395	1,242	1,713	0.65	1.43
1-Dec-12	226	293	1,427	1,683	193	282	1,214	1,529	0.78	1.13
1-Jan-13	295	609	1,786	2,844	253	384	1,613	3,005	0.75	1.45
1-Feb-13	299	345	1,497	1,772	260	292	1,297	1,427	0.64	0.91
1-Mar-13	300	443	1,454	1,921	281	401	1,358	1,739	0.59	0.81
1-Apr-13	381	674	1,625	2,530	335	515	1,427	1,933	0.57	0.82
1-May-13	375	530	1,499	2,166	337	380	1,344	1,500	0.48	0.70
1-Jun-13	385	461	1,463	1,725	395	538	1,498	1,974	0.46	0.55
1-Jul-13	394	568	1,337	2,037	337	424	1,135	1,384	0.40	0.44
1-Aug-13	474	540	1,624	1,922	439	730	1,498	1,693	0.41	0.48
1-Sep-13	459	625	1,689	2,241	457	755	1,683	2,708	0.46	0.58
1-Oct-13	417	553	1,540	1,937	432	645	1,594	2,313	0.44	0.51
1-Nov-13	409	529	1,739	2,118	386	539	1,634	2,158	0.55	1.17
1-Dec-13	373	489	1,677	1,876	347	523	1,561	2,050	0.54	0.93
1-Jan-14	209	286	1,087	1,350	320	403	1,703	2,373	0.66	1.28
1-Feb-14	229	315	1,248	1,940	298	499	1,578	2,122	0.65	1.24
1-Mar-14	354	456	1,994	2,605	337	487	1,872	2,275	0.66	1.06
1-Apr-14	398	513	1,803	2,481	391	524	1,776	2,404	0.55	0.70
1-May-14	367	503	1,697	2,391	340	425	1,576	2,020	0.61	1.91
1-Jun-14	362	432	1,390	1,657	396	538	1,489	1,802	0.46	0.60
1-Jul-14	470	632	1,750	2,319	397	486	1,480	1,783	0.44	0.56
1-Aug-14	376	513	1,426	1,840	349	453	1,329	1,806	0.44	0.60
1-Sep-14	381	654	1,567	2,945	321	437	1,321	2,041	0.47	0.56
1-Oct-14	363	451	1,592	2,129	315	399	1,384	1,732	0.52	0.93
1-Nov-14	334	464	2,181	3,173	334	571	2,216	3,905	0.84	1.60
1-Dec-14	304	410	1,681	2,188	273	414	1,575	2,736	0.81	2.09
1-Jan-15	286	538	1,868	4,884	247	439	1,617	4,430	0.74	1.97
1-Feb-15	373	491	2,193	3,871	365	564	2,199	4,939	0.79	1.61
1-Mar-15	346	451	2,376	3,331	307	374	2,119	3,159	0.82	1.90
1-Apr-15	414	567	2,354	5,013	334	391	1,904	3,351	0.68	1.19
1-May-15	436	595	2,128	3,575	347	436	1,718	3,107	0.57	0.95
1-Jun-15	390	459	1,449	1,684	331	471	1,227	1,689	0.44	0.48
1-Jul-15	431	560	1,536	1,868	386	473	1,374	1,610	0.46	0.83
1-Aug-15	495	831	1,680	2,829	415	741	1,404	2,488	0.41	0.47
1-Sep-15	381	512	1,572	2,345	314	493	1,263	1,798	0.48	0.91
1-Oct-15	435	508	1,643	1,862	428	653	1,608	2,377	0.46	0.69
1-Nov-15	273	387	1,793	3,064	248	355	1,874	3,963	0.77	2.21
1-Dec-15	268	552	1,839	3,217	277	518	1,933	3,846	0.93	1.82
1-Jan-16	311	382	1,569	1,931	257	399	1,322	2,280	0.65	1.11
1-Feb-16	275	382	1,496	1,834	261	358	1,405	1,851	0.70	1.38
1-Mar-16	284	407	1,432	2,027	270	354	1,371	1,740	0.61	0.88
AVE:	353	493	1,620	2,319	322	463	1,494	2,213	0.59	1.05
MIN:	209	286	1,087	1,350	193	280	1,054	1,372	0.40	0.44
MAX:	495	831	2,376	5,013	457	755	2,216	4,939	0.93	2.21

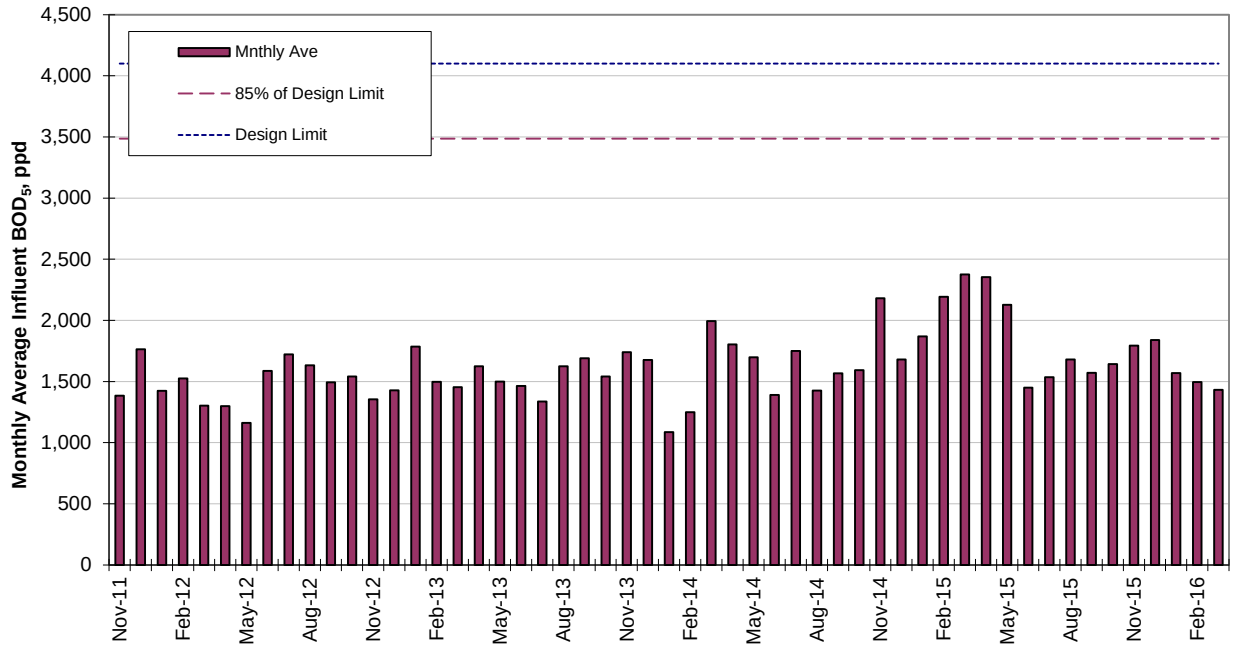
	Effluent															
Date	Flow, MGD	Flow, MGD	BOD, mg/L	BOD, mg/L	BOD, ppd	BOD, ppd	BOD, % Removal	TSS, mg/L	TSS, mg/L	TSS, ppd	TSS, ppd	TSS, % Removal	PH	PH	Fecal Coliform, #/100 ml	Fecal Coliform, #/100 ml
	Mnthly Ave	Mnthly Max	Mnthly Ave	Wkly Ave	Mnthly Ave	Wkly Ave	Ave	Mnthly Ave	Wkly Ave	Mnthly Ave	Wkly Ave	Ave	Min	Max	GEM	GM7
1-Nov-11	0.60	1.63	6	10	28	61	96	10	15	47	96	98	7.2	7.6	10	23
1-Dec-11	0.50	0.56	9	12	36	66	97	10	13	43	58	98	7.3	7.7	16	33
1-Jan-12	0.59	1.35	4	8	19	34	96	10	15	47	67	99	7.1	7.7	11	24
1-Feb-12	0.71	1.15	5	5	30	58	96	8	10	48	75	98	7.1	7.7	11	16
1-Mar-12	0.79	1.15	3	7	20	29	97	6	7	41	70	98	7.1	7.7	25	61
1-Apr-12	0.66	0.91	4	6	21	37	96	9	13	51	62	98	7.1	7.6	12	27
1-May-12	0.83	1.20	2	5	15	21	98	6	9	46	82	99	7.0	7.6	25	36
1-Jun-12	0.50	0.83	3	4	12	13	98	6	9	22	40	99	7.2	7.6	21	31
1-Jul-12	0.46	0.73	4	7	17	25	98	6	7	24	33	99	7.2	7.7	16	24
1-Aug-12	0.40	0.46	4	7	14	19	98	7	9	22	27	99	7.4	7.7	23	33
1-Sep-12	0.40	0.46	3	4	9	14	99	5	6	17	21	99	7.5	7.7	10	25
1-Oct-12	0.47	0.93	3	5	15	24	98	6	10	27	40	99	7.2	7.9	9	30
1-Nov-12	0.64	1.34	2	2	9	12	98	5	8	33	71	99	7.3	7.7	6	8
1-Dec-12	0.78	1.22	3	2	17	33	97	6	9	38	71	99	7.3	7.6	6	6
1-Jan-13	0.75	1.49	2	5	20	50	98	6	8	45	89	99	7.3	7.6	6	9
1-Feb-13	1.02	1.45	3	7	28	61	97	8	11	73	102	99	7.1	7.6	4	5
1-Mar-13	0.60	0.87	2	3	11	13	98	5	5	24	32	99	7.4	7.7	4	5
1-Apr-13	0.56	0.94	2	3	9	15	98	7	9	30	45	99	7.4	7.7	4	4
1-May-13	0.45	0.73	3	5	12	21	98	7	11	22	31	97	7.5	7.8	4	6
1-Jun-13	0.44	0.56	3	4	14	18	99	5	8	21	33	97	7.5	7.8	5	6
1-Jul-13	0.38	0.51	3	6	11	22	98	6	8	20	24	97	7.5	7.8	6	8
1-Aug-13	0.37	0.49	2	3	8	10	99	3	5	10	16	96	7.6	7.8	5	10
1-Sep-13	0.46	0.90	4	5	14	20	99	5	7	19	30	95	7.5	7.8	7	8
1-Oct-13	0.40	0.48	3	4	9	20	99	4	5	13	18	96	7.4	7.8	7	7
1-Nov-13	0.52	1.11	3	4	12	18	99	4	5	19	23	96	7.3	7.7	6	10
1-Dec-13	0.53	0.92	3	3	14	20	98	5	5	24	34	97	7.3	7.7	6	9
1-Jan-14	0.65	1.24	3	2	8	10	98	4	5	24	28	96	7.2	7.6	5	7
1-Feb-14	0.64	1.34	3	7	19	49	98	6	9	38	64	97	7.2	7.7	5	6
1-Mar-14	0.66	1.30	5	7	35	66	98	8	10	38	81	97	7.1	7.7	8	13
1-Apr-14	0.55	0.69	4	7	20	34	98	6	9	30	48	96	7.1	7.7	4	4
1-May-14	0.57	1.06	3	4	15	20	98	4	5	18	25	97	7.2	7.8	2	3
1-Jun-14	0.47	0.65	2	2	7	8	98	5	9	19	32	97	7.5	7.8	3	6
1-Jul-14	0.40	0.54	3	4	9	14	98	6	7	22	25	97	7.5	7.8	3	4
1-Aug-14	0.42	0.63	2	3	8	10	98	5	6	18	20	98	7.4	7.8	5	6
1-Sep-14	0.39	0.57	3	4	12	16	98	5	7	20	31	97	7.4	7.8	4	6
1-Oct-14	0.53	0.94	5	9	24	41	97	8	14	36	68	97	7.6	7.8	7	8
1-Nov-14	0.88	1.65	6	7	43	52	97	10	11	79	96	98	7.5	7.7	11	13
1-Dec-14	0.72	2.02	8	10	39	72	95	14	22	72	160	98	7.0	7.8	14	27
1-Jan-15	0.77	2.06	5	9	33	52	96	9	11	55	76	99	7.4	7.9	7	9
1-Feb-15	0.81	1.68	5	7	32	44	98	6	8	41	62	96	7.5	7.7	11	23
1-Mar-15	0.81	1.93	4	5	26	34	99	4	6	30	44	98	7.5	7.8	9	14
1-Apr-15	0.68	1.20	3	5	19	22	99	4	6	23	33	98	7.2	7.9	4	7
1-May-15	0.55	0.96	3	4	11	18	99	3	6	16	22	98	7.6	7.8	5	7
1-Jun-15	0.43	0.57	4	6	16	20	99	5	8	19	25	97	7.5	7.8	5	7
1-Jul-15	0.44	0.78	3	5	10	16	99	4	7	13	20	95	7.7	7.8	2	2
1-Aug-15	0.40	0.58	3	4	10	13	99	4	6	14	17	96	7.7	7.9	3	4
1-Sep-15	0.49	0.92	3	4	12	15	99	4	6	16	21	96	7.5	7.7	5	6
1-Oct-15	0.44	0.71	3	4	11	16	99	4	4	14	16	97	7.5	7.7	3	5
1-Nov-15	0.74	1.67	3	4	23	46	97	7	14	56	163	98	7.3	7.7	8	12
1-Dec-15	0.97	1.83	4	7	34	72	97	5	8	41	90	97	7.3	7.6	15	39
1-Jan-16	0.66	1.15	3	5	15	21	97	6	9	29	44	96	7.4	7.7	7	17
1-Feb-16	0.71	1.46	4	5	24	45	98	6	7	32	54	95	7.4	7.6	5	6
1-Mar-16	0.59	0.82	4	7	18	25	98	5	10	23	31	97	7.4	7.6	4	5
AVE:	0.59	1.04	3.6	5.3	18.1	29.9	98	6.0	8.6	31.3	50.6	97	7.3	7.7	8.1	13.8
MIN:	0.37	0.46	2.0	2.0	7.0	8.0	95	3.0	4.0	10.0	15.5	95	7.0	7.6	2.0	2.4
MAX:	1.02	2.06	9.0	12.0	43.0	72.0	99	14.0	22.0	79.0	162.5	99	7.7	7.9	25.0	61.0

City of Stanwood WWTP Influent – Flow

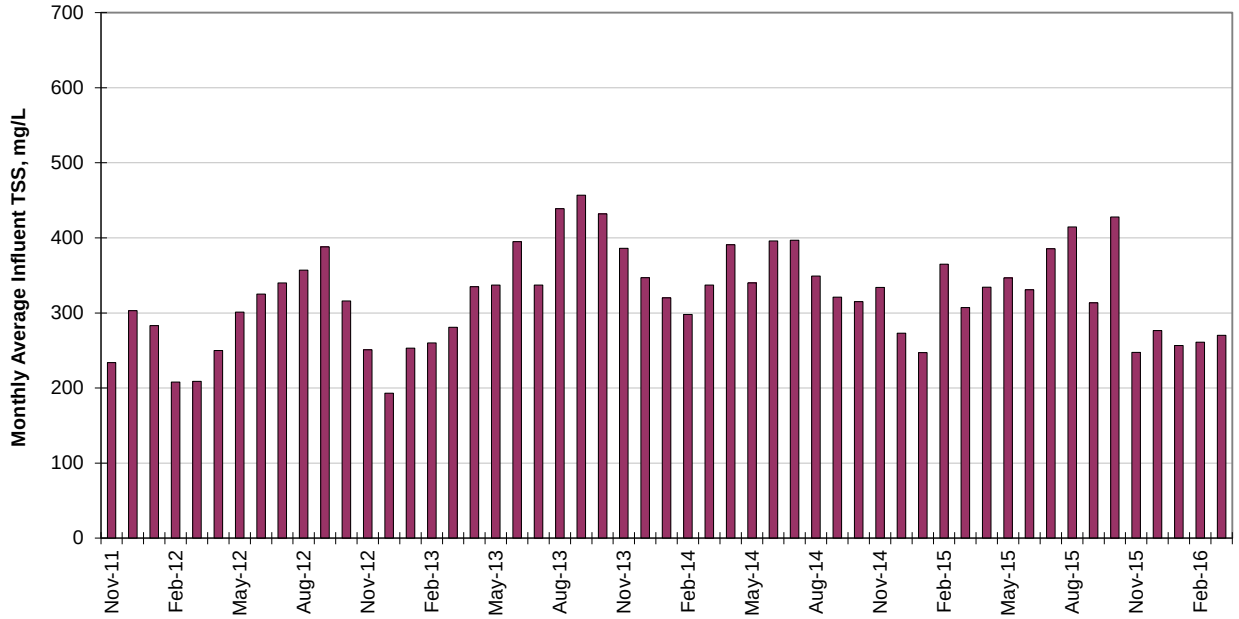


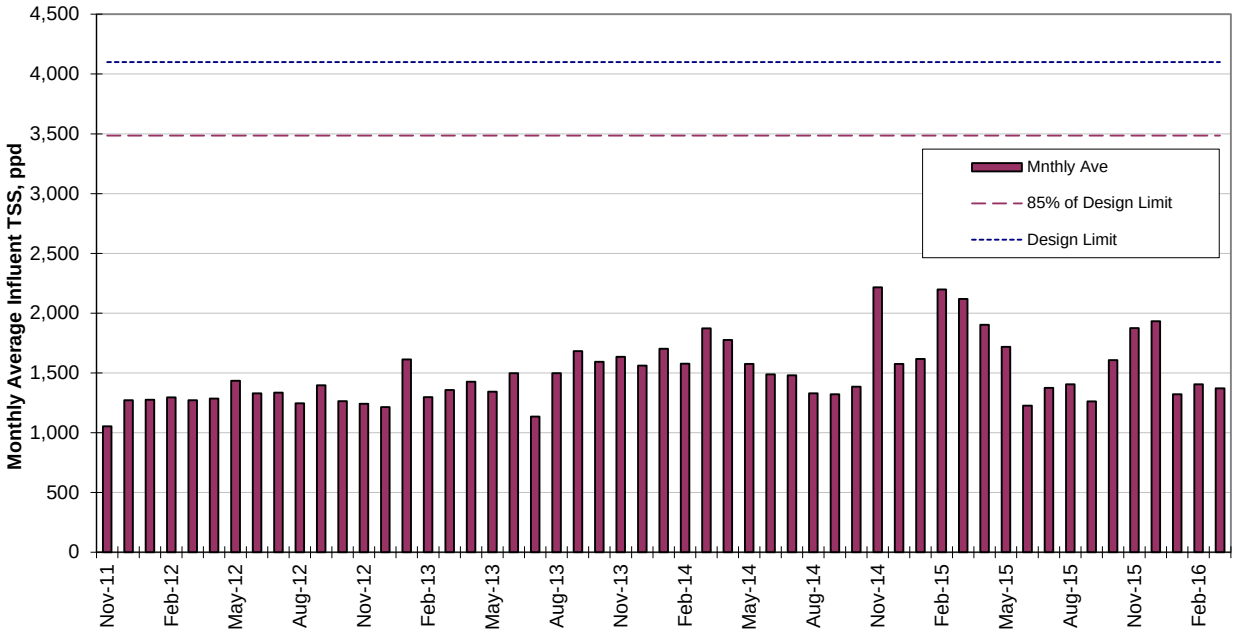
City of Stanwood WWTP Influent – BOD_5



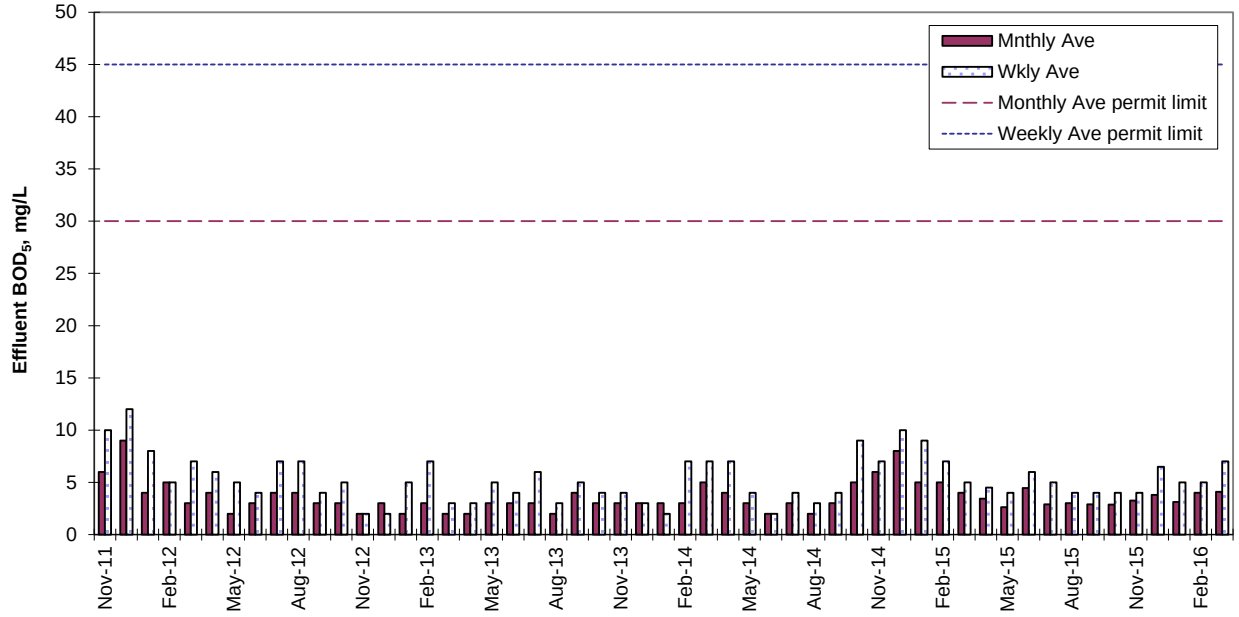


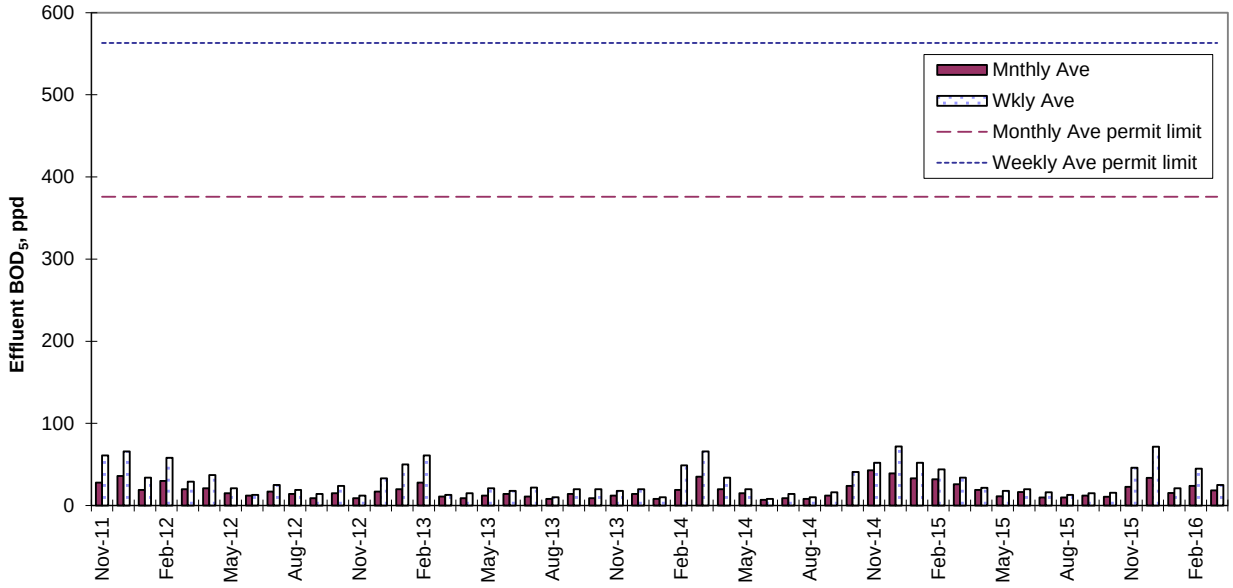
City of Stanwood WWTP Influent – TSS



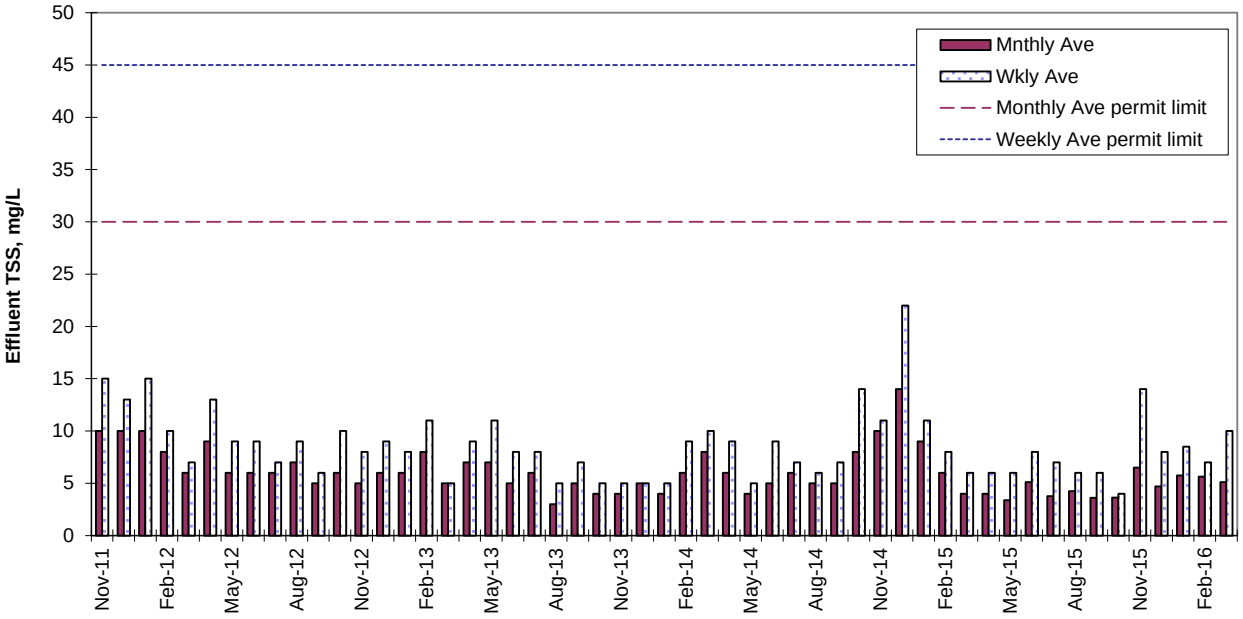


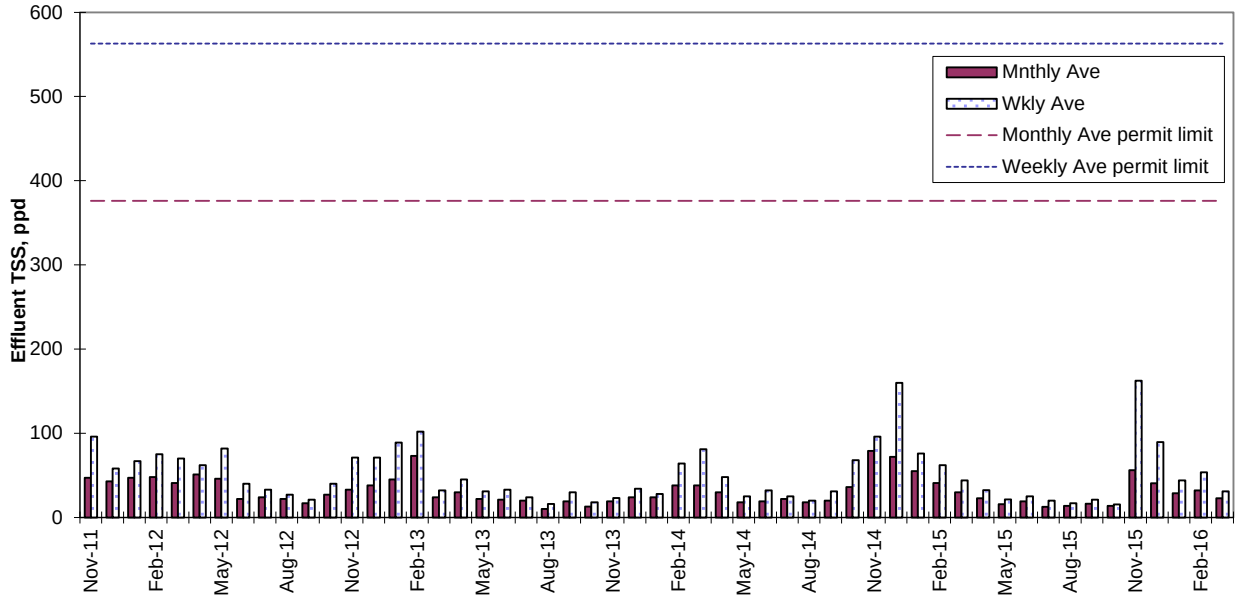
City of Stanwood WWTP Effluent – BOD_5



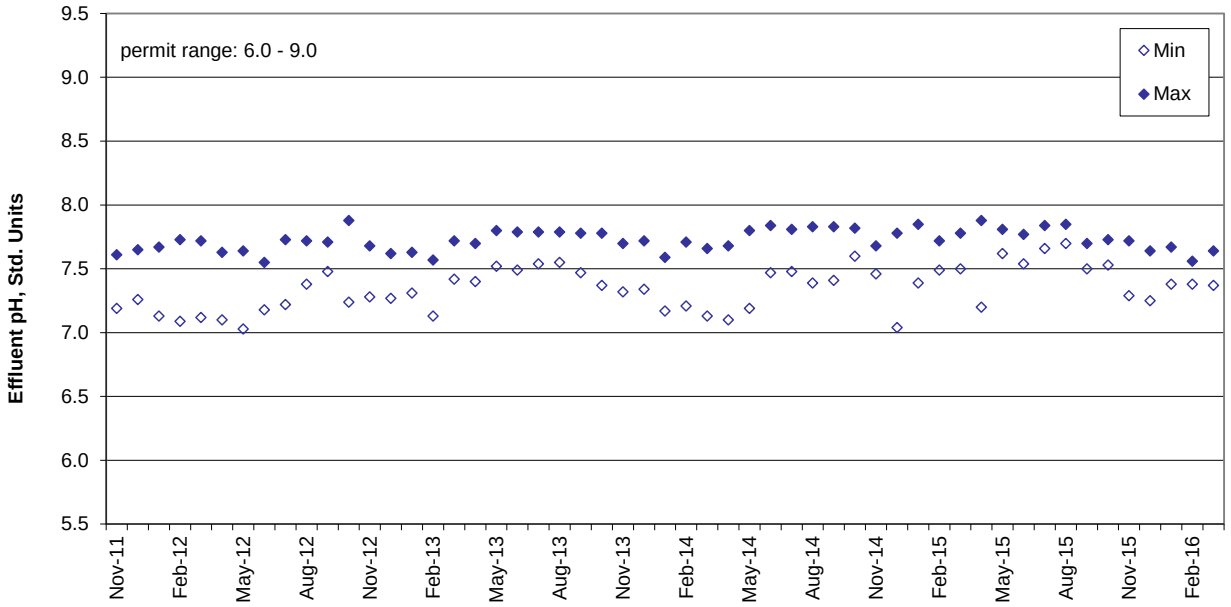


City of Stanwood WWTP Effluent – TSS

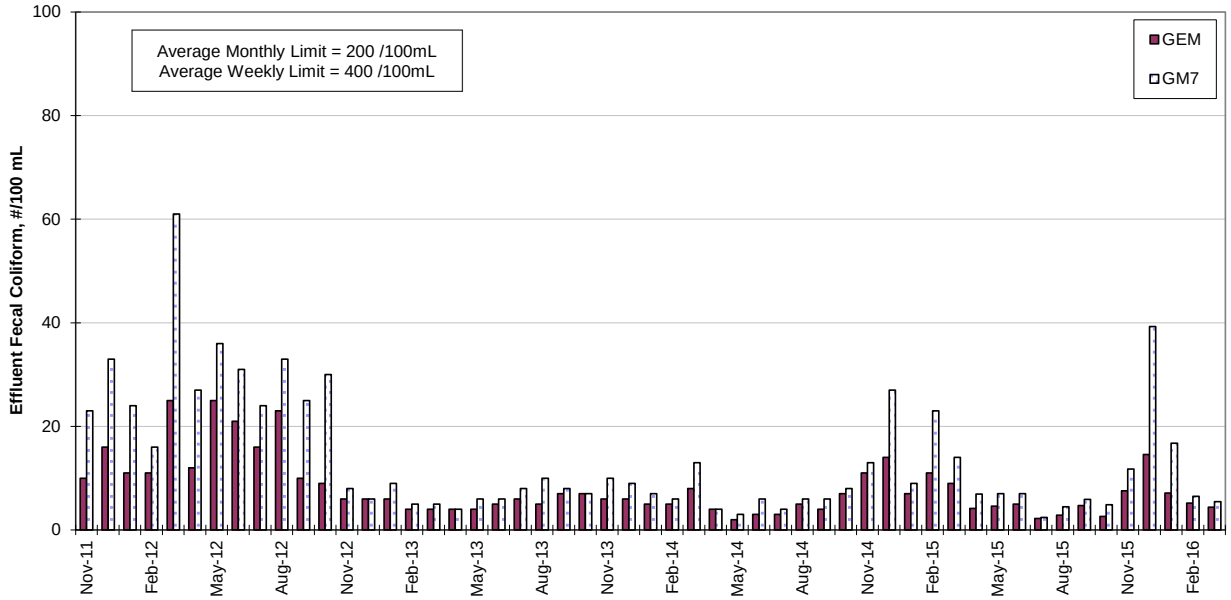




City of Stanwood WWTP Effluent – pH



City of Stanwood WWTP Effluent – Fecal Coliform



Appendix G--Response to Comments

City of Stanwood Entity Review Comments:

Good Morning Lazaro,

Regarding the comment period allowed by Ecology for draft review, please accept this email as confirmation of receipt and review. The City of Stanwood has reviewed the draft of the new NPDES permit and fact sheet. The City of Stanwood has no comments to submit to Ecology at this time.

Thank you,

Victoria Leigh Danielson
City of Stanwood
Wastewater Department Lead
10220 270th Street NW Stanwood WA 98292
(360) 629-9781 x4532
Leigh@ci.stanwood.wa.us

Public Review 30-day Comment Period:

No comments were submitted to the Department of Ecology during the official 30-day public review comment period.

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Date Accepted (MM/DD/YY)	Scheduled Delivery Time	Insurance Fee	COD Fee
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Time Accepted	10:30 AM Delivery Fee	Return Receipt Fee	Live Animal Transportation Fee
10:20 ☐ AM ☐ PM	$	$	$

Special Handling/Fragile	Sunday/Holiday Premium Fee	Total Postage & Fees
$	$	$ 26.35

Weight	☐ Flat Rate	Acceptance Employee Initials
lbs. 7 ozs. 1		

DELIVERY (POSTAL SERVICE USE ONLY)

Delivery Attempt (MM/DD/YY)	Time	Employee Signature
	☐ AM ☐ PM	
Delivery Attempt (MM/DD/YY)	Time	Employee Signature
	☐ AM ☐ PM	

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EPA Identification Number	NPDES Permit Number	Facility Name	Form Approved 03/05/19 OMB No. 2040-0004
110012854820	WA0020290	Stanwood WWTP	

Form 2A NPDES | EPA

U.S. Environmental Protection Agency
Application for NPDES Permit to Discharge Wastewater
NEW AND EXISTING PUBLICLY OWNED TREATMENT WORKS

SECTION 1. BASIC APPLICATION INFORMATION FOR ALL APPLICANTS (40 CFR 122.21(j)(1) and (9))

Facility Information

1.1 Facility name
City of Stanwood Wastewater Treatment Plant

Mailing address (street or P.O. box)
10220 270th Street N.W.

City or town	State	ZIP code
Stanwood	WA	98292

Contact name (first and last)	Title	Phone number	Email address
Victoria Leigh Danielson	Utilities Supervisor	(360) 454-5238	Victoria.Danielson@ci.stanwo

Location address (street, route number, or other specific identifier) ☐ Same as mailing address
26279 98th Avenue N.W.

City or town	State	ZIP code
Stanwood	WA	98292

1.2 Is this application for a facility that has yet to commence discharge?
☐ Yes ➔ See instructions on data submission requirements for new dischargers. ☑ No

Applicant Information

1.3 Is applicant different from entity listed under Item 1.1 above?
☐ Yes ☑ No ➔ SKIP to Item 1.4.

Applicant name

Applicant address (street or P.O. box)

City or town	State	ZIP code

Contact name (first and last)	Title	Phone number	Email address

1.4 Is the applicant the facility's owner, operator, or both? (Check only one response.)
☐ Owner ☐ Operator ☑ Both

1.5 To which entity should the NPDES permitting authority send correspondence? (Check only one response.)
☐ Facility ☐ Applicant ☑ Facility and applicant (they are one and the same)

Existing Environmental Permits

1.6 Indicate below any existing environmental permits. (Check all that apply and print or type the corresponding permit number for each.)

Existing Environmental Permits

☑ NPDES (discharges to surface water) WA0020290	☐ RCRA (hazardous waste)	☐ UIC (underground injection control)
☐ PSD (air emissions)	☐ Nonattainment program (CAA)	☐ NESHAPs (CAA)
☐ Ocean dumping (MPRSA)	☐ Dredge or fill (CWA Section 404)	☑ Other (specify) Biosolids BA0020290

Collection System and Population Served

1.7 Provide the collection system information requested below for the treatment works.

Municipality Served	Population Served	Collection System Type (indicate percentage)	Ownership Status
City of Stanwood		100 % separate sanitary sewer ____ % combined storm and sanitary sewer ☐ Unknown	☑ Own ☑ Maintain ☐ Own ☐ Maintain ☐ Own ☐ Maintain
		____ % separate sanitary sewer ____ % combined storm and sanitary sewer ☐ Unknown	☐ Own ☐ Maintain ☐ Own ☐ Maintain ☐ Own ☐ Maintain
		____ % separate sanitary sewer ____ % combined storm and sanitary sewer ☐ Unknown	☐ Own ☐ Maintain ☐ Own ☐ Maintain ☐ Own ☐ Maintain
		____ % separate sanitary sewer ____ % combined storm and sanitary sewer ☐ Unknown	☐ Own ☐ Maintain ☐ Own ☐ Maintain ☐ Own ☐ Maintain
Total Population Served			

	Separate Sanitary Sewer System	Combined Storm and Sanitary Sewer
Total percentage of each type of sewer line (in miles)	100 %	0 %

Indian Country

1.8 Is the treatment works located in Indian Country?

☐ Yes ☑ No

1.9 Does the facility discharge to a receiving water that flows through Indian Country?

☐ Yes ☑ No

Design and Actual Flow Rates

1.10 Provide design *and* actual flow rates in the designated spaces.

Design Flow Rate
1.5 mgd

Annual Average Flow Rates (Actual)		
Two Years Ago	Last Year	This Year
.50 mgd	.58 mgd	.79 mgd

Maximum Daily Flow Rates (Actual)		
Two Years Ago	Last Year	This Year
1.08 mgd	1.73 mgd	1.84 mgd

Discharge Points by Type

1.11 Provide the total number of effluent discharge points to waters of the United States by type.

Total Number of Effluent Discharge Points by Type				
Treated Effluent	Untreated Effluent	Combined Sewer Overflows	Bypasses	Constructed Emergency Overflows
1				

Outfalls and Other Discharge or Disposal Methods

Outfalls Other Than to Waters of the United States

1.12 Does the POTW discharge wastewater to basins, ponds, or other surface impoundments that do not have outlets for discharge to waters of the United States?

☐ Yes ☑ No → SKIP to Item 1.14.

1.13 Provide the location of each surface impoundment and associated discharge information in the table below.

Surface Impoundment Location and Discharge Data

Location	Average Daily Volume Discharged to Surface Impoundment	Continuous or Intermittent (check one)
	gpd	☐ Continuous ☐ Intermittent
	gpd	☐ Continuous ☐ Intermittent
	gpd	☐ Continuous ☐ Intermittent

1.14 Is wastewater applied to land?

☐ Yes ☑ No → SKIP to Item 1.16.

1.15 Provide the land application site and discharge data requested below.

Land Application Site and Discharge Data

Location	Size	Average Daily Volume Applied	Continuous or Intermittent (check one)
	acres	gpd	☐ Continuous ☐ Intermittent
	acres	gpd	☐ Continuous ☐ Intermittent
	acres	gpd	☐ Continuous ☐ Intermittent

1.16 Is effluent transported to another facility for treatment prior to discharge?

☐ Yes ☑ No → SKIP to Item 1.21.

1.17 Describe the means by which the effluent is transported (e.g., tank truck, pipe).

1.18 Is the effluent transported by a party other than the applicant?

☐ Yes ☑ No → SKIP to Item 1.20.

1.19 Provide information on the transporter below.

Transporter Data

Entity name	Mailing address (street or P.O. box)	
City or town	State	ZIP code
Contact name (first and last)	Title	
Phone number	Email address	

Outfalls and Other Discharge or Disposal Methods Continued

1.20 In the table below, indicate the name, address, contact information, NPDES number, and average daily flow rate of the receiving facility.

Receiving Facility Data		
Facility name	Mailing address (street or P.O. box)	
City or town	State	ZIP code
Contact name (first and last)	Title	
Phone number	Email address	
NPDES number of receiving facility (if any) ☐ None	Average daily flow rate	mgd

1.21 Is the wastewater disposed of in a manner other than those already mentioned in Items 1.14 through 1.21 that do not have outlets to waters of the United States (e.g., underground percolation, underground injection)?

☐ Yes ☑ No → SKIP to Item 1.23.

1.22 Provide information in the table below on these other disposal methods.

Information on Other Disposal Methods				
Disposal Method Description	Location of Disposal Site	Size of Disposal Site	Annual Average Daily Discharge Volume	Continuous or Intermittent (check one)
		acres	gpd	☐ Continuous ☐ Intermittent
		acres	gpd	☐ Continuous ☐ Intermittent
		acres	gpd	☐ Continuous ☐ Intermittent

Variance Requests

1.23 Do you intend to request or renew one or more of the variances authorized at 40 CFR 122.21(n)? (Check all that apply. Consult with your NPDES permitting authority to determine what information needs to be submitted and when.)

☐ Discharges into marine waters (CWA Section 301(h))

☐ Water quality related effluent limitation (CWA Section 302(b)(2))

☑ Not applicable

Contractor Information

1.24 Are any operational or maintenance aspects (related to wastewater treatment and effluent quality) of the treatment works the responsibility of a contractor?

☐ Yes ☑ No → SKIP to Section 2.

1.25 Provide location and contact information for each contractor in addition to a description of the contractor's operational and maintenance responsibilities.

Contractor Information			
	Contractor 1	Contractor 2	Contractor 3
Contractor name (company name)			
Mailing address (street or P.O. box)			
City, state, and ZIP code			
Contact name (first and last)			
Phone number			
Email address			
Operational and maintenance responsibilities of contractor			

SECTION 2. ADDITIONAL INFORMATION (40 CFR 122.21(j)(1) and (2))

Design Flow

Outfalls to Waters of the United States

2.1 Does the treatment works have a design flow greater than or equal to 0.1 mgd?

☑ Yes ☐ No ➔ SKIP to Section 3.

Inflow and Infiltration

2.2 Provide the treatment works' current average daily volume of inflow and infiltration.

Average Daily Volume of Inflow and Infiltration
180,000 gpd

Indicate the steps the facility is taking to minimize inflow and infiltration.

City conducted an I&I Study 2019. The study didn't find significant issues. The City is continuing to collect data with flow modules to give accurate information on what is happening in the system. The City of Stanwood also continues to use the CCTV for collection system inspection. The number of 180,000 is an estimate during the winter.

Topographic Map

2.3 Have you attached a topographic map to this application that contains all the required information? (See instructions for specific requirements.)

☑ Yes ☐ No

Flow Diagram

2.4 Have you attached a process flow diagram or schematic to this application that contains all the required information? (See instructions for specific requirements.)

☑ Yes ☐ No

Scheduled Improvements and Schedules of Implementation

2.5 Are improvements to the facility scheduled?

☑ Yes ☐ No ➔ SKIP to Section 3.

Briefly list and describe the scheduled improvements.

1. Sewer Master Plan update to begin 9/2021. Improvements to be determined.
2.
3.
4.

2.6 Provide scheduled or actual dates of completion for improvements.

Scheduled or Actual Dates of Completion for Improvements

Scheduled Improvement (from above)	Affected Outfalls (list outfall number)	Begin Construction (MM/DD/YYYY)	End Construction (MM/DD/YYYY)	Begin Discharge (MM/DD/YYYY)	Attainment of Operational Level (MM/DD/YYYY)
1.					
2.					
3.					
4.					

2.7 Have appropriate permits/clearances concerning other federal/state requirements been obtained? Briefly explain your response.

☐ Yes ☐ No ☐ None required or applicable

Explanation:

SECTION 3. INFORMATION ON EFFLUENT DISCHARGES (40 CFR 122.21(j)(3) to (5))

Description of Outfalls

3.1 Provide the following information for each outfall. (Attach additional sheets if you have more than three outfalls.)

	Outfall Number 001	Outfall Number _____	Outfall Number _____
State	Washington		
County	Snohomish		
City or town	Stanwood		
Distance from shore	30 ft.	ft.	ft.
Depth below surface	10 ft.	ft.	ft.
Average daily flow rate	.89 mgd	mgd	mgd
Latitude	48° 14′ 09″ N	° ′ ″	° ′ ″
Longitude	122° 21′ 22″ W	° ′ ″	° ′ ″

Seasonal or Periodic Discharge Data

3.2 Do any of the outfalls described under Item 3.1 have seasonal or periodic discharges?

☐ Yes ☑ No → SKIP to Item 3.4.

3.3 If so, provide the following information for each applicable outfall.

	Outfall Number _____	Outfall Number _____	Outfall Number _____
Number of times per year discharge occurs			
Average duration of each discharge (specify units)			
Average flow of each discharge	mgd	mgd	mgd
Months in which discharge occurs			

Diffuser Type

3.4 Are any of the outfalls listed under Item 3.1 equipped with a diffuser?

☐ Yes ☑ No → SKIP to Item 3.6.

3.5 Briefly describe the diffuser type at each applicable outfall.

	Outfall Number _____	Outfall Number _____	Outfall Number _____

Waters of the U.S.

3.6 Does the treatment works discharge or plan to discharge wastewater to waters of the United States from one or more discharge points?

☑ Yes ☐ No → SKIP to Section 6.

Receiving Water Description

3.7 Provide the receiving water and related information (if known) for each outfall.

	Outfall Number 001	Outfall Number _____	Outfall Number _____
Receiving water name	Old Stilliguamish River		
Name of watershed, river, or stream system	Stillaguamish River WRIA-5		
U.S. Soil Conservation Service 14-digit watershed code			
Name of state management/river basin	Stillaguamish		
U.S. Geological Survey 8-digit hydrologic cataloging unit code	17110008		
Critical low flow (acute)	cfs	cfs	cfs
Critical low flow (chronic)	cfs	cfs	cfs
Total hardness at critical low flow	mg/L of $CaCO_3$	mg/L of $CaCO_3$	mg/L of $CaCO_3$

Treatment Description

3.8 Provide the following information describing the treatment provided for discharges from each outfall.

	Outfall Number 001	Outfall Number _____	Outfall Number _____
Highest Level of Treatment (check all that apply per outfall)	☐ Primary ☐ Equivalent to secondary ☑ Secondary ☑ Advanced ☐ Other (specify) _____	☐ Primary ☐ Equivalent to secondary ☐ Secondary ☐ Advanced ☐ Other (specify) _____	☐ Primary ☐ Equivalent to secondary ☐ Secondary ☐ Advanced ☐ Other (specify) _____
Design Removal Rates by Outfall			
BOD_5 or $CBOD_5$	min 85% %	%	%
TSS	min 85% %	%	%
Phosphorus	☑ Not applicable %	☐ Not applicable %	☐ Not applicable %
Nitrogen	☑ Not applicable %	☐ Not applicable %	☐ Not applicable %
Other (specify) _____	☑ Not applicable %	☐ Not applicable %	☐ Not applicable %

Treatment Description Continued

3.9 Describe the type of disinfection used for the effluent from each outfall in the table below. If disinfection varies by season, describe below.

The WEDECO UV disinfection system consists of two banks of 24 lamps. Sluice gates are used to distribute the flow between the two channels. The effluent is monitored and is automatically diverted when turbidity exceeds 35 NTU. The effluent is diverted to the 35 Acre Lagoon until the situation is addressed. Lagoon effluent is sent to headworks to treat.

	Outfall Number 001	Outfall Number _____	Outfall Number _____
Disinfection type	Ultra Violet Disinfection		
Seasons used	year round		
Dechlorination used?	☐ Not applicable ☐ Yes ☑ No	☐ Not applicable ☐ Yes ☐ No	☐ Not applicable ☐ Yes ☐ No

Effluent Testing Data

3.10 Have you completed monitoring for all Table A parameters and attached the results to the application package?

☑ Yes ☐ No

3.11 Have you conducted any WET tests during the 4.5 years prior to the date of the application on any of the facility's discharges or on any receiving water near the discharge points?

☑ Yes ☐ No → SKIP to Item 3.13.

3.12 Indicate the number of acute and chronic WET tests conducted since the last permit reissuance of the facility's discharges by outfall number or of the receiving water near the discharge points.

	Outfall Number 001		Outfall Number _____		Outfall Number _____	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Number of tests of discharge water	4	4				
Number of tests of receiving water	0	0				

3.13 Does the treatment works have a design flow greater than or equal to 0.1 mgd?

☑ Yes ☐ No → SKIP to Item 3.16.

3.14 Does the POTW use chlorine for disinfection, use chlorine elsewhere in the treatment process, or otherwise have reasonable potential to discharge chlorine in its effluent?

☐ Yes → Complete Table B, including chlorine. ☑ No → Complete Table B, omitting chlorine.

3.15 Have you completed monitoring for all applicable Table B pollutants and attached the results to this application package?

☑ Yes ☐ No

3.16 Does one or more of the following conditions apply?

- The facility has a design flow greater than or equal to 1 mgd.
- The POTW has an approved pretreatment program or is required to develop such a program.
- The NPDES permitting authority has informed the POTW that it must sample for the parameters in Table C, must sample other additional parameters (Table D), or submit the results of WET tests for acute or chronic toxicity for each of its discharge outfalls (Table E).

☑ Yes → Complete Tables C, D, and E as applicable. ☐ No → SKIP to Section 4.

3.17 Have you completed monitoring for all applicable Table C pollutants and attached the results to this application package?

☑ Yes ☐ No

3.18 Have you completed monitoring for all applicable Table D pollutants required by your NPDES permitting authority and attached the results to this application package?

☑ Yes ☐ No additional sampling required by NPDES permitting authority.

Effluent Testing Data Continued

3.19 Has the POTW conducted either (1) minimum of four quarterly WET tests for one year preceding this permit application or (2) at least four annual WET tests in the past 4.5 years?

☑ Yes ☐ No ➔ Complete tests and Table E and SKIP to Item 3.26.

3.20 Have you previously submitted the results of the above tests to your NPDES permitting authority?

☑ Yes ☐ No ➔ Provide results in Table E and SKIP to Item 3.26.

3.21 Indicate the dates the data were submitted to your NPDES permitting authority and provide a summary of the results.

Date(s) Submitted (MM/DD/YYYY)	Summary of Results
04/22/2021	Tests showed no statistically significant difference in organism response for all testing.

3.22 Regardless of how you provided your WET testing data to the NPDES permitting authority, did any of the tests result in toxicity?

☐ Yes ☑ No ➔ SKIP to Item 3.26.

3.23 Describe the cause(s) of the toxicity:

3.24 Has the treatment works conducted a toxicity reduction evaluation?

☐ Yes ☑ No ➔ SKIP to Item 3.26.

3.25 Provide details of any toxicity reduction evaluations conducted.

3.26 Have you completed Table E for all applicable outfalls and attached the results to the application package?

☐ Yes ☑ Not applicable because previously submitted information to the NPDES permitting authority.

SECTION 4. INDUSTRIAL DISCHARGES AND HAZARDOUS WASTES (40 CFR 122.21(j)(6) and (7))

Industrial Discharges and Hazardous Wastes

4.1 Does the POTW receive discharges from SIUs or NSCIUs?

☑ Yes ☐ No ➔ SKIP to Item 4.7.

4.2 Indicate the number of SIUs and NSCIUs that discharge to the POTW.

Number of SIUs	Number of NSCIUs
2	

4.3 Does the POTW have an approved pretreatment program?

☐ Yes ☑ No

4.4 Have you submitted either of the following to the NPDES permitting authority that contains information substantially identical to that required in Table F: (1) a pretreatment program annual report submitted within one year of the application or (2) a pretreatment program?

☐ Yes ☑ No ➔ SKIP to Item 4.6.

4.5 Identify the title and date of the annual report or pretreatment program referenced in Item 4.4. SKIP to Item 4.7.

4.6 Have you completed and attached Table F to this application package?

☑ Yes ☐ No

Industrial Discharges and Hazardous Wastes Continued

4.7 Does the POTW receive, or has it been notified that it will receive, by truck, rail, or dedicated pipe, any wastes that are regulated as RCRA hazardous wastes pursuant to 40 CFR 261?

☐ Yes ☑ No → SKIP to Item 4.9.

4.8 If yes, provide the following information:

Hazardous Waste Number	Waste Transport Method (check all that apply)	Annual Amount of Waste Received	Units
	☐ Truck ☐ Rail ☐ Dedicated pipe ☐ Other (specify) _____		
	☐ Truck ☐ Rail ☐ Dedicated pipe ☐ Other (specify) _____		
	☐ Truck ☐ Rail ☐ Dedicated pipe ☐ Other (specify) _____		

4.9 Does the POTW receive, or has it been notified that it will receive, wastewaters that originate from remedial activities, including those undertaken pursuant to CERCLA and Sections 3004(7) or 3008(h) of RCRA?

☐ Yes ☑ No → SKIP to Section 5.

4.10 Does the POTW receive (or expect to receive) less than 15 kilograms per month of non-acute hazardous wastes as specified in 40 CFR 261.30(d) and 261.33(e)?

☐ Yes → SKIP to Section 5. ☐ No

4.11 Have you reported the following information in an attachment to this application: identification and description of the site(s) or facility(ies) at which the wastewater originates; the identities of the wastewater's hazardous constituents; and the extent of treatment, if any, the wastewater receives or will receive before entering the POTW?

☐ Yes ☐ No

SECTION 5. COMBINED SEWER OVERFLOWS (40 CFR 122.21(j)(8))

CSO Map and Diagram

5.1 Does the treatment works have a combined sewer system?

☐ Yes ☑ No → SKIP to Section 6.

5.2 Have you attached a CSO system map to this application? (See instructions for map requirements.)

☐ Yes ☐ No

5.3 Have you attached a CSO system diagram to this application? (See instructions for diagram requirements.)

☐ Yes ☐ No

CSO Outfall Description

5.4 For each CSO outfall, provide the following information. (Attach additional sheets as necessary.)

	CSO Outfall Number ____	CSO Outfall Number ____	CSO Outfall Number ____
City or town			
State and ZIP code			
County			
Latitude	° ' "	° ' "	° ' "
Longitude	° ' "	° ' "	° ' "
Distance from shore	ft.	ft.	ft.
Depth below surface	ft.	ft.	ft.

CSO Monitoring

5.5 Did the POTW monitor any of the following items in the past year for its CSO outfalls?

	CSO Outfall Number ____	CSO Outfall Number ____	CSO Outfall Number ____
Rainfall	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
CSO flow volume	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
CSO pollutant concentrations	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Receiving water quality	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
CSO frequency	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Number of storm events	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

CSO Events in Past Year

5.6 Provide the following information for each of your CSO outfalls.

	CSO Outfall Number ____	CSO Outfall Number ____	CSO Outfall Number ____
Number of CSO events in the past year	events	events	events
Average duration per event	hours ☐ Actual or ☐ Estimated	hours ☐ Actual or ☐ Estimated	hours ☐ Actual or ☐ Estimated
Average volume per event	million gallons ☐ Actual or ☐ Estimated	million gallons ☐ Actual or ☐ Estimated	million gallons ☐ Actual or ☐ Estimated
Minimum rainfall causing a CSO event in last year	inches of rainfall ☐ Actual or ☐ Estimated	inches of rainfall ☐ Actual or ☐ Estimated	inches of rainfall ☐ Actual or ☐ Estimated

CSO Receiving Waters

5.7 Provide the information in the table below for each of your CSO outfalls.

	CSO Outfall Number ____	CSO Outfall Number ____	CSO Outfall Number ____
Receiving water name			
Name of watershed/ stream system			
U.S. Soil Conservation Service 14-digit watershed code (if known)	☐ Unknown	☐ Unknown	☐ Unknown
Name of state management/river basin			
U.S. Geological Survey 8-Digit Hydrologic Unit Code (if known)	☐ Unknown	☐ Unknown	☐ Unknown
Description of known water quality impacts on receiving stream by CSO (see instructions for examples)			

SECTION 6. CHECKLIST AND CERTIFICATION STATEMENT (40 CFR 122.22(a) and (d))

Checklist and Certification Statement

6.1 In Column 1 below, mark the sections of Form 2A that you have completed and are submitting with your application. For each section, specify in Column 2 any attachments that you are enclosing to alert the permitting authority. Note that not all applicants are required to provide attachments.

Column 1	Column 2	
☑ Section 1: Basic Application Information for All Applicants	☐ w/ variance request(s)	☐ w/ additional attachments
☑ Section 2: Additional Information	☑ w/ topographic map ☐ w/ additional attachments	☑ w/ process flow diagram
☑ Section 3: Information on Effluent Discharges	☑ w/ Table A ☑ w/ Table B ☑ w/ Table C	☑ w/ Table D ☑ w/ Table E ☑ w/ additional attachments
☑ Section 4: Industrial Discharges and Hazardous Wastes	☐ w/ SIU and NSCIU attachments ☐ w/ additional attachments	☑ w/ Table F
☐ Section 5: Combined Sewer Overflows	☐ w/ CSO map ☐ w/ CSO system diagram	☐ w/ additional attachments
☑ Section 6: Checklist and Certification Statement	☐ w/ attachments	

6.2 **Certification Statement**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name (print or type first and last name)	Official title
Kevin Hushagen	Public Works Director
Signature	**Date signed**
Kevin Hushagen	7/26/21

EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110012854820	WA0020290	Stanwood WWTP	001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE A. EFFLUENT PARAMETERS FOR ALL POTWS

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
Biochemical oxygen demand ☑ BOD_5 or ☐ $CBOD_5$ (report one)	14	MG/L	4.19	MG/L	442	SM 5210 B-2011	2mg/L ☐ ML ☐ MDL
Fecal coliform	188	MPN/100mL	4.40	MPN/100mL	442	SM 9222 D(mFC)-06	☐ ML ☐ MDL
Design flow rate	1.99	MGD	.58	MGD	51		
pH (minimum)	6.86	mg/L					
pH (maximum)	7.92	mg/L					
Temperature (winter)	21.4	Degrees Celsius	14.09	Degrees Celsius	51		
Temperature (summer)	24.1	Degrees Celsius	20.3	Degrees Celsius	51		
Total suspended solids (TSS)	804.00	mg/L	299.65	mg/L	442	SM2540 D-2011	5mg/L ☐ ML ☐ MDL

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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EPA Identification Number	NPDES Permit Number	Facility Name	Outfall Number
110012854820	WA0020290	Stanwood WWTP	001

Form Approved 03/05/19
OMB No. 2040-0004

TABLE B. EFFLUENT PARAMETERS FOR ALL POTWS WITH A FLOW EQUAL TO OR GREATER THAN 0.1 MGD

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
Ammonia (as N)	30.66	mg/L	2.64	mg/L	17	350.1	0012 mg/L ☐ ML ☑ MDL
Chlorine (total residual, TRC)[2]	NA	NA	NA	NA	NA	NA	NA ☐ ML ☐ MDL
Dissolved oxygen	6.92	mg/L	5.46	mg/L	4	SM 4500-O G	.2mg/L ☐ ML ☑ MDL
Nitrate/nitrite	58.9	mg/L	8.84	mg/L	17	SM4500-NO3F	.0026mg/L ☐ ML ☑ MDL
Kjeldahl nitrogen	35.85	mg/L	4.18	mg/L	17	351.2	.0047mg/L ☐ ML ☑ MDL
Oil and grease	ND <1.4	mg/L	ND <1.4	mg/L	4	1664	1.3mg/L ☐ ML ☑ MDL
Phosphorus	11.58	mg/L	2.37	mg/L	17	SM 4500-P F	.0011mg/L ☐ ML ☑ MDL
Total dissolved solids	473	mg/L	451.5	mg/L	4	SM 2540 C	10 ☐ ML ☑ MDL

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

[2] Facilities that do not use chlorine for disinfection, do not use chlorine elsewhere in the treatment process, and have no reasonable potential to discharge chlorine in their effluent are not required to report data for chlorine.

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TABLE C. EFFLUENT PARAMETERS FOR SELECTED POTWS

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
Metals, Cyanide, and Total Phenols							
Hardness (as $CaCO_3$)	188.1	mg/L	151.75	mg/L	4	200.7/3010A	.01mg/L ☐ ML ☑ MDL
Antimony, total recoverable	.47	ug/L	.4825	ug/L	4	200.8/3010A	.00691 ☐ ML ☑ MDL
Arsenic, total recoverable	9	ug/L	6.95	ug/L	4	200.8/3010A	.00218 ☐ ML ☑ MDL
Beryllium, total recoverable	.015	ug/L	.00375	ug/L	4	200.8/3010A	.00676 ☐ ML ☑ MDL
Cadmium, total recoverable	.02	ug/L	.005	ug/L	4	200.8/3010A	.00113 ☐ ML ☑ MDL
Chromium, total recoverable	2	ug/L	.95	ug/L	4	200.8/3010A	.00203 ☐ ML ☑ MDL
Copper, total recoverable	7.9	ug/L	7.13	ug/L	4	200.8/3010A	.00276 ☐ ML ☑ MDL
Lead, total recoverable	.26	ug/L	.16	ug/L	4	200.8/3010A	.00666 ☐ ML ☑ MDL
Mercury, total recoverable	.913	ng/L	.23	ng/L	4	200.8/3010A	.0019 ☐ ML ☑ MDL
Nickel, total recoverable	2.9	ug/L	1.85	ug/L	4	200.8/3010A	.00162 ☐ ML ☑ MDL
Selenium, total recoverable	1	ug/L	.6	ug/L	4	200.8/3010A	.00266 ☐ ML ☑ MDL
Silver, total recoverable	.7	ug/L	.175	ug/L	4	200.8/3010A	.00117 ☐ ML ☑ MDL
Thallium, total recoverable	.06	ug/L	.175	ug/L	4	200.8/3010A	.00706 ☐ ML ☑ MDL
Zinc, total recoverable	60	ug/L	43.95	ug/L	4	200.8/3010A	.00055 ☐ ML ☑ MDL
Cyanide	11	ugL	5.25	ug/L	4	D7511-09	4 ☐ ML ☑ MDL
Total phenolic compounds	120	ug/L	36.25	ug/L	4	420.4	0.05 ☐ ML ☑ MDL
Volatile Organic Compounds							
Acrolein	<5	ug/L	<5	ug/L	4	624(pH4)	1.66 ☐ ML ☑ MDL
Acrylonitrile	<1	ug/L	<1	ug/L	4	624(pH4)	.56 ☐ ML ☑ MDL
Benzene	<1	ug/L	<1	ug/L	4	624.1	0.23 ☐ ML ☐ MDL
Bromoform	<1	ug/L	<1	ug/L	4	624.1	0.26 ☐ ML ☑ MDL

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TABLE C. EFFLUENT PARAMETERS FOR SELECTED POTWS

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
Carbon tetrachloride	<1	ug/L	<1	ug/L	4	624.1	0.24 ☐ ML ☑ MDL
Chlorobenzene	<1	ug/L	<1	ug/L	4	624.1	0.28 ☐ ML ☑ MDL
Chlorodibromomethane	<1	ug/L	<1	ug/L	4	624.1	0.28 ☐ ML ☑ MDL
Chloroethane	<1	ug/L	<1	ug/L	4	624.1	0.34 ☐ ML ☑ MDL
2-chloroethylvinyl ether	<1	ug/L	<1	ug/L	4	624.1	0.46 ☐ ML ☑ MDL
Chloroform	<1	ug/L	<1	ug/L	4	624.1	0.25 ☐ ML ☑ MDL
Dichlorobromomethane	<1	ug/L	<1	ug/L	4	624.1	0.28 ☐ ML ☑ MDL
1,1-dichloroethane	<1	ug/L	<1	ug/L	4	624.1	0.32 ☐ ML ☑ MDL
1,2-dichloroethane	<1	ug/L	<1	ug/L	4	624.1	.038 ☐ ML ☑ MDL
trans-1,2-dichloroethylene	<1	ug/L	<1	ug/L	4	624.1	0.34 ☐ ML ☑ MDL
1,1-dichloroethylene	<1	ug/L	<1	ug/L	4	624.1	0.25 ☐ ML ☑ MDL
1,2-dichloropropane	<1	ug/L	<1	ug/L	4	624.1	0.22 ☐ ML ☑ MDL
1,3-dichloropropylene	<1	ug/L	<1	ug/L	4	624.1	0.24 ☐ ML ☑ MDL
Ethylbenzene	<1	ug/L	<1	ug/L	4	624.1	0.29 ☐ ML ☐ MDL
Methyl bromide	<5	ug/L	<1	ug/L	4	624.1	0.37 ☐ ML ☑ MDL
Methyl chloride	<1	ug/L	<1	ug/L	4	624.1	0.28 ☐ ML ☑ MDL
Methylene chloride	<5	ug/L	<1	ug/L	4	624.1	0.28 ☐ ML ☑ MDL
1,1,2,2-tetrachloroethane	<1.9	ug/L	<1	ug/L	4	624.1	0.37 ☐ ML ☑ MDL
Tetrachloroethylene	<1	ug/L	<1	ug/L	4	624.1	0.24 ☐ ML ☑ MDL
Toluene	<1	ug/L	<1	ug/L	4	625	0.24 ☐ ML ☑ MDL
1,1,1-trichloroethane	<1	ug/L	<1	ug/L	4	625	0.26 ☐ ML ☑ MDL
1,1,2-trichloroethane	<1	ug/L	<1	ug/L	4	625	0.28 ☐ ML ☑ MDL

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TABLE C. EFFLUENT PARAMETERS FOR SELECTED POTWS

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
Trichloroethylene	<1	ug/L	<1	ug/L	4	625	0.29 ☐ ML ☑ MDL
Vinyl chloride	<1	ug/L	<1	ug/L	4	625	0.28 ☐ ML ☑ MDL
Acid-Extractable Compounds							
p-chloro-m-cresol	<1	ug/L	<1	ug/L	4	625	0.2 ☐ ML ☑ MDL
2-chlorophenol	<1	ug/L	<1	ug/L	4	625	0.1 ☐ ML ☑ MDL
2,4-dichlorophenol	<.5	ug/L	<.5	ug/L	4	625	0.2 ☐ ML ☑ MDL
2,4-dimethylphenol	<.5	ug/L	<.5	ug/L	4	625	0.4 ☐ ML ☑ MDL
4,6-dinitro-o-cresol	<1	ug/L	<1	ug/L	4	625	0.3 ☐ ML ☑ MDL
2,4-dinitrophenol	<1	ug/L	<1	ug/L	4	625	0.5 ☐ ML ☑ MDL
2-nitrophenol	<.5	ug/L	<.5	ug/L	4	625	0.2 ☐ ML ☑ MDL
4-nitrophenol	<.5	ug/L	<.5	ug/L	4	625	0.3 ☐ ML ☑ MDL
Pentachlorophenol	<.5	ug/L	<.5	ug/L	4	625	0.2 ☐ ML ☑ MDL
Phenol	<2	ug/L	<2	ug/L	4	625	0.1 ☐ ML ☑ MDL
2,4,6-trichlorophenol	<2	ug/L	<2	ug/L	4	625	0.1 ☐ ML ☑ MDL
Base-Neutral Compounds							
Acenaphthene	<.2	ug/L	<.2	ug/L	4	625	0.04 ☐ ML ☑ MDL
Acenaphthylene	<.3	ug/L	<.3	ug/L	4	625	0.07 ☐ ML ☑ MDL
Anthracene	<.3	ug/L	<.3	ug/L	4	625	0.05 ☐ ML ☑ MDL
Benzidine	<12	ug/L	<12	ug/L	4	625	9 ☐ ML ☑ MDL
Benzo(a)anthracene	<.3	ug/L	<.3	ug/L	4	625	0.05 ☐ ML ☑ MDL
Benzo(a)pyrene	<.5	ug/L	<.5	ug/L	4	625	0.05 ☐ ML ☑ MDL
3,4-benzofluoranthene	<.8	ug/L	<.8	ug/L	4	625	0.08 ☐ ML ☑ MDL

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TABLE C. EFFLUENT PARAMETERS FOR SELECTED POTWS

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
Benzo(ghi)perylene	<.5	ug/L	<.5	ug/L	4	625	0.05 ☐ ML ☑ MDL
Benzo(k)fluoranthene	<.8	ug/L	<.8	ug/L	4	625	0.08 ☐ ML ☑ MDL
Bis (2-chloroethoxy) methane	<5.3	ug/L	<5.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
Bis (2-chloroethyl) ether	<.3	ug/L	<.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
Bis (2-chloroisopropyl) ether	<5.7	ug/L	<5.7	ug/L	4	625	0.06 ☐ ML ☑ MDL
Bis (2-ethylhexyl) phthalate	6.7	ug/L	2.4	ug/L	4	625	0.1 ☐ ML ☑ MDL
4-bromophenyl phenyl ether	<.2	ug/L	<.2	ug/L	4	625	0.04 ☐ ML ☑ MDL
Butyl benzyl phthalate	<.3	ug/L	<.3	ug/L	4	625	0.03 ☐ ML ☑ MDL
2-chloronaphthalene	<.3	ug/L	<.3	ug/L	4	625	0.05 ☐ ML ☑ MDL
4-chlorophenyl phenyl ether	<.3	ug/L	<.3	ug/L	4	625	0.04 ☐ ML ☑ MDL
Chrysene	<.3	ug/L	<.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
di-n-butyl phthalate	<.5	ug/L	<.5	ug/L	4	625	0.07 ☐ ML ☑ MDL
di-n-octyl phthalate	<.3	ug/L	<.3	ug/L	4	625	0.02 ☐ ML ☑ MDL
Dibenzo(a,h)anthracene	<.8	ug/L	<.8	ug/L	4	625	0.05 ☐ ML ☑ MDL
1,2-dichlorobenzene	<1.9	ug/L	<1.9	ug/L	4	625	0.31 ☐ ML ☑ MDL
1,3-dichlorobenzene	<1.9	ug/L	<1.9	ug/L	4	625	0.29 ☐ ML ☑ MDL
1,4-dichlorobenzene	<4.4	ug/L	<4.4	ug/L	4	625	0.29 ☐ ML ☑ MDL
3,3-dichlorobenzidine	<.5	ug/L	<.5	ug/L	4	625	0.2 ☐ ML ☑ MDL
Diethyl phthalate	<1.9	ug/L	<1.9	ug/L	4	625	0.06 ☐ ML ☑ MDL
Dimethyl phthalate	<1.6	ug/L	<1.6	ug/L	4	625	0.05 ☐ ML ☐ MDL
2,4-dinitrotoluene	<.2	ug/L	<.2	ug/L	4	625	0.07 ☐ ML ☑ MDL
2,6-dinitrotoluene	<.2	ug/L	<.2	ug/L	4	625	0.09 ☐ ML ☑ MDL

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TABLE C. EFFLUENT PARAMETERS FOR SELECTED POTWS

Pollutant	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
1,2-diphenylhydrazine	<5	ug/L	<5	ug/L	4	625	0.06 ☐ ML ☑ MDL
Fluoranthene	<.3	ug/L	<.3	ug/L	4	625	0.05 ☐ ML ☑ MDL
Fluorene	<.3	ug/L	<.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
Hexachlorobenzene	<.3	ug/L	<.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
Hexachlorobutadiene	<.5	ug/L	<.5	ug/L	4	625	0.09 ☐ ML ☑ MDL
Hexachlorocyclo-pentadiene	<.5	ug/L	<.5	ug/L	4	625	0.2 ☐ ML ☑ MDL
Hexachloroethane	<.5	ug/L	<.5	ug/L	4	625	0.09 ☐ ML ☑ MDL
Indeno(1,2,3-cd)pyrene	<.5	ug/L	<.5	ug/L	4	625	0.09 ☐ ML ☑ MDL
Isophorone	<.5	ug/L	<.5	ug/L	4	625	0.07 ☐ ML ☑ MDL
Naphthalene	<.3	ug/L	<.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
Nitrobenzene	<.5	ug/L	<.5	ug/L	4	625	0.05 ☐ ML ☑ MDL
N-nitrosodi-n-propylamine	<.5	ug/L	<.5	ug/L	4	625	0.1 ☐ ML ☑ MDL
N-nitrosodimethylamine	<2	ug/L	<2	ug/L	4	625	0.3 ☐ ML ☑ MDL
N-nitrosodiphenylamine	<.5	ug/L	<.5	ug/L	4	625	0.05 ☐ ML ☑ MDL
Phenanthrene	<.3	ug/L	<.3	ug/L	4	625	0.06 ☐ ML ☑ MDL
Pyrene	<.3	ug/L	<.3	ug/L	4	625	0.05 ☐ ML ☑ MDL
1,2,4-trichlorobenzene	<.3	ug/L	<.3	ug/L	4	625	0.05 ☐ ML ☑ MDL

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR Chapter I, Subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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TABLE D. ADDITIONAL POLLUTANTS AS REQUIRED BY NPDES PERMITTING AUTHORITY

Pollutant (list)	Maximum Daily Discharge		Average Daily Discharge			Analytical Method[1]	ML or MDL (include units)
	Value	Units	Value	Units	Number of Samples		
☐ No additional sampling is required by NPDES permitting authority.							
Total Phosphorus	20.21	mg/L	3.53	mg/L	17	SM4500-PF	.0026mg/L ☐ ML ☑ MDL
						SM4500-PB(5)	☐ ML ☑ MDL
Chromium Hexavalent	.038	ug/L	.018	ug/L	4	218.6	.0016ug/L ☐ ML ☑ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL
							☐ ML ☐ MDL

[1] Sampling shall be conducted according to sufficiently sensitive test procedures (i.e., methods) approved under 40 CFR 136 for the analysis of pollutants or pollutant parameters or required under 40 CFR chapter I, subchapter N or O. See instructions and 40 CFR 122.21(e)(3).

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TABLE E. EFFLUENT MONITORING FOR WHOLE EFFLUENT TOXICITY

The table provides response space for one whole effluent toxicity sample. Copy the table to report additional test results.

Test Information	Test Number 7-040	Test Number 7-041	Test Number _____
Test species	Ceriodaphnia dubia	Pimephales promelas	
Age at initiation of test	<24 hours	<24 hours	
Outfall number	001	001	001
Date sample collected	07/20/2020	07/20/2020	
Date test started	07/21/2020	07/21/2021	
Duration	49 hours	96 hours	
Toxicity Test Methods			
Test method number	EPA-821-R-02-012	EPA-821-R-02-012	
Manual title	USEPA (2002a)	USEPA (2002a)	
Edition number and year of publication			
Page number(s)			
Sample Type			
Check one:	☐ Grab ☑ 24-hour composite	☐ Grab ☑ 24-hour composite	☐ Grab ☑ 24-hour composite
Sample Location			
Check one:	☐ Before Disinfection ☑ After Disinfection ☐ After Dechlorination	☐ Before Disinfection ☑ After Disinfection ☐ After Dechlorination	☐ Before disinfection ☑ After disinfection ☐ After dechlorination
Point in Treatment Process			
Describe the point in the treatment process at which the sample was collected for each test.	After UV disinfection before Outfall	After UV disinfection before Outfall	After UV disinfection before Outfall
Toxicity Type			
Indicate for each test whether the test was performed to asses acute or chronic toxicity, or both. (Check one response.)	☑ Acute ☐ Chronic ☐ Both	☑ Acute ☐ Chronic ☐ Both	☐ Acute ☐ Chronic ☐ Both

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TABLE E. EFFLUENT MONITORING FOR WHOLE EFFLUENT TOXICITY

The table provides response space for one whole effluent toxicity sample. Copy the table to report additional test results.

	Test Number 7-040	Test Number 7-041	Test Number ____
Test Type			
Indicate the type of test performed. (Check one response.)	☑ Static ☐ Static-renewal ☐ Flow-through	☐ Static ☑ Static-renewal ☐ Flow-through	☐ Static ☐ Static-renewal ☐ Flow-through
Source of Dilution Water			
Indicate the source of dilution water. (Check one response.)	☑ Laboratory water ☐ Receiving water	☑ Laboratory water ☐ Receiving water	☐ Laboratory water ☐ Receiving water
If laboratory water, specify type.	mod hard synthetic	mod hard synthetic water	
If receiving water, specify source.			
Type of Dilution Water			
Indicate the type of dilution water. If salt water, specify "natural" or type of artificial sea salts or brine used.	☑ Fresh water ☐ Salt water (specify)	☑ Fresh water ☐ Salt water (specify)	☐ Fresh water ☐ Salt water (specify)
Percentage Effluent Used			
Specify the percentage effluent used for all concentrations in the test series.	100, 50, 25, 12.5, 6.25, lab control	100, 50, 25, 12.5, 6.25,lab control	

Parameters Tested						
Check the parameters tested.	☐ pH ☐ Salinity ☑ Temperature	☐ Ammonia ☐ Dissolved oxygen	☐ pH ☐ Salinity ☑ Temperature	☐ Ammonia ☐ Dissolved oxygen	☐ pH ☐ Salinity ☐ Temperature	☐ Ammonia ☐ Dissolved oxygen

Acute Test Results			
Percent survival in 100% effluent	100 %	92.5 %	%
LC_{50}	100	97.5	
95% confidence interval	100 %	100 %	%
Control percent survival	100 %	97.5 %	%

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TABLE E. EFFLUENT MONITORING FOR WHOLE EFFLUENT TOXICITY

The table provides response space for one whole effluent toxicity sample. Copy the table to report additional test results.

	Test Number 7-040		Test Number 7-041		Test Number _____	
Acute Test Results Continued						
Other (describe)						
Chronic Test Results						
NOEC	%		%		%	
IC_{25}	%		%		%	
Control percent survival	%		%		%	
Other (describe)						
Quality Control/Quality Assurance						
Is reference toxicant data available?	☑ Yes	☐ No	☑ Yes	☐ No	☐ Yes	☐ No
Was reference toxicant test within acceptable bounds?	☑ Yes	☐ No	☑ Yes	☐ No	☐ Yes	☐ No
What date was reference toxicant test run (MM/DD/YYYY)?	07/08/2020		07/08/2020			
Other (describe)						

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TABLE F. INDUSTRIAL DISCHARGE INFORMATION

Response space is provided for three SIUs. Copy the table to report information for additional SIUs.

	SIU 001	SIU 002	SIU ____
Name of SIU	Roy N Carlson Inc Stanwood	North Star Cold Storage	
Mailing address (street or P.O. box)	8506 Cedarhome Drive	27100 Pioneer HWY SR 532	
City, state, and ZIP code	Stanwood Washington 98292	Stanwood Washington 98292	
Description of all industrial processes that affect or contribute to the discharge.	Washing out container trucks that haul edible commodities	Fresh and frozen seafood processing. Butcher,cook,freeze,glaze and packaging.	
List the principal products and raw materials that affect or contribute to the SIU's discharge.	Rinse water from washing trucks that transport edible products: milk, flour, sugar, and vegetable oils	wash water from fish timmings,crab processing and condensate from freezers. Any solids are collected and storged until they are picked up by a waste hauler.	
Indicate the average daily volume of wastewater discharged by the SIU.	2000 gpd	<50,000 gpd	gpd
How much of the average daily volume is attributable to process flow?	1250 gpd	<50,000 gpd	gpd
How much of the average daily volume is attributable to non-process flow?	<750 gpd	<50,000 gpd	gpd
Is the SIU subject to local limits?	☑ Yes ☐ No	☑ Yes ☐ No	☐ Yes ☐ No
Is the SIU subject to categorical standards?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

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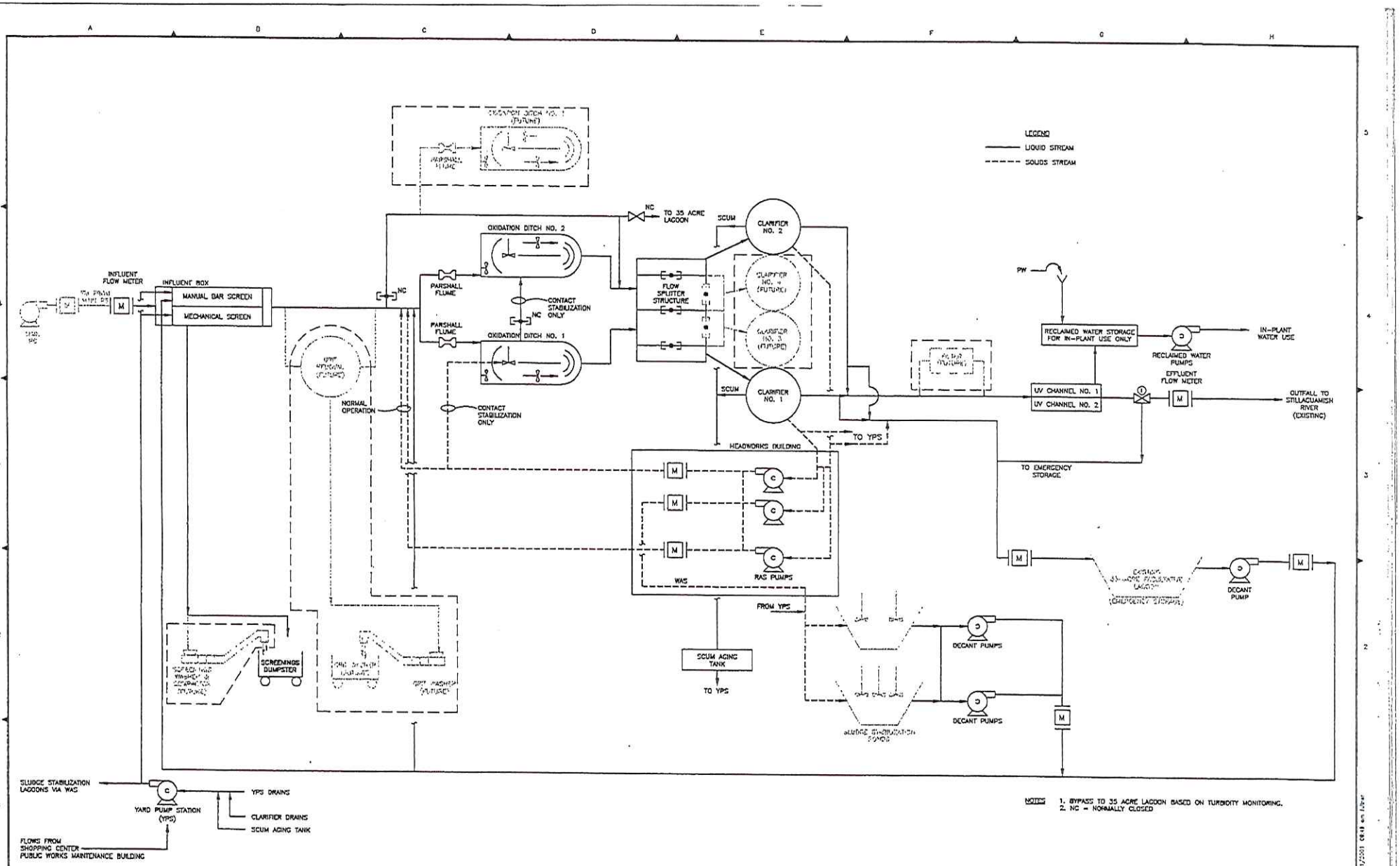
TABLE F. INDUSTRIAL DISCHARGE INFORMATION

Response space is provided for three SIUs. Copy the table to report information for additional SIUs.

	SIU 001	SIU 002	SIU ____
Under what categories and subcategories is the SIU subject?	SIC Code: 4213 Maintenance Facilities for motor freight SIC Code:516 SIC Code:4212 NAICS: 48890 Trucking Terminals	SIC:2092 Seafood Processing	
Has the POTW experienced problems (e.g., upsets, pass-through interferences) in the past 4.5 years that are attributable to the SIU?	☐ Yes ☑ No	☐ Yes ☑ No	☐ Yes ☐ No
If yes, describe.			



NOTES
1. BYPASS TO 35 ACRE LAGOON BASED ON TURBIDITY MONITORING.
2. NC = NORMALLY CLOSED

REV	DATE	DES	CHECK	APPROVALS	REVISION DESCRIPTION

This drawing is full size when 22"x 34" or is reduced to half size when 11"x17"

DATE: JUNE 2001 — CIVIL REVIEW:
DESIGNED: — ARCH REVIEW:
DRAWN: — STRUC REVIEW:
CHECKED: — MECH REVIEW:
APPROVED:

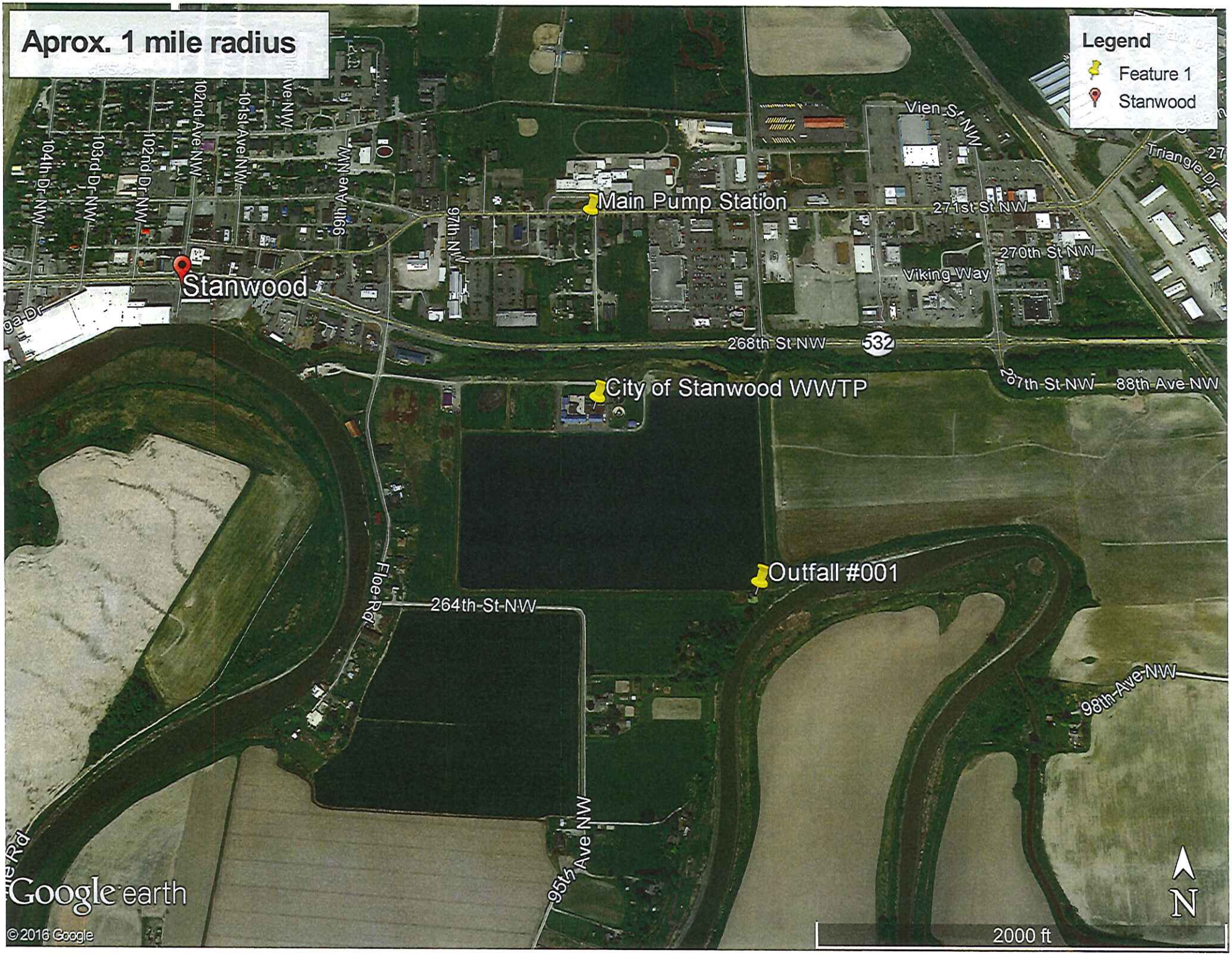
Tetra Tech/KCM, Inc.
1917 First Avenue
Seattle, Washington 98101
206-443-5300 Fax 206-443-5372

SECOND INTERMEDIATE REVIEW SET

CITY OF STANWOOD, WASHINGTON
WASTEWATER TREATMENT PLANT UPGRADE AND EXPANSION

PROCESS FLOW DIAGRAM

FILE NO: SAE01C07
PROJECT NO: 2030086
DWG NO: G7
SHEET: OF


Aprox. 1 mile radius
Legend
Feature 1
Stanwood
Main Pump Station
Stanwood
City of Stanwood WWTP
Outfall #001
Vien St NW
271st St NW
270th St NW
Viking Way
268th St NW
532
267th St NW
88th Ave NW
264th St NW
Floe Rd
95th Ave NW
98th Ave NW
Triangle Dr
104th Dr NW
103rd Dr NW
102nd Dr NW
102nd Ave NW
101st Ave NW
99th Ave NW
97th Ave NW
Google earth
© 2016 Google
2000 ft
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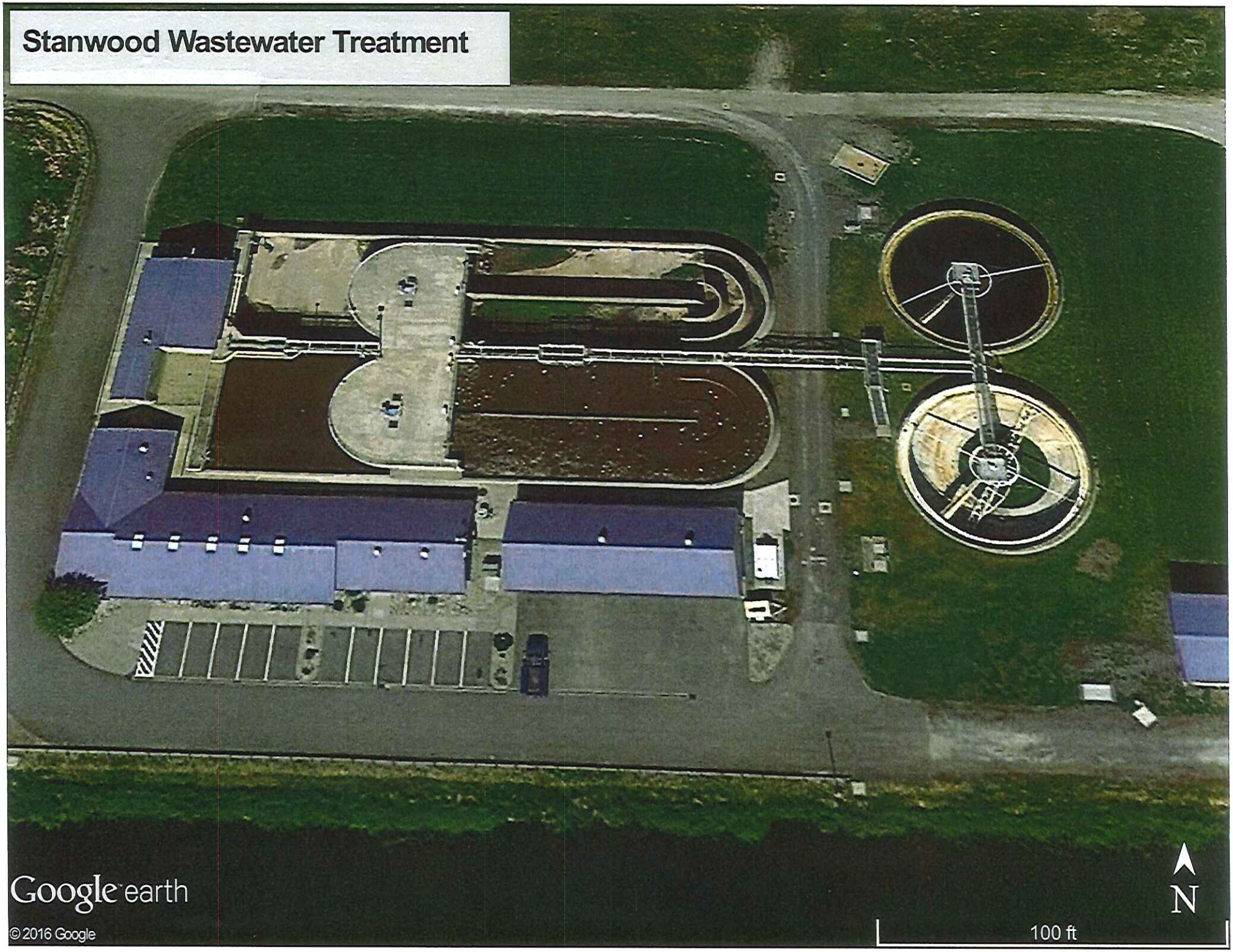
Stanwood Wastewater Treatment
Google earth
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100 ft

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • PO Box 330316 • Shoreline, Washington 98133-9716 • (206) 594-0000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

June 16, 2021

Victoria Danielson
City of Stanwood Public Works
10220 – 270th Street NW
Stanwood, WA 98292

Re: National Pollutant Discharge Elimination System (NPDES)
Permit No. WA0020290; City of Stanwood Wastewater Treatment Plant (WWTP)

Dear Victoria Danielson:

The Washington State Department of Ecology (Ecology) acknowledges receiving a NPDES permit renewal application for the City of Stanwood WWTP on April 30, 2021. The application has been reviewed and accepted as complete on June 15, 2021.

Your current NPDES permit has an expiration date of October 31, 2021. Renewal of the permit is in process; however, the permit may not be issued by the expiration date. If your new permit is not issued and effective by the current permit's expiration date, then the current permit and its terms and conditions are administratively extended and will remain in effect and enforceable until Ecology issues a new permit and it becomes effective for your facility, in accordance with the Washington State Administrative Procedures Act (RCW 34.05.422(3)) and Washington Administrative Code 173-220-180(5).

If you have any questions regarding the development of your renewal permit, please contact Stephanie Allen at (206) 594-0162 or Email at stephanie.allen@ecy.wa.gov

Sincerely,

Tricia Miller
Permit Coordinator
Northwest Regional Office

Sent Via Electronic Mail – victoria.danielson@stanwoodwa.org

cc: Stephanie Allen, P.E., Permit Manager (stephanie.allen@ecy.wa.gov)
Chris Smith, Compliance Specialist (chris.smith@ecy.wa.gov)
PARIS: Stanwood STP; WA0020290

Issuance Date: December 1, 2021
Effective Date: January 1, 2022
Expiration Date: December 31, 2026

PUGET SOUND NUTRIENT GENERAL PERMIT

A National Pollutant Discharge Elimination System and State Waste Discharge General Permit

State of Washington
Department of Ecology
Olympia, Washington

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Until this permit expires, is modified or revoked, Permittees that have properly obtained coverage under this general permit are authorized to discharge nutrients in accordance with the conditions, which follow.

DEPARTMENT OF ECOLOGY
State of Washington

Vincent McGowan, P.E.
Water Quality Program Manager
Washington State Department of Ecology

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SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions within this permit for additional submittal requirements. Appendix A provides a list of definitions. Appendix B provides a list of acronyms.

Table 1. Summary of Permit Report Submittals

Permit Section	Submittal	Frequency	First Submittal Date
S2.A.1	Permit Application (Notice of Intent)	Once	For new Permittees: No later than 90 days following permit issuance
S4.C	Nitrogen Optimization Report for Dominant Loaders	Annually	March 31, 2023
S4.D	Corrective Action Engineering Report	As necessary	
S4.E	Nutrient Reduction Evaluation for Dominant Loaders	1/permit cycle	December 31, 2025
S5.C	Nitrogen Optimization Report for Moderate Loaders	Annually	March 31, 2023
S5.D	Corrective Action Engineering Report	As necessary	
S5.E	Nutrient Reduction Evaluation for Moderate Loaders	1/permit cycle	December 31, 2025
S6.B	Nitrogen Optimization Report for Small Loaders	1/permit cycle	March 31, 2026
S5.D	AKART Evaluation for Small Loaders	1/permit cycle	December 31, 2025
S9.A	Discharge Monitoring Reports (DMRs)	Monthly	Within 15 days of applicable monitoring period
G2	Notice of Change in Authorization	As necessary	As necessary
G7	Application for Permit Renewal	1/permit cycle	No later than 180 days before expiration
G20	Reporting Anticipated Non-Compliance	As necessary	As necessary

Table 2. Summary of Required On-Site Documentation

Permit Condition(s)	Document Title
S9.B.3	Original Sampling Records (Field notes, as applicable and Laboratory Reports)
S9.G.1.a	Copy of Permit Coverage Letter
S9.G.1.b	Copy of Puget Sound Nutrient General Permit
S9.G.1.c	Copies of Discharge Monitoring Reports
S9.G.1.d	Copies of attachment to the Annual or Single NOP Reports (as applicable)
S9.G.1.e	Copy of the Nutrient Reduction Evaluation or AKART Analysis (as applicable)

The Department of Ecology is committed to providing people with disabilities access to information and services by meeting or exceeding the requirements of the Americans with Disabilities Act (ADA), Section 504 and 508 of the Rehabilitation Act, and Washington State Policy #188.

To request ADA Accommodation, contact Water Quality Reception at 360-407-6600. For Washington Relay Service or TTY call 711 or 877-833-6341. Visit Ecology's accessibility webpage[1] for more information.

For document translation services, call Water Quality Reception at 360-407-6600. Por publicaciones en espanol, por favor llame Water Quality Reception al 360-407-6600.

[1] https://ecology.wa.gov/About-us/Accountability-transparency/Our-website/Accessibility

SPECIAL CONDITIONS

S1. PERMIT COVERAGE

A. COVERAGE AREA AND ELIGIBLE DISCHARGES

This Puget Sound Nutrient General Permit (PSNGP) applies to the 58 publically owned ***domestic wastewater*** treatment plants (WWTPs) discharging into ***Washington Waters of the Salish Sea***, except for federal and Tribal lands and waters as specified in Special Condition S1.D. Table 3 identifies the WWTPs covered by this permit along with their individual ***NPDES*** permit number for reference. This proposed permit assigns a category to each WWTP based on their percentage of the ***total inorganic nitrogen*** **(TIN)** load currently discharged to Washington Waters of the Salish Sea. Special Condition S4 lists permit conditions and limits for the WWTPs with the **dominant (D) TIN loads**. Special Condition S5 lists the conditions and limits for the WWTPs with **moderate (M) loads**. Special Condition S6 lists the conditions and limits for the WWTPs with **small (S) loads**.

Table 3. List of Domestic WWTPs Discharging to Puget Sound

Wastewater Treatment Plant	Individual NPDES Permit Number	Category
Alderwood Sewage Treatment Plant (STP)	WA0020826	S
Anacortes WWTP	WA0020257	M
Bainbridge Island WWTP	WA0020907	S
Birch Bay Sewage Treatment Plant (STP)	WA0029556	M
Boston Harbor STP	WA0040291	S
Bremerton WWTP	WA0029289	M
Clallam Bay WWTP	WA0024431	S
Clallam Bay Corrections Center WWTP	WA0039845	S
Coupeville WWTP	WA0029378	S
Eastsound Orcas Village WWTP	WA0030911	S
Eastsound Sewer and Water District WWTP	WA0030571	S
Edmonds STP	WA0024058	M
Everett STP	WA0024490	D
Fisherman Bay STP	WA0030589	S
Friday Harbor STP	WA0023582	S
Gig Harbor WWTP	WA0023957	S
Hartstene Pointe STP	WA0038377	S
King County, Brightwater WWTP	WA0032247	D

Wastewater Treatment Plant	Individual NPDES Permit Number	Category
King County, South WWTP	WA0029581	D
King County, Vashon WWTP	WA0022527	S
King County, West Point WWTP	WA0029181	D
Kitsap County, Central Kitsap WWTP	WA0030520	M
Kitsap County, Kingston WWTP	WA0032077	S
Kitsap County, Manchester WWTP	WA0023701	S
Kitsap County Sewer District #7 Water Reclamation Facility (WRF)	WA0030317	S
La Conner STP	WA0022446	S
Lake Stevens Sewer District WWTP	WA0020893	M
Lakota WWTP	WA0022624	M
Langley WWTP	WA0020702	S
Lighthouse Point WRF/Blaine STP	WA0022641	M
LOTT Budd Inlet WRF	WA0037061	M
Lynnwood STP	WA0024031	M
Marysville STP	WA0022497	M
McNeil Island Special Commitment Center WWTP	WA0040002	S
Midway Sewer District WWTP	WA0020958	M
Miller Creek WWTP	WA0022764	M
Mt Vernon WWTP	WA0024074	M
Mukilteo Water and Wastewater District WWTP	WA0023396	S
Oak Harbor STP	WA0020567	S
Penn Cove WWTP	WA0029386	S
Pierce County Chambers Creek Regional WWTP	WA0039624	D
Port Angeles WWTP	WA0023973	M
Port Orchard WWTP (South Kitsap WRF)	WA0020346	M
Port Townsend STP	WA0037052	S
Post Point WWTP (Bellingham STP)	WA0023744	D
Redondo WWTP	WA0023451	M
Rustlewood WWTP	WA0038075	S
Salmon Creek WWTP	WA0022772	M

Wastewater Treatment Plant	Individual NPDES Permit Number	Category
Sekiu WWTP	WA0024449	S
Sequim WRF	WA0022349	S
Shelton WWTP	WA0023345	S
Skagit County Sewer District 2 Big Lake WWTP	WA0030597	S
Snohomish STP	WA0029548	M
Stanwood STP	WA0020290	S
Tacoma Central No. 1 WWTP	WA0037087	D
Tacoma North No. 3 WWTP	WA0037214	M
Tamoshan STP	WA0037290	S
WA Parks Larrabee WWTP	WA0023787	S

B. LIMITS ON COVERAGE

Coverage under this General Permit does not include discharges from WWTPs not listed in Table 3. Coverage under this General Permit also excludes all discharges from non-WWTP outfalls.

This permit does not cover the following discharges:

1. Discharges from facilities located on "Indian Country" as defined in 18 U.S.C. §1151, except portions of the Puyallup Reservation as noted below. Indian Country includes:
   a. All land within any Indian Reservation, notwithstanding the issuance of any patent, and including rights-of-way running through the reservation. This includes all federal, tribal, and Indian and non-Indian privately owned land within the reservation.
   b. All off-reservation Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same.
   c. All off-reservation federal trust lands held for Native American Tribes.

   Puyallup Exception: Following the *Puyallup Tribes of Indians Land Settlement Act of 1989*, 25 U.S.C. §1773,the permit does apply to land within the Puyallup Reservation except for discharges to surface water on land held in trust by the federal government.
2. Discharges from activities operated by any department, agency, or instrumentality of the executive, legislative, and judicial branches of the Federal Government of the United States, or another entity, such as a private contractor, performing industrial activity for any such department, agency, or instrumentality.

3. Discharges from any industrial or privately owned domestic wastewater treatment plant into Washington waters of the Salish Sea.
4. Discharges from domestic WWTPs entering tributary watersheds to Washington waters of the Salish Sea, upstream of Ecology ambient monitoring stations.

S2. APPLICATION FOR COVERAGE

A. OBTAINING PERMIT COVERAGE

1. The ***owner/operator*** seeking coverage under this permit must apply for permit coverage within the following time limits.
    a. Existing facilities are WWTPs in operation prior to the effective date of this permit, January 1, 2022 and are identified in Table 3.
    b. The owner/operator of an existing domestic wastewater treatment plant must submit a complete application for coverage no later than ninety (90) ***days*** after the issuance date of this permit. Upon submittal of a complete application for coverage (also called a ***Notice of Intent*** or NOI) ***Ecology*** will issue a decision on permit coverage pursuant to Special Condition S2.C.

B. HOW TO APPLY FOR PERMIT COVERAGE

The owner/operator seeking coverage under this permit must do the following:

1. Submit to Ecology, a complete application for coverage using the permit specific Notice of Intent through Ecology's Water Quality Permitting Portal: https://secureaccess.wa.gov/ecy/wqwebportal. The ***applicant*** must submit this application for coverage electronically. For more information about the WQWebPortal, visit Ecology's WQWebPortal guidance webpage[2].
2. A responsible person, as defined in General Condition G2, must sign the signature page of the NOI and submit it to Ecology.
3. Public Notice
    a. Public notice of the application for coverage is not required for the facilities subject to this general permit because they are all existing facilities.
    b. The owner/operator of an existing facility with coverage under the Puget Sound Nutrient General Permit (***Permittee***) wanting to modify their permit coverage must comply with public notice requirements specified in Special Condition S2.D.2.

C. PERMIT COVERAGE EFFECTIVE DATE

Permit coverage begins on the day Ecology issues the coverage letter to the applicant.

[2] https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Water-quality-permits-guidance/WQWebPortal-guidance

D. MODIFICATION OF PERMIT COVERAGE

A permittee requesting a reduction in monitoring, or a change in action level, or otherwise requesting a modification of permit coverage, must submit a complete Modification of Coverage Form to Ecology. The Permittee must:

1. Apply for modification of coverage at least 60 days prior to the change necessitating the coverage modification.
2. Complete the public notice requirements in WAC 173-226-130(5) as part of a complete application for modification of coverage.
3. Comply with ***SEPA*** as part of a complete application for modification of coverage if undergoing a significant process change driven by a corrective action.

S3. COMPLIANCE WITH STANDARDS

A. Discharges must not cause or contribute to a violation of surface water quality standards (Chapter 173-201A WAC), sediment management standards (Chapter 173-204 WAC), or human health-based criteria in the Federal water quality criteria applicable to Washington (40 CFR Part 135.45). This permit does not authorize discharge in violation of water quality standards.

B. Ecology presumes that a Permittee complies with water quality standards unless discharge monitoring data or other ***site***-specific information demonstrates that a discharge causes or contributes to a violation of water quality standards, when the Permittee complies with the following conditions. The Permittee must fully comply with all permit conditions, including planning, ***optimization***, corrective actions (as necessary), sampling, monitoring, reporting, waste management, and recordkeeping conditions.

S4. NARRATIVE EFFLUENT LIMITS FOR WWTPS WITH DOMINANT TIN LOADS

A. APPLICABILITY AND NARRATIVE EFFLUENT LIMITS

Beginning on the effective date, each of the Permittees with dominant TIN loads listed in Table 5 may discharge TIN from the WWTP through the designated ***outfall(s)*** described in its individual NPDES permit. See Table 3 in Section S1.A for the load category assignment.

All discharges and activities authorized by this permit must comply with the terms and conditions of this permit. Each Permittee listed in Table 5 must comply with the facility specific or bubbled ***action levels*** and narrative effluent limits listed in Table 4, which constitute the suite of ***best management practices*** (BMPs) required for a water quality based effluent limit under 40 CFR 122.44(k).

Table 4. Narrative Effluent Limits for Dominant TIN Loaders

Parameter	Narrative Effluent Limit
Monitoring	Monitor and report per the requirements in S7.A.
Nitrogen Optimization Plan	Optimize treatment performance to stay below the action level. Submit Optimization Report annually per the requirements in S4.C
Nutrient Reduction Evaluation	Submit Nutrient Reduction Evaluation per the requirements in S4.E

B. TIN ACTION LEVELS

If the action level listed in Table 5 for individual WWTPs or the bubbled action levels listed for single jurisdictions in Table 6 are exceeded, the Permittee must employ corrective actions identified in S4.D.

The annual Action Level is the sum of monthly nutrient loads measured over one year. Ecology will assess this total once per year based on the Permittee's Annual Report.

Table 5. Dominant WWTPs and Total Inorganic Nitrogen Action Levels

Wastewater Treatment Plant	Individual NPDES Permit Number	Action Level, TIN lbs/year	Outfall Number
Everett STP	WA0024490	1,530,000	100/015
King County Brightwater WWTP [1]	WA0032247	1,810,000	001
King County South WWTP [1]	WA0029581	7,340,000	001
King County West Point WWTP [1]	WA0029181	6,670,000	001
Pierce County Chambers Creek Regional WWTP	WA0039624	1,880,000	001
Post Point WWTP (Bellingham STP)	WA0023744	993,000	001
Tacoma Central No. 1 WWTP [4]	WA0037087	2,410,000	001

Table 6. Bubbled Action Levels for Corrective Action Assessment

Jurisdiction	Bubbled Action Level, TIN lbs/year
King County	15,820,000

C. NITROGEN OPTIMIZATION PLAN AND REPORT

Each Permittee listed in Table 5 must develop, implement and maintain a Nitrogen Optimization Plan to evaluate operational strategies for maximizing nitrogen removal from the existing treatment plant to stay below the calculated action level. Each Permittee must document their actions taken, any action level exceedances, and apply an adaptive management approach at the WWTP. Permittees will quantify results with required monitoring under this Permit.

The Permittee must begin the actions described in this section immediately upon permit coverage. Documentation of Nitrogen Optimization Plan implementation must be submitted annually through the Annual Report (S9- Reporting Requirements). See Appendix C for Annual Report questions that satisfy the Nitrogen Optimization Plan requirements.

The Nitrogen Optimization Plan submitted by each Permittee in Table 5 must include the following components:

1. Treatment Process Performance Assessment

   Assess the nitrogen removal potential of the current treatment process and identify viable optimization strategies prior to implementation.

   a. *Treatment Assessment* Develop a method to evaluate potential optimization approaches for the existing treatment process. Use the evaluation to:

      i. Determine current (pre-optimization) process performance to determine the existing TIN removal performance for the WWTP.

      ii. Create a list of potential optimization strategies capable of meeting the action level at the WWTP prior to starting optimization. Update the assessment and list of options as necessary with each Annual Report.

   b. *Identify and evaluate optimization strategies.* From the list developed in S4.C.1.a.ii, identify viable optimization strategies for each WWTP owned and operated by the Permittee. Prioritize and update this list as necessary to continuously maintain a working set of strategies for meeting the action level with the existing treatment processes.

      The Permittee may exclude any optimization strategy from the initial list created in S4.C.a.ii that was considered but found to exceed a reasonable implementation cost or timeframe. Documentation must include an explanation of the rationale and financial criteria used in the exclusion determination. If the Permittee finds no viable optimization strategies exist

for their current treatment processes, they must immediately proceed to the identification of a corrective action under S4.D.

c. *Initial Selection.* **As soon as possible and no later than July 1, 2022**, select at least one optimization strategy for implementation.

Document the expected performance (i.e., % TIN removal or a calculated reduction in effluent load or concentration) for the initial optimization strategy prior to implementation.

2. Optimization Implementation

All Permittees in Table 5 must document implementation of the selected optimization strategy (from S4.C.1.c) during the first reporting period in the first Annual Report due March 31, 2023. Permittees must document implementation during every reporting period thereafter. The documentation must include:

a. *Strategy Implementation.* Describe how the permittee implemented the selected strategy during each reporting period, following permit coverage. Including:

i. Initial implementation costs

ii. Length of time for full implementation, including start date.

iii. Any adaptive management applied to refine implementation during the reporting period.

iv. Anticipated and unanticipated challenges.

v. Any impacts to the overall treatment performance as a result of process changes.

b. *Discharge Evaluation.* By March 31 each year beginning in 2023, each Permittee in Table 5 must review effluent data collected during the previous calendar year to determine whether TIN loads are increasing.

i. Using all accredited monitoring data, determine facility's annual average TIN concentration and load from the reporting period. **If the annual TIN load exceeds the Action Level in Table 5 (or the applicable bubbled Action Level in Table 6) take the corrective actions in S4.D.**

ii. Determine the treatment plant's TIN removal rate observed during the reporting period.

3. Influent Nitrogen Reduction Measures/Source Control

Permittees in Table 5 must investigate opportunities to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources and submit documentation with the Annual Report. The investigation must:

a. Review non-residential sources of nitrogen and identify any possible pretreatment opportunities.

b. Identify potential strategies for reducing TIN from new multi-family/dense residential developments and commercial buildings.

D. ACTION LEVEL EXCEEDANCE CORRECTIVE ACTIONS

Permittees in Table 5 must evaluate whether or not they exceeded the facility specific action level or the bubbled action level (as applicable) and, if they did, implement corrective actions while continuing optimization.

1. If the Permittee determines in the Annual Report that they have exceeded their action level, they must:

   a. Identify possible factors that caused the action level exceedance.

   b. Identify whether modifications to the optimization strategy can improve performance.

   c. Assess whether a different strategy or combination of strategies may provide better overall process improvements.

   d. Document changes made to the optimization strategy, if any, while completing corrective action requirements.

      i. Provide a detailed description of the modified or new optimization strategy selected from the list developed in S4.C.1.b. Include an implementation schedule for any changes and, as necessary, use the treatment process assessment developed to evaluate anticipated results.

      ii. If the Permittee proposes no changes to the optimization strategy, they must provide reasons for not making changes.

2. With the next Annual Report, submit for review a proposed approach to reduce the annual effluent load by at least 10% below the action level listed in Table 5 for individual plants or Table 6 for multiple plants under a bubbled action level. This must be an abbreviated engineering report or technical memo, unless Ecology has previously approved a design document with the proposed solution. The proposed approach must utilize solutions that can be implemented as soon as possible. This may include influent load reduction strategies identified in S4.C.3.

   The engineering document must include:

      i. Brief summary of the treatment alternatives considered and why the proposed approach was selected. Include cost estimates for operation and maintenance;

      ii. The basic design information, including influent characterization;

      iii. A description of the proposed treatment approach and operation, including updates to the WWTP's process flow diagram;

iv. Anticipated results from the proposed approach including expected effluent quality;

v. Certification by a licensed professional engineer.

a. If a Permittee exceeds an action level two years in a row, or for a third year during the permit term, the Permittee must begin to reduce nitrogen loads by implementing the proposed approach submitted per S4.D.2 following Ecology's written approval of the proposed approach and implementation schedule.

b. Submit an update to the Permittee's Operation and Maintenance Manual no later than 6 months following implementation.

E. NUTRIENT REDUCTION EVALUATION

1. All permittees in Table 5, except for those who meet the exclusions listed in this paragraph, must prepare and submit an approvable Nutrient Reduction Evaluation (NRE) to Ecology for review by December 31, 2025. Permittees with multiple plants may submit a combined report. This combined report must include an evaluation for all plants owned and operated by the jurisdiction. Permittees that maintain an annual TIN average of < 10 mg/L and meet their action level throughout the permit term must submit a truncated NRE that satisfies S4.E.3-S4.E.5. Permittees that meet their action level throughout the permit term, maintain an annual average of < 10 mg/L TIN and a seasonal average of < 3 mg/L do not have to submit the NRE.

2. The NRE must include an all known, available and reasonable treatment (***AKART***) analysis for purposes of evaluating reasonable treatment alternatives capable of reducing total inorganic nitrogen (TIN). It must present an alternative representing the greatest TIN reduction that is reasonably feasible on an annual basis.

3. In addition, the NRE must assess other site-specific main stream treatment plant upgrades, the applicability of side stream treatment opportunities, alternative effluent management options (e.g., disposal to ground, reclaimed water beneficial uses), the viability of satellite treatment, and other nutrient reduction opportunities that could achieve a final effluent concentration of 3 mg/L TIN (or equivalent load reduction) on seasonal average (April – October) basis.

4. The analysis must be sufficiently complete that an engineering report may be developed for the preferred AKART alternative as well as the preferred alternatives to reach 3 mg/L TIN seasonally, without substantial alterations of concept or basic considerations. The final report must contain appropriate requirements as described in the following guidance (or most recent version):
    a. The Criteria for Sewage Works Design (ECY Publication No. 98-37, 2019)[3]
    b. Reclaimed Water Facilities Manual: The Purple Book (ECY Publication No. 15-10-024, 2019)[4]
5. The analysis conducted for the NRE must include the following elements:
    a. Wastewater Characterization
        i. Current flowrates and growth trends within the sewer service area.
        ii. Current influent and effluent quality.
    b. Treatment Technology Analysis
        i. Description of current treatment processes, including any modifications made for optimization or due to corrective actions.
        ii. Description of site limitations, constraints, or other treatment implementation challenges that exist.
        iii. Identification and screening of potential treatment technologies for meeting two different levels of treatment:
            1. AKART for nitrogen removal (annual basis), and
            2. 3 mg/L TIN (or equivalent load), as a seasonal average April - October
    c. Economic Evaluation
        i. Develop capital, operation and maintenance costs and 20 year net present value using the real discount rate in the most current Appendix C to Office of Management and Budget Circular No. A-94[5] for each technology alternative evaluated.
        ii. Provide cost per pound of nitrogen removed.
        iii. Provide details on basis for current wastewater utility rate structure, including:
            1. How utilities allocate and recover costs from customers.

[3] https://apps.ecology.wa.gov/publications/summarypages/9837.html
[4] https://apps.ecology.wa.gov/publications/SummaryPages/1510024.html
[5] https://www.whitehouse.gov/wp-content/uploads/2020/12/2020_Appendix-C.pdf

2. How frequently rate structures are reviewed.

3. The last time rates were adjusted and the reason for that adjustment.

iv. Provide impact to current rate structure for each alternative assessed.

d. Environmental Justice (EJ) Review

i. Evaluate the demographics within the sewer service area to identify communities of color, Tribes, indigenous communities, and low income populations.

ii. Identify areas within service area that exceed the median household income.

iii. Include an affordability assessment to identify how much overburdened communities identified in S4.E.5.d.i can afford to pay for the wastewater utility.

iv. Propose alternative rate structures or measures that can be taken to prevent adverse effects of rate increases on populations with economic hardship identified in S4.E.5.d.i.

v. Provide information on how recreational and commercial opportunities may be improved for communities identified in S4.E.5.d.i as a result of the treatment improvements identified.

e. Selection of the most reasonable treatment alternative based on the AKART assessment; and the selected alternative for achieving an effluent concentration of 3 mg/L TIN (or equivalent load reduction) based on an April – October seasonal average.

f. Viable implementation timelines that include funding, design, and construction for meeting both the AKART and seasonal average 3 mg/L TIN preferred alternatives.

S5. NARRATIVE EFFLUENT LIMITS FOR WWTPS WITH MODERATE TIN LOADS

A. APPLICABILITY AND NARRATIVE EFFLUENT LIMITS

Beginning on the effective date, each of the Permittees with moderate TIN loads listed in Table 8 may discharge TIN from the WWTP through the designated ***outfall(s)*** described in its individual NPDES permit. See Table 3 in Section S1.A for the load category assignment.

All discharges and activities authorized by this permit must comply with the terms and conditions of this permit. Each Permittee listed in Table 8 must comply with the facility specific or bubbled ***action levels*** and narrative effluent limits listed in Table 7, which constitute the suite of ***best management practices*** (BMPs) required for a water quality based effluent limit under 40 CFR 122.44(k).

Table 7. Narrative Effluent Limits for Moderate TIN Loaders

Parameter	Narrative Effluent Limit
Monitoring	Monitor and report per the requirements in S7.B.
Nitrogen Optimization Plan	Optimize treatment performance to stay below the action level. Submit Optimization Report annually per the requirements in S5.C
Nutrient Reduction Evaluation	Submit Nutrient Reduction Evaluation per the requirements in S5.E

B. TIN ACTION LEVELS

If the action level listed in Table 8 for individual WWTPs or the bubbled action levels listed for single jurisdictions in Table 9 are exceeded, the Permittee must employ corrective actions identified in S5.D.

The annual Action Level is the sum of monthly nutrient loads measured over one year. Ecology will assess this total once per year based on the Permittee's Annual Report.

Table 8. Moderate WWTPs and Total Inorganic Nitrogen Action Levels

Wastewater Treatment Plant	Individual NPDES Permit Number	Action Level, TIN lbs/year	Outfall Number
Anacortes WWTP	WA0020257	167,000	001
Birch Bay Sewage Treatment Plant (STP)	WA0029556	66,400	001
Blaine STP (Lighthouse Point WRF)	WA0022641	18,200	001
Bremerton WWTP	WA0029289	602,000	001
Kitsap County Central Kitsap WWTP	WA0030520	306,000	001
Edmonds STP	WA0024058	432,000	001
Lake Stevens Sewer District WWTP	WA0020893	127,000	002
Lakota WWTP [1]	WA0022624	597,000	001

Wastewater Treatment Plant	Individual NPDES Permit Number	Action Level, TIN lbs/year	Outfall Number
LOTT Budd Inlet WWTF	WA0037061	338,000	001
Lynnwood STP	WA0024031	340,000	001
Marysville STP	WA0022497	592,000	100/001
Midway Sewer District WWTP	WA0020958	625,500	001
Miller Creek WWTP [2]	WA0022764	297,000	001
Mt Vernon WWTP	WA0024074	396,000	004
Port Angeles WWTP	WA0023973	177,000	001/002
Port Orchard WWTP (South Kitsap WRF)	WA0020346	215,000	001
Redondo WWTP [1]	WA0023451	249,000	001
Salmon Creek WWTP [2]	WA0022772	199,000	001
Snohomish STP	WA0029548	83,600	001
Tacoma North No. 3 WWTP	WA0037214	339,000	001

Table 9. Bubbled Action Levels for Corrective Action Assessment

Jurisdiction	Bubbled Action Level, TIN lbs/year
Lakehaven Water and Sewer District [1]	846,000
Southwest Suburban Sewer District [2]	496,000

C. NITROGEN OPTIMIZATION PLAN AND REPORT

Each Permittee listed in Table 8 must develop, implement and maintain a Nitrogen Optimization Plan to evaluate operational strategies for maximizing nitrogen removal from the existing treatment plant to stay below the calculated action level. Each Permittee must document their actions taken, any action level exceedances, and apply an adaptive management approach at the WWTP. Permittees will quantify results with required monitoring under this Permit.

The Permittee must begin the actions described in this section immediately upon permit coverage. Documentation of Nitrogen Optimization Plan implementation must be submitted annually through the Annual Report (S9- Reporting Requirements). See Appendix D for annual report questions that satisfy the Nitrogen Optimization Plan requirements.

The Nitrogen Optimization Plan submitted by each Permittee in Table 8 must include the following components:

1. Treatment Process Performance Assessment

   Assess the nitrogen removal potential of the current treatment process and identify viable optimization strategies prior to implementation.

   a. *Treatment Assessment.* Develop a method to evaluate potential optimization approaches for the existing treatment process. Use the evaluation to:

      i. Evaluate current (pre-optimization) process performance to determine the existing TIN removal performance for the WWTP.

      ii. Create a list of potential optimization strategies capable of meeting the action level at the WWTP prior to starting optimization. Update the assessment and list of options as necessary with each Annual Report.

   b. *Identify and evaluate optimization strategies.* From the list developed in S5.C.1.a.ii, identify viable optimization strategies for each WWTP owned and operated by the Permittee. Prioritize and update this list as necessary to continuously maintain a working set of strategies for meeting the action level with the existing treatment processes.

      The Permittee may exclude any optimization strategy from the initial list created in S5.C.a.ii that was considered but found to exceed a reasonable implementation cost or timeframe. Documentation must include an explanation of the rationale and financial criteria used in the exclusion determination. If the Permittee finds no viable optimization strategies exist for their current treatment processes, they must immediately proceed to the identification of a corrective action under S5.D.

   c. *Initial Selection.* **As soon as possible and no later than July 1, 2022** select at least one optimization strategy for implementation.

      Document the expected performance (i.e., % TIN removal or a calculated reduction in effluent load or concentration) for the initial optimization strategy prior to implementation.

2. Optimization Implementation

   All Permittees in Table 8 must document implementation of the selected optimization strategy (from S5.C.1.c) during the first reporting period in the first Annual Report due March 31, 2023. Permittees must document implementation during every reporting period thereafter. The documentation must include:

   a. *Strategy Implementation.* Describe how the permittee implemented the selected strategy during each reporting period, following permit coverage. Including:

      i. Initial implementation costs

      ii. Length of time for full implementation, including start date.

iii. Any adaptive management applied to refine implementation during the reporting period.

iv. Anticipated and unanticipated challenges.

v. Any impacts to the overall treatment performance as a result of process changes.

b. *Discharge Evaluation.* By March 31 each year beginning in 2023, each Permittee in Table 8 must review effluent data collected during the previous calendar year to determine whether TIN loads are increasing.

i. Using all accredited monitoring data, determine facility's annual average TIN concentration and load from the reporting period. **If the annual TIN load exceeds the Action Level in Table 8 (or the applicable bubbled Action Level in Table 9) take the corrective actions in S5.D.**

ii. Determine the treatment plant's TIN removal rate observed during the reporting period.

3. Influent Nitrogen Reduction Measures/Source Control

Permittees in Table 8 must investigate opportunities to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources and submit documentation with the Annual Report. The investigation must:

a. Review non-residential sources of nitrogen and identify any possible pretreatment opportunities.

b. Identify potential strategies for reducing TIN from new multi-family/dense residential developments and commercial buildings.

D. ACTION LEVEL EXCEEDANCE CORRECTIVE ACTIONS

Permittees in Table 8 must evaluate whether or not they exceeded the facility specific action level or the bubbled action level (as applicable) and, if they did, implement corrective actions while continuing optimization.

1. If the Permittee determines in the Annual Report that they have exceeded their action level, they must:

a. Identify possible factors that caused the action level exceedance.

b. Identify whether modifications to the optimization strategy can improve performance.

c. Assess whether a different strategy or combination of strategies may provide better overall process improvements.

d. Document changes made to the optimization strategy, if any, while completing corrective action requirements.

i. Provide a detailed description of the modified or new optimization strategy selected from the list developed in S5.C.1.b. Include an implementation schedule for any changes and, as necessary, use the treatment process assessment developed to evaluate anticipated results.

ii. If the Permittee proposes no changes to the optimization strategy, they must provide reasons for not making changes.

2. With the next Annual Report, submit for review a proposed approach to reduce the annual effluent load below the action level listed in either Table 8 or Table 9 (as applicable for those jurisdictions) for the duration of the permit term. This must be an abbreviated engineering report or technical memo, unless Ecology has previously approved a design document with the proposed solution. The proposed approach must utilize solutions that can be implemented as soon as possible. This may include influent load reduction strategies identified in S5.C.3.

   The engineering document must include:

   i. Brief summary of the treatment alternatives considered and why the proposed approach was selected. Include cost estimates for operation and maintenance;

   ii. The basic design information, including influent characterization;

   iii. A description of the proposed treatment approach and operation, including updates to the WWTP's process flow diagram;

   iv. Anticipated results from the proposed approach including expected effluent quality;

   v. Certification by a licensed professional engineer.

   b. If a Permittee exceeds an action level two years in a row, or for a third year during the permit term, the Permittee must begin to reduce nitrogen loads by implementing the proposed approach submitted per S5.D.2 following Ecology's written approval of the proposed approach and implementation schedule.

   c. Submit an update to the Permittee's Operation and Maintenance Manual no later than 6 months following implementation.

E. NUTRIENT REDUCTION EVALUATION

1. Permittees in Table 8, except for those who meet the exclusions listed in this paragraph, must prepare and submit an approvable Nutrient Reduction Evaluation (NRE) to Ecology for review by December 31, 2025. Permittees with multiple plants may submit a combined report. This combined report must include an evaluation for all plants owned and operated by the jurisdiction. Permittees that maintain an annual TIN average of < 10 mg/L and meet their action level throughout the permit term must submit a truncated NRE that satisfies S5.E.3-S5.E.5. Permittees that meet their action level throughout the permit term, maintain an annual average of < 10 mg/L TIN and a seasonal average of < 3 mg/L do not have to submit the NRE.
2. The NRE must include an all known, available and reasonable treatment (***AKART***) analysis for purposes of evaluating reasonable treatment alternatives capable of reducing total inorganic nitrogen (TIN). It must present an alternative representing the greatest TIN reduction that is reasonably feasible on an annual basis.
3. In addition, the NRE must assess other site- specific main stream treatment plant upgrades, the applicability of side stream treatment opportunities, alternative effluent management options (e.g., disposal to ground, reclaimed water beneficial uses), the viability of satellite treatment, and other nutrient reduction opportunities that could achieve a final effluent concentration of 3 mg/L TIN (or equivalent load reduction) on seasonal average (April – October) basis.
4. The analysis must be sufficiently complete that an engineering report may be developed for the preferred AKART alternative as well as the preferred alternatives to reach 3 mg/L TIN seasonally, without substantial alterations of concept or basic considerations. The final report must contain appropriate requirements as described in the following guidance (or most recent version):
    a. The Criteria for Sewage Works Design (ECY Publication No. 98-37, 2019)[6]
    b. Reclaimed Water Facilities Manual: The Purple Book (ECY Publication No. 15-10-024, 2019)[7]
5. The analysis conducted for the NRE must include the following elements:
    a. Wastewater Characterization
        i. Current flowrates and growth trends within the sewer service area.
        ii. Current influent and effluent quality.
    b. Treatment Technology Analysis

[6] https://apps.ecology.wa.gov/publications/summarypages/9837.html
[7] https://apps.ecology.wa.gov/publications/SummaryPages/1510024.html

i. Description of current treatment processes, including any modifications made for optimization or due to corrective actions.

ii. Description of site limitations, constraints, or other treatment implementation challenges that exist.

iii. Identification and screening of potential treatment technologies for meeting two different levels of treatment:

1. AKART for nitrogen removal (annual basis), and

2. 3 mg/L TIN (or equivalent load), as a seasonal average (April through October)

c. Economic Evaluation

i. Develop capital, operation and maintenance costs and 20 year net present value using the real discount rate in the most current Appendix C to Office of Management and Budget Circular No. A-94[8] for each technology alternative evaluated.

ii. Provide cost per pound of nitrogen removed.

iii. Provide details on basis for current wastewater utility rate structure, including:

1. How utilities allocate and recover costs from customers.

2. How frequently rate structures are reviewed.

3. The last time rates were adjusted and the reason for that adjustment.

iv. Provide impact to current rate structure for each alternative assessed.

d. Environmental Justice (EJ) Review

i. Evaluate the demographics within the sewer service area to identify communities of color, Tribes, indigenous communities, and low income populations.

ii. Identify areas within service area that exceed the median household income.

iii. Include an affordability assessment to identify how much overburdened communities identified in S5.E.5.d.i can afford to pay for the wastewater utility.

iv. Propose alternative rate structures or measures that can be taken to prevent adverse effects of rate increases on populations with economic hardship identified in S5.E.5.d.i.

[8] https://www.whitehouse.gov/wp-content/uploads/2020/12/2020_Appendix-C.pdf

v. Provide information on how recreational and commercial opportunities may be improved for communities identified in S5.E.5.d.i as a result of the treatment improvements identified.

e. Selection of the most reasonable treatment alternative based on the AKART assessment; and the selected alternative for achieving an effluent concentration of 3 mg/L TIN (or equivalent load reduction) based on an April through October seasonal average.

f. Viable implementation timelines that include funding, design, and construction for meeting both the AKART and seasonal average 3 mg/L TIN preferred alternatives.

S6. NARRATIVE EFFLUENT LIMITS FOR WWTPS WITH SMALL TIN LOADS

A. APPLICABILITY AND NARRATIVE EFFLUENT LIMITS

Beginning on the effective date, each of the Permittees with small TIN loads listed in Table 11 may discharge total inorganic nitrogen from the WWTP through each facility's designated outfall. See Table 3 in Section S1.A for the load category assignment.

All discharges and activities authorized by this permit must comply with the terms and conditions of this permit. Each Permittee listed in Table 11 must comply with the narrative effluent limits listed in Table 10 which constitute the suite of BMPs required for a narrative water quality based effluent limit under 40 CFR 122.44(k).

Table 10.Narrative Effluent Limits for WWTPs with Small TIN Loads

Parameter	Narrative Effluent Limit
Monitoring	Monitor and report per the requirements in S7.C.
Nitrogen Optimization Plan	Submit one Optimization Report per the requirements in S6.B
AKART Analysis	Submit an AKART Analysis per the requirements in S6.C

Table 11.Permittees with Small TIN Loads

Wastewater Treatment Plant	Individual NPDES Permit Number	Outfall Number
Alderwood STP	WA0020826	001
Bainbridge Island WWTP	WA0020907	001
Boston Harbor STP	WA0040291	001
Clallam Bay STP	WA0024431	001
Clallam Bay Corrections Center STP	WA0039845	001
Coupeville STP	WA0029378	001
Eastsound Orcas Village WWTP	WA0030911	001
Eastsound Sewer and Water District WWTP	WA0030571	001
Fisherman Bay STP	WA0030589	001
Friday Harbor STP	WA0023582	001
Gig Harbor WWTP	WA0023957	001
Hartstene Pointe STP	WA0038377	001
King County Vashon WWTP	WA0022527	001
Kitsap County Kingston WWTP	WA0032077	001
Kitsap County Manchester WWTP	WA0023701	001
Kitsap County Sewer District #7 Water Reclamation Facility (WRF)	WA0030317	001
La Conner STP	WA0022446	001
Langley WWTP	WA0020702	001
McNeil Island Special Commitment Center WWTP	WA0040002	001
Mukilteo Water and Wastewater District WWTP	WA0023396	001
Oak Harbor STP	WA0020567	003
Penn Cove WWTP	WA0029386	001
Port Townsend STP	WA0037052	001
Rustlewood STP	WA0038075	001
Sekiu WWTP	WA0024449	001
Sequim WRF	WA0022349	001
Shelton WWTP	WA0023345	001

Wastewater Treatment Plant	Individual NPDES Permit Number	Outfall Number
Skagit County Sewer District 2 Big Lake WWTP	WA0030597	001
Stanwood STP	WA0020290	001
Tamoshan STP	WA0037290	001
WA Parks Larrabee WWTP	WA0023787	001

B. NITROGEN OPTIMIZATION PLAN AND REPORT

Each Permittee listed in Table 11 must develop, implement, and maintain a Nitrogen Optimization Plan to evaluate and implement operational strategies for maximizing nitrogen removal from the existing treatment plant during the permit term. Permittees must document their actions taken and apply an adaptive management approach at the WWTP. Permittees will quantify results with required monitoring under this Permit.

The Permittee must begin the actions described in this section immediately upon permit coverage. Documentation of Nitrogen Optimization Plan implementation must be submitted through the Single Report (S9- Reporting Requirements). See Appendix E for report questions that satisfy the Nitrogen Optimization Plan requirements. This report must be submitted by March 31, 2026.

The Nitrogen Optimization Plan submitted by each Permittee in Table 11 must include the following components:

1. Treatment Process Performance Assessment

   Each Permittee listed in Table 11 must assess the nitrogen removal potential of the current treatment process and have the ability to evaluate optimization strategies prior to implementation.

   a. *Evaluation.* Each Permittee in Table 11 must develop a treatment process assessment method for purposes of evaluating optimization approaches during the permit term.

      i. Evaluate current (pre-optimization) process performance. Determine the empirical TIN removal rate for the WWTP.

      ii. Develop an initial assessment approach to evaluate possible optimization strategies at the WWTP prior to and after implementation.

      iii. Determine the optimization goal for the WWTP. Develop and document a prioritized list of optimization strategies capable of achieving the optimization goal for each WWTP owned and operated by the Permittee. Update this list as necessary to continuously maintain a selection of strategies for achieving each optimization goal identified.

iv. The Permittee may exclude from the initial selection any optimization strategy considered but found to exceed a reasonable implementation cost or timeframe. Documentation must include an explanation of the rationale and financial criteria used for the exclusion determination.

b. *Initial Selection.* **By December 31, 2022** identify the optimization strategy selected for implementation.

Document the expected % TIN removal (or the expected reduction in effluent load) for the optimization strategy prior to implementation.

2. Optimization Implementation

Permittees in Table 11 must document implementation of the selected optimization strategy (from S6.B.1.b) as it is applied to the existing treatment process during the reporting period. Permittees must document adaptive management applied to optimization strategies following initial implementation through the permit term.

a. *Strategy Implementation.* Describe how the selected strategy was implemented during the reporting period, following permit coverage. Including:

i. Initial implementation costs.

ii. Length of time for full implementation, including start date.

iii. Anticipated and unanticipated challenges.

iv. Any impacts to the overall treatment performance as a result of process changes.

b. *Load Evaluation.* Each Permittee listed in Table 11 must review effluent data collected during the reporting period to determine whether TIN loads are increasing.

i. Using all accredited monitoring data, determine the facility's annual average TIN concentration and load for each year during the reporting period.

ii. Determine the treatment plant's TIN removal rate at the end of each year. Compare the removal rate with the pre-optimization rate identified in S6.B.1.a.i.

c. *Strategy Assessment.* Quantify the results of the implemented strategy and compare to the performance metric identified in S6.B.1.b.

If the TIN loading increased, apply adaptive management, re-evaluate the optimization strategies and the resulting performance to identify the reason. Select a new optimization strategy for implementation and/or revise implementation for better performance. Document any updates to the implementation schedule and overall plan.

3. Influent Nitrogen Reduction Measures/Source Control

   Permittees in Table 11 must investigate opportunities to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources and submit documentation with the Annual Report. The investigation must:

   a. Review non-residential sources of nitrogen and identify any possible pretreatment opportunities.

   b. Identify strategies for reducing TIN from new multi-family/dense residential developments and commercial buildings.

C. AKART ANALYSIS

1. Permittees in Table 11, except for those who meet the exclusions listed in this paragraph, must prepare and submit an approvable all known, available and reasonable treatment (AKART) analysis to Ecology for purposes of evaluating reasonable treatment alternatives capable of reducing total inorganic nitrogen (TIN). Permittees must submit this report by December 31, 2025. Permittees that maintain an annual TIN average of < 10 mg/L and do not document an increase in load through their DMRs do not have to submit this analysis.

2. The analysis must contain appropriate requirements as described in the following guidance (or the most recent version):

   a. The Criteria for Sewage Works Design (ECY Publication No. 98-37, 2019)[9]

   b. Reclaimed Water Facilities Manual: The Purple Book (ECY Publication No. 15-10-024, 2019)[10]

3. The AKART analysis must include the following elements:

   a. Wastewater Characterization

      i. Current volumes, flowrates and growth trends

      ii. Current influent and effluent quality

   b. Treatment Technology Analysis

      i. Description of current treatment processes

      ii. Identification and screening of potential treatment technologies for TIN reduction that achieves AKART for nitrogen removal

   c. Economic Evaluation

[9] https://apps.ecology.wa.gov/publications/documents/9837.pdf
[10] https://apps.ecology.wa.gov/publications/SummaryPages/1510024.html

i. Develop capital, operation and maintenance costs and 20 year net present value using the real discount rate in the most current Appendix C to Office of Management and Budget Circular No. A-94[11] for each technology alternative evaluated.

ii. Provide cost per pound of nitrogen removed

iii. Provide details on basis for current wastewater utility rate structure, including:

1. How utilities allocate and recover costs from customers.
2. How frequently rate structures are reviewed.
3. The last time rates were adjusted and the reason for that adjustment.

iv. Provide impact to current rate structure for each alternative assessed.

d. Environmental Justice (EJ) Review

i. Evaluate the demographics within the sewer service area to identify communities of color, Tribes, indigenous communities, and low income populations.

ii. Identify areas within the service area that exceed the median household income.

iii. Include an affordability assessment to identify how much overburdened communities identified in S6.C.3.d.i can afford to pay for the wastewater utility.

iv. Propose alternative rate structures or measures that can be taken to prevent adverse effects of rate increases on populations with economic hardship identified in S6.C.3.d.i.

v. Provide information on how recreation and commercial opportunities may be improved for communities identified in S6.C.3.d.i as a result of the treatment improvements identified.

e. Selection of most reasonable treatment alternative.

f. Attainable implementation schedule that includes funding, design and construction of infrastructure improvement capable of achieving and maintaining AKART.

[11] https://www.whitehouse.gov/wp-content/uploads/2020/12/2020_Appendix-C.pdf

S7. MONTORING SCHEDULES AND SAMPLING REQUIREMENTS

A. MONITORING REQUIREMENTS FOR DOMINANT LOADERS

Each permittee listed in Table 5 must monitor influent and effluent in accordance with the following schedule and requirements specified in Table 12 and 13, respectively. Influent and effluent monitoring locations must be representative. Permittees may use the monitoring locations identified in their individual NPDES permit. If a Permittee conducts additional sampling of required parameters during the month, they must report all results on the monthly DMR.

Table 12. Influent Sampling Requirements for Dominant Loaders

Wastewater influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant, if possible.

The Permittee must collect total ammonia, nitrate plus nitrite, and TKN samples during the same sampling event.

Parameter	Units & Specifications	Minimum Sampling or Calculation Frequency	Analytical Method [k]	Laboratory Quantitation Level [l]	Sample Type
$CBOD_5$	mg/L	2/week [b]	SM5210-B	2 mg/L	24-hour composite [e]
Total Ammonia	mg/L as N	2/week [b]	SM4500-NH_3-B/C/D/E/F/G/H	0.02 mg/L	24-hour composite [e]
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month [c]	SM4500-NO_3-E/F/H	0.1 mg/L	24-hour composite [e]
Total Kjeldahl Nitrogen (TKN)	mg/L as N	1/month [c]	SM4500-N_{org}-B/C and SM4500-NH_3-B/C/D/E/F/G/H	0.3 mg/L	24-hour composite [e]

Table 13. Effluent Sampling Requirements for Dominant Loaders

Final wastewater effluent means wastewater exiting the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process. The total ammonia, TKN, and nitrate plus nitrite samples must be taken during the same sampling event.

Parameter	Units & Specifications	Minimum Sampling or Calculation Frequency	Analytical Method [k]	Laboratory Quantitation Level [l]	Sample Type
Flow [f]	MGD	2/week [b]	--	--	Metered/ recorded
$CBOD_5$ [a]	mg/L	2/week [b]	SM5210-B	2 mg/L	24-hour composite [e]
Total Organic Carbon	mg/L	1/quarter [d]	SM5310-B/C/D	1 mg/L	24-hour composite [e]
Total Ammonia	mg/L as N	2/week [b]	SM4500-NH_3-B/C/D/E/F/G/H	0.02 mg/L	24-hour composite [e]
Nitrate plus Nitrite Nitrogen	mg/L as N	2/week [b]	SM4500-NO_3-E/F/H	0.1 mg/L	24-hour composite [e]
TKN	mg/L as N	1/month [c]	SM4500-N_{org}-B/C and SM4500-NH_3-B/C/D/E/F/G/H	0.3 mg/L	24-hour composite [e]
Total Inorganic Nitrogen	mg/L as N	2/week [b]	--	--	Calculated [g]
Total Inorganic Nitrogen	Lbs/day	2/week [b]	--	--	Calculated [h]
Average Monthly Total Inorganic Nitrogen	Lbs	1/month [c]	--	--	Calculated [i]
Annual Total Inorganic Nitrogen, year to date	Lbs	1/month [c]	--	--	Calculated [j]

Table 14. Footnotes for Influent and Effluent Monitoring Tables 12 and 13

Footnote	Information
a	Take effluent samples for the $CBOD_5$ analysis before or after the disinfection process. If taken after disinfection and chlorine is used, dechlorinate and reseed the sample.
b	2/*week* means two (2) times during each week
c	1/month means one (1) time during each month
d	Quarterly sampling periods are January through March, April through June, July through September, and October through December. The Permittee must begin quarterly monitoring for the quarter beginning on 1/1/22 4/1/22 7/1/22 10/1/22 and submit results by 4/15/22, 7/15/22, 10/15/22, 1/15/22.
e	24-hour *composite* means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
f	Report daily flows only on days when collecting total ammonia and nitrate plus nitrite samples.
g	TIN (mg/L) as N = Total Ammonia (mg/L as N) + Nitrate plus Nitrite (mg/L as N)
h	Calculate mass concurrently with the respective concentration of a sample, using the following formula: Concentration (in mg/L) X daily flow (in MGD) X Conversion Factor (8.34) = lbs/day
i	Calculate the monthly average total inorganic nitrogen load (lbs as N) using the following equation: $\text{Monthly average TIN load (lbs as N)} = ((\sum \text{Calculated TIN loads } (\frac{\text{lbs}}{\text{day}} as\ N)) /number\ of\ samples) \text{ x number of days in the calendar month}$
j	Calculate the annual total inorganic nitrogen, year to date using the following calculation: $\text{Annual TIN load (lbs as N)} = \sum \text{Monthly average TIN loads, to date}$
k	Or other equivalent EPA-approved method with the same or lower quantitation level
l	The Permittee must ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternative method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. If the Permittee uses an alternative method it must report the test method and QL on the discharge monitoring report. If the permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR. The permittee must also upload the QA/QC documentation from the lab on the QL development.

B. MONITORING REQUIREMENTS FOR MODERATE LOADERS

Each permittee listed in Table 8 must monitor influent and effluent in accordance with the following schedule and requirements specified in Table 15 and 16, respectively. Influent and effluent monitoring locations must be representative. Permittees may use the monitoring locations identified in their individual NPDES permit. If a Permittee conducts additional sampling of required parameters during the month, they must report all results on the monthly DMR.

Table 15. Influent Sampling Requirements for Moderate Loaders

Wastewater influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant, if possible.

The Permittee must collect total ammonia, nitrate plus nitrite, and TKN samples during the same sampling event.

Parameter	Units & Specifications	Minimum Sampling or Calculation Frequency	Analytical Method [k]	Laboratory Quantitation Level [l]	Sample Type
$CBOD_5$	mg/L	1/week [b]	SM5210-B	2 mg/L	24-hour composite [e]
Total Ammonia	mg/L as N	1/week [b]	SM4500-NH_3-B/C/D/E/F/G/H	0.02 mg/L	24-hour composite [e]
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month [c]	SM4500-NO_3-E/F/H	0.1 mg/L	24-hour composite [e]
Total Kjeldahl Nitrogen (TKN)	mg/L as N	1/month [c]	SM4500-N_{org}-B/C and SM4500-NH_3-B/C/D/E/F/G/H	0.3 mg/L	24-hour composite [e]

Table 16. Effluent Sampling Requirements for Moderate Loaders

Final wastewater effluent means wastewater exiting the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process. The total ammonia, TKN, and nitrate plus nitrite samples must be taken during the same sampling event.

Parameter	Units & Specifications	Minimum Sampling or Calculation Frequency	Analytical Method [k]	Laboratory Quantitation Level [l]	Sample Type
Flow [f]	MGD	1/week [b]	–	–	Metered/ recorded
$CBOD_5$ [a]	mg/L	1/week [b]	SM5210-B	2 mg/L	24-hour composite [e]
Total Organic Carbon	mg/L	1/quarter [c]	SM5310-B/C/D	1 mg/L	24-hour composite [e]
Total Ammonia	mg/L as N	1/week [b]	SM4500-NH_3-B/C/D/E/F/G/H	0.02 mg/L	24-hour composite [e]
Nitrate plus Nitrite Nitrogen	mg/L as N	1/week [b]	SM4500-NO_3-E/F/H	0.1 mg/L	24-hour composite [e]
TKN	mg/L as N	1/month [c]	SM4500-N_{org}-B/C and SM4500-NH_3-B/C/D/E/F/G/H	0.3 mg/L	24-hour composite [e]
Total Inorganic Nitrogen	mg/L as N	1/week [b]	–	–	Calculated [g]
Total Inorganic Nitrogen	Lbs/day	1/week [b]	–	–	Calculated [h]
Average Monthly Total Inorganic Nitrogen	Lbs	1/month [c]	–	–	Calculated [i]
Annual Total Inorganic Nitrogen, year to date	Lbs	1/month [c]	–	–	Calculated [j]

Table 17. Footnotes for Influent and Effluent Monitoring Tables 15 and 16

Footnote	Information
a	Take effluent samples for the $CBOD_5$ analysis before or after the disinfection process. If taken after disinfection and chlorine is used, dechlorinate and reseed the sample.
b	1/*week* means one (1) times during each week
c	1/month means one (1) time during each month
d	Quarterly sampling periods are January through March, April through June, July through September, and October through December. The Permittee must begin quarterly monitoring for the quarter beginning on 1/1/22 4/1/22 7/1/22 10/1/22 and submit results by 4/15/22, 7/15/22, 10/15/22, 1/15/22.
e	24-hour *composite* means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
f	Report daily flows only on days when collecting total ammonia and nitrate plus nitrite samples.
g	TIN (mg/L) as N = Total Ammonia (mg/L as N) + Nitrate plus Nitrite (mg/L as N)
h	Calculate mass concurrently with the respective concentration of a sample, using the following formula: Concentration (in mg/L) X daily flow (in MGD) X Conversion Factor (8.34) = lbs/day
i	Calculate the monthly average total inorganic nitrogen load (lbs as N) using the following equation: $\text{Monthly average TIN load (lbs as N)} = ((\sum \text{Calculated TIN loads } (\frac{\text{lbs}}{\text{day}} as\ N)) /number\ of\ samples) \text{ x number of days in the calendar month}$
j	Calculate the annual total inorganic nitrogen, year to date using the following calculation: $\text{Annual TIN load (lbs as N)} = \sum \text{Monthly average TIN loads, to date}$
k	Or other equivalent EPA-approved method with the same or lower quantitation level
l	The Permittee must ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternative method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. If the Permittee uses an alternative method it must report the test method and QL on the discharge monitoring report. If the permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR. The permittee must also upload the QA/QC documentation from the lab on the QL development.

C. MONITORING REQUIREMENTS FOR SMALL LOADERS

Each permittee listed in Table 11 must monitor influent and effluent in accordance with the following schedule and requirements specified in Table 18 and 19, respectively. Influent and effluent monitoring locations must be representative. Permittees may use the monitoring locations identified in their individual NPDES permit. If a Permittee conducts additional sampling of required parameters during the month, they must report all results on the monthly DMR.

Table 18. Influent Sampling Requirements for Small Loaders

Wastewater influent means the raw sewage flow from the collection system into the treatment facility. Sample the wastewater entering the headworks of the treatment plant excluding any side-stream returns from inside the plant, if possible.

The Permittee must collect total ammonia, nitrate plus nitrite, and TKN samples during the same sampling event.

Parameter	Units & Specifications	Minimum Sampling or Calculation Frequency	Analytical Method [j]	Laboratory Quantitation Level [k]	Sample Type
$CBOD_5$	mg/L	2/month [c]	SM5210-B	2 mg/L	24-hour composite [e]
Total Ammonia	mg/L as N	2/month [c]	SM4500-NH_3-B/C/D/E/F/G/H	0.02 mg/L	24-hour composite [e]
Nitrate plus Nitrite Nitrogen	mg/L as N	1/month [b]	SM4500-NO_3-E/F/H	0.1 mg/L	24-hour composite [e]
Total Kjeldahl Nitrogen (TKN)	mg/L as N	1/month [b]	SM4500-N_{org}-B/C and SM4500-NH_3-B/C/D/E/F/G/H	0.3 mg/L	24-hour composite [e]

Table 19. Effluent Sampling Requirements for Small Loaders

Final wastewater effluent means wastewater exiting the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process. The total ammonia, TKN, and nitrate plus nitrite samples must be taken during the same sampling event.

Parameter	Units & Specifications	Minimum Sampling or Calculation Frequency	Analytical Method [k]	Laboratory Quantitation Level [l]	Sample Type
Flow [f]	MGD	2/month [c]	--	--	Metered/ recorded
$CBOD_5$ [a]	mg/L	2/month [c]	SM5210-B	2 mg/L	24-hour composite [e]
Total Organic Carbon	mg/L	1/quarter [d]	SM5310-B/C/D	1 mg/L	24-hour composite [e]
Total Ammonia	mg/L as N	2/month [c]	SM4500-NH_3-B/C/D/E/F/G/H	0.02 mg/L	24-hour composite [e]
Nitrate plus Nitrite Nitrogen	mg/L as N	2/month [c]	SM4500-NO_3-E/F/H	0.1 mg/L	24-hour composite [e]
TKN	mg/L as N	1/month [b]	SM4500-N_{org}-B/C and SM4500-NH_3-B/C/D/E/F/G/H	0.3 mg/L	24-hour composite [e]
Total Inorganic Nitrogen	mg/L as N	2/month [c]	--	--	Calculated [g]
Total Inorganic Nitrogen	Lbs/day	2/month [c]	--	--	Calculated [h]
Average Monthly Total Inorganic Nitrogen	Lbs	1/month [b]	--	--	Calculated [i]
Annual Total Inorganic Nitrogen, year to date	Lbs	1/month [b]	--	--	Calculated [j]

Table 20. Footnotes for Influent and Effluent Monitoring Tables 18 and 19

Footnote	Information
a	Take effluent samples for the $CBOD_5$ analysis before or after the disinfection process. If taken after disinfection and chlorine is used, dechlorinate and reseed the sample.
b	1/month means one (1) time during each month
c	2/month means two (2) times during each month and on a rotational basis throughout the days of the week, except weekends and holidays.
d	Quarterly sampling periods are January through March, April through June, July through September, and October through December. The Permittee must begin quarterly monitoring for the quarter beginning on 1/1/22 4/1/22 7/1/22 10/1/22 and submit results by 4/15/22, 7/15/22, 10/15/22, 1/15/22.
e	24-hour composite means a series of individual samples collected over a 24-hour period into a single container, and analyzed as one sample.
f	Report daily flows only on days when collecting total ammonia and nitrate plus nitrite samples.
g	TIN (mg/L) as N = Total Ammonia (mg/L as N) + Nitrate plus Nitrite (mg/L as N)
h	Calculate mass concurrently with the respective concentration of a sample, using the following formula: Concentration (in mg/L) X daily flow (in MGD) X Conversion Factor (8.34) = lbs/day
i	Calculate the monthly average total inorganic nitrogen load (lbs as N) using the following equation: $\text{Monthly average TIN load (lbs as N)} = ((\sum \text{Calculated TIN loads } (\frac{\text{lbs}}{\text{day}} as\ N)) /number\ of\ samples) \text{ x number of days in the calendar month}$
j	Calculate the annual total inorganic nitrogen, year to date using the following calculation: $\text{Annual TIN load (lbs as N)} = \sum \text{Monthly average TIN loads, to date}$
k	Or other equivalent EPA-approved method with the same or lower quantitation level
l	The Permittee must ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternative method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. If the Permittee uses an alternative method it must report the test method and QL on the discharge monitoring report. If the permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR. The permittee must also upload the QA/QC documentation from the lab on the QL development.

D. SAMPLING AND ANALYTICAL PROCEDURES

Samples and measurements taken to meet the requirements of this permit must represent the volume and nature of the monitored parameters, including ***representative sampling*** of any unusual discharge or discharge condition, including authorized ***bypasses***, upsets, and maintenance-related conditions affecting effluent quality.

Sampling and analytical methods used to meet the monitoring requirements specified in this permit must conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants*[12] contained in 40 CFR 136[13] (or as applicable in 40 CFR subchapter N[14] [Parts 400-471] or 40 CFR subchapter O[15] [Parts 501-503]) unless otherwise specified in this permit.

E. FLOW MEASUREMENT

The Permittee must:

1. Select and use appropriate flow measurement and method consistent with accepted scientific practices.
2. Install, calibrate, and maintain these devices to ensure the accuracy of the measurements is consistent with the accepted industry standard, the manufacture's recommendation, and approved O&M manual procedures for the device and the wastestream.
3. Establish a calibration frequency for each device or instrument in the Permittee's O&M Manual that conforms to the frequency recommended by the manufacturer.
4. Maintain calibration records for at least three years.

F. LABORATORY ACCREDITATION

1. The Permittee must ensure that all monitoring data required by Ecology for permit specified parameters is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories.* Flow and internal process control parameters are exempt from this requirement.

G. REQUEST FOR REDUCTION IN MONITORING

1. The Permittee may request a reduction of the sampling frequency after twelve (12) months of monitoring by demonstrating that the distribution of

[12] https://www.ecfr.gov/cgi-bin/text-idx?SID=0e534d17f9783994a26ffee684d260c2&mc=true&node=pt40.25.136&rgn=div5
[13] https://www.ecfr.gov/cgi-bin/text-idx?SID=0e534d17f9783994a26ffee684d260c2&mc=true&node=pt40.25.136&rgn=div5
[14] https://www.ecfr.gov/cgi-bin/text-idx?SID=0e534d17f9783994a26ffee684d260c2&mc=true&tpl=/ecfrbrowse/Title40/40CIsubchapN.tpl
[15] https://www.ecfr.gov/cgi-bin/text-idx?SID=0e534d17f9783994a26ffee684d260c2&mc=true&tpl=/ecfrbrowse/Title40/40CIsubchapO.tpl

concentrations can be accurately represented with a lower sampling frequency. Ecology will review each request and at its discretion grant the request in writing when it reissues the permit coverage or by a permit coverage modification.

2. The Permittee must:
    a. Provide a written request.
    b. Clearly state the parameters for which it is requesting reduced monitoring.
    c. Clearly state the justification for the reduction.

S8. DISCHARGES TO 303(D) OR TMDL WATER BODIES

If EPA approves an applicable ***Total Maximum Daily Load*** (TMDL) that includes wasteload allocations for WWTPs owned and operated by the Permittee Ecology will address any permit requirements related to the approved TMDL in the Permittee's individual permit or through a modification of this permit.

S9. REPORTING AND RECORDKEEPING REQUIREMENTS

A. DISCHARGE MONITORING REPORTS

Permittees required to conduct ***water quality*** sampling in accordance with Special Conditions S7, and/or G12 (Additional Monitoring) must submit the results to Ecology. Permittees must submit the monthly DMR by the 15th day of the following month.

Permittees must submit monitoring data using Ecology's WQWebDMR program.

B. MONITORING REQUIREMENTS

1. Wastewater Sampling Frequency

   a. The Permittee must sample both the influent and effluent discharge location at the frequencies listed in Condition S7.A, S7.B and S7.C.

   b. Samples must be representative of the flow and characteristics of the discharge.

   c. Sampling is not required outside of normal working hours or during unsafe conditions.

2. Wastewater Sampling Locations

   Influent and effluent sampling locations must be representative. Permittees may use the compliance monitoring locations in their individual NPDES permit, prior to entry into waters of the state.

3. Wastewater Sampling Documentation

   For each sample taken, the Permittee must record and retain the following information:

   a. Sample date and time

   b. Sample location

   c. Method of sampling, and method of sample preservation, if applicable

   d. Individual who performed the sampling

4. Where wastewater monitoring requirements under this Permit mirror requirements in a Permittee's individual permit, the same result may be applied to both permits.

5. Additional Monitoring by the Permittee

   If the Permittee monitors any ***pollutant*** more frequently than required by this permit using test procedures specified by Condition S7, the Permittee must include the results of the extra monitoring in the calculation and reporting of the data submitted in the Permittee's DMR.

C. ANNUAL REPORT FOR DOMINANT LOADERS

1. No later than March 31 of each year, each Permittee listed in Table 5 must submit an Annual Report documenting optimization and the adaptive management used at their WWTP. The Permittee must submit their first annual report by March 31, 2023 for the reporting period that begins on January 1, 2022 and lasts through December 31, 2022. All subsequent Annual Reports must use the reporting period of the previous calendar year unless otherwise specified.
2. Permittees must submit Annual reports electronically using Ecology's Water Quality Permitting Portal (WQWebPortal) available on Ecology's website, unless otherwise directed by Ecology.
3. The Annual Report documenting the Nutrient Optimization Plan for Permittees listed in Table 5 must include the following:
    a. Submittal of the Annual Report form as provided by Ecology pursuant to S4.C, describing the status of the requirements of this Permit during the reporting period.
    b. Attachments to the Annual Report including summaries, descriptions, reports and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period, or as a required submittal. Refer to Appendix C for Annual Report questions.
    c. Certification and signature pursuant to G2.D and notification of any changes to authorization pursuant to G2.C.

D. ANNUAL REPORT FOR MODERATE LOADERS

1. No later than March 31 of each year, each Permittee listed in Table 8 must submit an Annual Report documenting optimization and the adaptive management used at their WWTP. The Permittee must submit their first annual report by March 31, 2023 for the reporting period that begins on January 1, 2022 and lasts through December 31, 2022. All subsequent Annual Reports must use the reporting period of the previous calendar year unless otherwise specified.
2. Permittees must submit Annual reports electronically using Ecology's Water Quality Permitting Portal (WQWebPortal) available on Ecology's website, unless otherwise directed by Ecology.
3. The Annual Report documenting the Nutrient Optimization Plan for Permittees listed in Table 8 must include the following:
    a. Submittal of the Annual Report form as provided by Ecology pursuant to S5.C, describing the status of the requirements of this Permit during the reporting period.
    b. Attachments to the Annual Report including summaries, descriptions, reports and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period, or as a required submittal. Refer to Appendix D for Annual Report questions.

c. Certification and signature pursuant to G2.D and notification of any changes to authorization pursuant to G2.C.

E. REPORTING FOR SMALL LOADERS

1. No later than March 31, 2026 each Permittee listed in Table 11 must submit an Optimization Report documenting optimization and the adaptive management used at their WWTP. The reporting period for this report will be from January 1, 2022 through December 31, 2025.
2. Permittees must submit the Nitrogen Optimization Report electronically using Ecology's Water Quality Permitting Portal (WQWebPortal) available on Ecology's website, unless otherwise directed by Ecology.
3. The electronic report documenting the optimization for Permittees listed in Table 11 must include the following:
   a. Submittal of the Optimization Report form as provided by Ecology pursuant to S6.B, describing the status of the requirements of this Permit during the reporting period.
   b. Attachments to the Optimization Report including summaries, descriptions, reports and other information as required, or as applicable, to meet the requirements of this Permit during the reporting period, or as a required submittal. Refer to Appendix E for Optimization Report questions.
   c. Certification and signature pursuant to G2.D and notification of any changes to authorization pursuant to G2.C.

F. RECORDS RETENTION

The Permittee must retain records of all monitoring information (field notes, sampling results, etc.), optimization documents submitted with the annual or one-time report, and any other documentation of compliance with permit requirements for a minimum of five years following the termination of permit coverage. Such information must include all calibration and maintenance records, and records of all data used to complete the application for this permit. This period of retention must be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

G. NONCOMPLIANCE NOTIFICATION

In the event the Permittee is unable to comply with any of the terms and conditions of this permit which may cause a threat to human health or the environment, including threats resulting from unanticipated ***bypass*** or upset, or does not comply with the narrative effluent requirements, the Permittee must:

1. Immediately, in no case more than 24 hours of becoming aware of the circumstances, notify Ecology of the failure to comply by calling the applicable regional office phone number (find at Ecology' Report a Spill webpage[16]).
2. Immediately take action to prevent the discharge/***pollution***, or otherwise stop or correct the noncompliance.
3. Submit a written report to Ecology using the WQWebPortal within five (5) days of the time the Permittee becomes aware of a reportable event. The report must contain:
    a. A description of the noncompliance and its cause
    b. The period of noncompliance including exact dates and times
    c. If the noncompliance has not been corrected, the anticipated time it is expected to continue
    d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance

Ecology may waive the written report on a case-by-case basis upon request if the Permittee has submitted a timely oral report.

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply. Refer to Section G13 of this permit for specific information regarding non-compliance.

H. ACCESS TO PLANS AND RECORDS

1. The Permittee must retain the following permit documentation (reports and monitoring records) on site, or within reasonable access to the site, for use by the operator or for on-site review by Ecology:
    a. Permit Coverage Letter
    b. Puget Sound Nutrient General Permit
    c. Discharge Monitoring Reports
    d. Attachments to the Annual or Single Report as required in the Nitrogen Optimization Plan (NOP)
    e. Nutrient Reduction Evaluation for Permittees listed in Tables 5 and 8 or AKART Analysis for Permittees listed in Table 11

S10. PERMIT FEES

The Permittee must pay permit fees assessed by Ecology. Fees for wastewater discharges covered under this permit are established by Chapter 173-224 WAC.

[16] https://ecology.wa.gov/About-us/Get-involved/Report-an-environmental-issue/Report-a-spill

GENERAL CONDITIONS

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this general permit must be consistent with the terms and conditions of this general permit. Failure to follow the corrective action requirement after discharge of TIN at a level that exceeds the action level identified and authorized by the general permit constitutes a violation of the terms and conditions of this permit.

G2. SIGNATORY REQUIREMENTS

A. All permit applications must bear a certification of correctness to be signed:

1. In the case of corporations, by a responsible corporate officer;
2. In the case of a partnership, by a general partner of a partnership;
3. In the case of sole proprietorship, by the proprietor; or
4. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

B. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

1. The authorization is made in writing by a person described above and submitted to Ecology.
2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.

C. Changes to authorization. If an authorization under paragraph G2.B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G2.B.2 above must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section must make the following certification:

E. "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G3. RIGHT OF INSPECTION AND ENTRY

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records are kept under the terms and conditions of this permit.

B. To have access to and copy – at reasonable times and at reasonable cost -- any records required to be kept under the terms and conditions of this permit.

C. To inspect – at reasonable times – any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor – at reasonable times – any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the ***Clean Water Act***.

G4. GENERAL PERMIT MODIFICATION AND REVOCATION

This permit may be modified, revoked and reissued, or terminated in accordance with the provisions of Chapter 173-226 WAC. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, the following:

A. When a change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this permit.

B. When effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this permit.

C. When a water quality management plan containing requirements applicable to the category of dischargers covered under this permit is approved, or

D. When information is obtained that indicates cumulative effects on the environment from dischargers covered under this permit are unacceptable.

G5. REVOCATION OF COVERAGE UNDER THE PERMIT

Pursuant to Chapter 43.21B RCW and Chapter 173-226 WAC, the ***Director*** may terminate coverage for any discharger under this permit for cause. Cases where coverage may be terminated include, but are not limited to, the following:

A. Violation of any term or condition of this permit.

B. Obtaining coverage under this permit by misrepresentation or failure to disclose fully all relevant facts.

C. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

D. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

E. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations.

F. Nonpayment of permit fees or penalties assessed pursuant to RCW 90.48.465 and Chapter 173-224 WAC.

G. Failure of the Permittee to satisfy the public notice requirements of WAC 173-226-130(5), when applicable.

G6. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit will be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G7. DUTY TO REAPPLY

The Permittee must apply for permit renewal at least 180 days prior to the specified expiration date of this permit.

G8. TRANSFER OF GENERAL PERMIT COVERAGE

In the event of any change in control or ownership of facilities from which the authorized discharge emanate, the Permittee must follow the procedures listed in their individual NPDES permit when notifying Ecology.

G9. REMOVED SUBSTANCES

The Permittee must not re-suspend or reintroduce collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewater to the final effluent stream for discharge to state waters.

G10. DUTY TO PROVIDE INFORMATION

The Permittee must submit to Ecology, within a reasonable time, all information that Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology, upon request, copies of records required to be kept by this permit [40 CFR 122.41(h)].

G11. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G12. ADDITIONAL MONITORING

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G13. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, and/or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G14. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G15. DUTY TO COMPLY

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G16. TOXIC POLLUTANTS

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G17. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than $20,000 per day of violation, or imprisonment of not more than four (4) years, or both.

G18. REPORTING PLANNED CHANGES

Report planned changes in a manner consistent with the individual permit.

G19. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to Ecology, it must promptly submit such facts or information.

G20. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee must give advance notice to Ecology by submission of a new application or supplement thereto at least one hundred and eighty (180) days prior to commencement of such discharges, of any facility expansions, or other planned changes, such as process modifications, in the permitted facility which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, must be scheduled during non-critical water quality periods and carried out in a manner approved by Ecology.

G21. APPEALS

A. The terms and conditions of this general permit, as they apply to the appropriate class of dischargers, are subject to appeal by any person within 30 days of issuance of this general permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.

B. The terms and conditions of this general permit, as they apply to an individual discharger, are appealable in accordance with Chapter 43.21B RCW within 30 days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the general permit's applicability or nonapplicability to that individual discharger.

C. The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this general permit. If the terms and conditions of this general permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

G22. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

G23. BYPASS PROHIBITED

This permit prohibits a bypass, which is the intentional diversion of waste streams from any portion of a treatment facility.

See bypass prohibitions included in each jurisdiction's individual NPDES permit.

APPENDIX A – DEFINITIONS

303(d) Listed Waters means waterbodies listed as Category 5 on Washington State's Water Quality Assessment.

Action Level means an indicator value used to determine the effectiveness of best management practices at a WWTPs. Action levels are not water quality criteria or effluent limits by themselves but indicators of treatment optimization.

Adaptive Management means the process of incorporating new information into optimization implementation to ensure effective attainment of documented goals or the facility specific action level.

AKART means acronym for "all known, available, and reasonable methods of prevention, control, and treatment." AKART represents the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants and controlling pollution associated with a discharge.

Alternative Restoration Plan means a near-term plan, or description of actions, with a schedule and milestones, that is more immediately beneficial or practicable to achieving water quality standards.

Applicant means an owner or **operator in responsible charge** seeking coverage under this permit**.**

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State.

Bubbled action level means the sum of individual action levels for all WWTPs in the same discharger category under a single jurisdiction's ownership.

Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

Day means a period of 24 consecutive hours.

Clean Water Act (CWA) means the Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, and 97-117; USC 1251 et seq.

Composite (also **Composite Sample)** means a mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increases while maintaining a constant time interval between the aliquots.

Director means the Director of the Washington Department of Ecology or his/her authorized representative.

Discharger means an owner or operator of any facility or activity subject to regulation under Chapter 90.48 RCW or the Federal Clean Water Act.

Domestic Wastewater means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such ground water infiltration or surface waters as may be present.

Dominant loader means domestic WWTPs discharging more than 2,000 lbs/day TIN. Cumulatively, dominant loaders constitute > 80% of the domestic point source TIN load.

Ecology means the Washington State Department of Ecology.

Ground Water means water in a saturated zone or stratum beneath the land surface or a surface water body.

Greater Puget Sound Region means the marine area where human nutrient loads, from Washington Waters of the Salish Sea, contribute to waters not meeting marine DO standards. The GPS region include the Northern Bays (Bellingham, Samish, and Padilla Bays) as well as Puget Sound Proper, which are the marine waters south of the entrance of Admiralty Inlet (Whidbey Basin, Main Basin, South Sound, and Hood Canal).

Moderate loader means a domestic WWTP discharging between 100 and 2,000 lbs/day TIN. Cumulatively, moderate loaders constitute roughly 19 % of the domestic point source TIN load.

National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington Department of Ecology.

Notice of Intent (NOI) means the application for, or a request for coverage under this general permit pursuant to WAC 173-226-200.

Operator means any individual who performs routine duties, onsite at a wastewater treatment plant that affect plant performance or effluent quality.

Operator in Responsible Charge means the individual who is designated by the owner as the person routinely onsite and in direct charge of the overall operation and maintenance of a wastewater treatment plant.

Optimization (also treatment optimization) means a best management practice (BMP) resulting in the refinement of WWTP operations that lead to improved effluent water quality and/or treatment efficiencies.

Outfall means the location where the site's wastewater discharges to surface water.

Overburdened community means a geographic area where vulnerable populations face combined, multiple environmental harms and health impacts, and includes, but is not limited to, highly impacted communities as defined in RCW 19.405.020.

Owner means a town or city, a county, a sewer district, board of public utilities, association, municipality or other public body.

Permittee means an entity that receives notice of coverage under this general permit.

Point source means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, and container from which pollutants are or may be discharged to surface waters of the State. This term does not include return flows from irrigated agriculture.

Pollutant means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, domestic sewage sludge (biosolids), munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste.

Pollution means contamination or other alteration of the physical, chemical, or biological properties of waters of the State; including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare; or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish or other aquatic life.

Receiving water means the water body at the point of discharge. If the discharge is to a storm sewer system, either surface or subsurface, the receiving water is the water body to which the storm system discharges. Systems designed primarily for other purposes such as for ground water drainage, redirecting stream natural flows, or for conveyance of irrigation water/return flows that coincidentally convey stormwater are considered the receiving water.

Representative sample (also **representative sampling**) means a wastewater sample which represents the flow and characteristics of the discharge. Representative samples may be a grab sample, a time-proportionate **composite sample**, or a flow proportionate sample.

Salish Sea means Puget Sound, Strait of Georgia, and Strait of Juan de Fuca, including their connecting channels and adjoining waters.

SEPA (State Environmental Policy Act) means the Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

Septage means, for the purposes of this permit, any liquid or semisolid removed from a septic tank, cesspool, vault toilet or similar source which concentrates wastes or to which chemicals have been added.

Site means the land where any "facility" is physically located.

Small Loader means a domestic WWTP discharging less than 100 lbs/day TIN. Cumulatively, small loaders constitute < 1% of the domestic point source TIN load.

Surface Waters of the State includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Total Inorganic Nitrogen (TIN) means the sum of ammonia, nitrate, and nitrite. It includes dissolved and particulate fractions.

Total Maximum Daily Load (TMDL) means a calculation of the maximum amount of a pollutant that a water body can receive and still meet state water quality standards. Percentages of the total maximum daily load are allocated to the various pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL calculations must include a "margin of safety" to ensure that the water body can be protected in case there are unforeseen events or unknown sources of the pollutant. The calculation must also account for seasonable variation in water quality.

Washington Waters of the Salish Sea means areas of the Salish Sea subject to Washington State's Water Pollution Control Act (Chapter 90.48 RCW)

Wasteload Allocation (WLA) means the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation (40 CFR 130.2[h]).

Water quality means the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Waters of the State includes those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the State" as defined in Chapter 90.48 RCW, which include lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Week (same as **Calendar Week**) means a period of seven consecutive days starting at 12:01 a.m. (0:01 hours) on Sunday.

APPENDIX B – ACRONYMS

AKART	All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment
BMP	Best Management Practice
CFR	Code of Federal Regulations
CWA	Clean Water Act
DIN	Dissolved Inorganic Nitrogen
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
FR	Federal Register
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRP	Nutrient Reduction Plan
PSNF	Puget Sound Nutrient Forum
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
TBEL	Technology Based Effluent Limit
TIN	Total Inorganic Nitrogen
TMDL	Total Maximum Daily Load
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
WQ	Water Quality
WQBEL	Water Quality Based Effluent Limit
WWTP	Wastewater Treatment Plant

APPENDIX C – ANNUAL REPORT QUESTIONS FOR DOMINANT LOADERS

Permittees are required to submit annual reports online, pursuant to Special Condition S9.C.

1. Did your facility stay below the Action Level in S4.b, Table 5 or Table 6 for the jurisdiction with a bubbled action level? (S4.C.2.b.i)
    a. Attach a document listing the contribution of each of your individual facilities to the total bubble allocation for the reporting period. (S4.C.2.b.i)
2. Did your facility stay below a 10 mg/L annual average TIN concentration? (S4.C.2.b.i) (**If Q1 =Y and Q2 = Y, then no further questions).**
3. **Attach** a document describing the assessment method applied to evaluate the existing treatment process. (S4.C.1.a)
4. What is your pre-optimization TIN removal rate, expressed as a percentage? (S4.c.1.a.i)
5. **Attach** a document explaining your initial approach for optimization. (S4.C.1.a)
6. Did you maintain and/or update your assessment approach after year 1?(S4.C.1.a.ii)
7. Do viable optimization strategies exist for your current treatment process? (S4.C.1.b)
8. Did all of the potential optimization strategies you identified and evaluated for S4.C.1.b have a reasonable implementation cost and timeframe? (S4.C.1.b)
9. ATTACH a document describing your preferred optimization strategy for implementation in 2022 (due July 1) (S4.C.1.c)
10. What is the expected performance for the selected optimization strategy? (S4.C.1.c**)**
11. **Attach** a document describing optimization plan implementation including start date, schedule for full implementation, initial costs, and challenges including impacts to other measures of treatment plant performance. (S4.C.2.a)
12. What TIN removal rate was observed during the reporting period? (S4.C.2.b.ii)
13. **Attach** a document describing your ongoing investigations to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources. (S4.C.3.a, S4.C.3.b)
14. **(If Q1=N and Q7 = Y) Attach** document including: factors causing the WWTP to not meet the optimization goal, whether modifications to the strategy could improve performance, and whether a different strategy or combination of strategies may be more appropriate. Also, document changes to the optimization strategy either through the selection of the new optimization strategy and new performance metric or existing implementation refinement. Revise the expected performance if electing to keep the existing strategy. Provide rationale for no changes if Permittee proposes no changes to the optimization strategy (S4.D.1.a and S4.D.1.b)
15. **(If Q1 = No and Q7 = No) Attach** abbreviated engineering report or technical memo (due 12 months after documenting action level exceedance or determination that no optimization strategies exist). (S4.D.2)

16. **(If Q1 = No in two prior years)** Did you implement the Engineering Report as planned, starting after Ecology's approval? (S4.D.2.a)
17. Did you submit the required Nutrient Reduction Evaluation on or before 12/31/2026? If no, **date** the document was or will be provided. (S4.E)
18. Did you submit discharge monitoring reports according to the required schedule? If no, **attach** a document describing/listing the missing records and corrective actions taken/or planned. (S7, S9.A)
19. Are you retaining all applicable records? If no, **attach** a document describing/listing the missing records and corrective actions taken and/or planned. (S9.F)
20. Did you follow non-compliance notification requirements? If no, **attach** a document describing the non-compliance and the corrective actions taken and/or planned. (S9.G)

APPENDIX D – ANNUAL REPORT QUESTIONS FOR MODERATE LOADERS

Permittees are required to submit annual reports online, pursuant to Special Condition S9.D.

1. Did your facility stay below the Action Level in S5.b, Table 8 or Table 9 for the jurisdiction with a bubbled action level? (S5.C.2.b.i)
    a. Attach a document listing the contribution of each of your individual facilities to the total bubble allocation for the reporting period. (S5.C.2.b.i)
2. Did your facility stay below a 10 mg/L annual average TIN concentration? (S5.C.2.b.i) (**If Q1 =Y and Q2 = Y, then no further questions).**
3. **Attach** a document describing the assessment method applied to evaluate the existing treatment process. (S5.C.1.a)
4. What is your pre-optimization TIN removal rate, expressed as a percentage? (S5.c.1.a.i)
5. **Attach** a document explaining your initial approach for optimization. (S5.C.1.a)
6. Did you maintain and/or update your assessment approach after year 1?(S5.C.1.a.ii)
7. Do viable optimization strategies exist for your current treatment process? (S5.C.1.b)
8. Did all of the potential optimization strategies you identified and evaluated for S5.C.1.b have a reasonable implementation cost and timeframe? (S5.C.1.b)
9. ATTACH a document describing your preferred optimization strategy for implementation in 2022 (selection due July 1) (S5.C.1.c)
10. What is the expected performance for the selected optimization strategy? (S5.C.1.c**)**
11. **Attach** a document describing optimization plan implementation including start date, schedule for full implementation, initial costs, and challenges including impacts to other measures of treatment plant performance. (S5.C.2.a)
12. What TIN removal rate was observed during the reporting period? (S5.C.2.b.ii)
13. **Attach** a document describing your ongoing investigations to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources. (S5.C.3.a, S5.C.3.b)
14. **(If Q1=N and Q7 = Y) Attach** document including: factors causing the WWTP to not meet the optimization goal, whether modifications to the strategy could improve performance, and whether a different strategy or combination of strategies may be more appropriate. Also, document changes to the optimization strategy either thorough the selection of the new optimization strategy and new performance metric or existing implementation refinement. Revise the expected performance if electing to keep the existing strategy. Provide rationale for no changes if Permittee proposes no changes to the optimization strategy (S5.D.1.a and S5.D.1.b)
15. **(If Q1 = No and Q7 = No) Attach** abbreviated engineering report or technical memo (due 12 months after documenting action level exceedance or determination that no optimization strategies exist). (S5.D.2)

16. **(If Q1 = No in two prior years)** Did you implement the Engineering Report as planned, starting after Ecology's approval? (S5.D.2.a)
17. Did you submit the required Nutrient Reduction Evaluation on or before 12/31/2026? If no, **date** the document was or will be provided. (S5.E)
18. Did you submit discharge monitoring reports according to the required schedule? If no, **attach** a document describing/listing the missing records and corrective actions taken/or planned. (S7, S9.A)
19. Are you retaining all applicable records? If no, **attach** a document describing/listing the missing records and corrective actions taken and/or planned. (S9.F)
20. Did you follow non-compliance notification requirements? If no, **attach** a document describing the non-compliance and the corrective actions taken and/or planned. (S9.G)

APPENDIX E – ONE TIME REPORT QUESTIONS FOR SMALL LOADERS

Permittees are required to submit the single report online, pursuant to Special Condition S9.E.

1. **Attach** a document describing your initial assessment process, your optimization goal, the list of prioritized optimization strategies identified, and the strategy implemented in 2022 (S6.B.1.b). If any optimization strategies were found to not have a reasonable implementation cost or timeframe (S6.B.2.a.iv), include description of the feasibility and cost analysis that led to exclusion of any approach(es). (S6.B.1.a, S6.B.1.b)
2. Did your plant meet or exceed the pre-optimization empirical TIN removal rate in each year of this permit and also maintain or reduce TIN loads? If no, **attach** a document describing how you revised your optimization strategy in response to the evaluation in each of the prior permit years, and document your adaptive management steps, your assessment process, and the new optimization strategy or strategies you identified, and your updated optimization goal(s) and performance metric(s). (S6.B.2.b.ii, S6.B.2.c)
3. Did your facility stay below a 10 mg/L annual average TIN concentration? (S6.B.2.b.i) (**If Q2 =Y and Q3 = Y, then no further questions)**
4. What is your pre-optimization empirical TIN removal rate? (S6.B.1.a.i)
5. Did you maintain you reassessment approach after year 1? If no, **attach** a document describing assessment revisions that occurred each year over the permit term. (S6.B.1.a.ii)
6. What is your expected TIN removal with the preferred optimization strategy? (S6.B.1.b)
7. **Attach** a document describing optimization implementation including costs, time for full implementation, start date, challenges, and impacts to treatment performance. (S6.B.2.a)
8. What was the TIN removal rate observed each year during the reporting period? (S6.B.2.b.ii)
9. **Attach** a document describing your ongoing investigations to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources. (S6.B.3)
10. Did you submit the required AKART analysis on or before 12/31/2025? If no, **date** document was or will be provided. (S6.C)
11. Did you submit discharge monitoring reports according to the required schedule? If no, **attach** a document describing the missed monitoring activities and the corrective action taken. (S7, S9.A)
12. Are you retaining all applicable records? If no, **attach** a document descripting the missing records and the corrective action taken and/or planned. (S9.F)
13. Did you follow non-compliance notification requirements? If no, **attach** a document describing the non-compliance and the corrective actions taken and/or planned. (S9.G)

FACT SHEET FOR THE PUGET SOUND NUTRIENT DRAFT GENERAL PERMIT

A NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM AND STATE WASTE DISCHARGE GENERAL PERMIT

ISSUANCE DATE: DECEMBER 1, 2021

EFFECTIVE DATE: JANUARY 1, 2022

DEPARTMENT OF ECOLOGY
State of Washington

SUMMARY

This fact sheet is a companion document to the draft National ***Pollutant Discharge Elimination System*** (NPDES) Permit for Discharges from municipal wastewater treatment plants in the ***Washington waters of the Salish Sea*** contributing to ***impairments*** within the ***greater Puget Sound region*** (Puget Sound Nutrient General Permit, or PSNGP). The ***permit*** authorizes the discharge of municipal wastewater containing ***total inorganic nitrogen***. Municipal wastewater refers to wastewater primarily from domestic (household) sources as well as commercial, industrial, and institutional sources that are treated at a ***publicly owned treatment works (POTW).*** The PSNGP limits the ***discharge*** of pollutants to ***surface waters*** under the authority of the Federal Water Pollution Control Act (U.S.C.S. 1251) and limits the discharge of ***pollutants*** to surface water under the authority of Chapter 90.48 RCW.

Washington State Department of Ecology (***Ecology***) announced a preliminary determination to develop a ***general permit*** for municipal wastewater containing total inorganic nitrogen on January 30, 2020. The United States Environmental Protection Agency (***EPA***) treats municipal wastewater discharged directly into the greater Puget Sound as a ***point source*** in ***40 Code of Federal Register (CFR)*** 122.2. Discharges from point sources require an NPDES permit. Ecology currently issues individual NPDES permits to municipal wastewater treatment plants. The PSNGP addresses the discharge of nutrient ***pollution*** from POTWs that hold an existing, individual NPDES permit.

The Washington State Department of Ecology is proposing to issue the PSNGP. This would be the first issuance of the PSNGP. This Fact Sheet explains the presence of nutrients in domestic sewage, Ecology's decisions on limiting total inorganic nitrogen in municipal wastewater, and the regulatory and technical basis for those decisions.

This Fact Sheet is a companion document to the draft permit that provides information to help interested parties better understand the technical issues associated with the permit. Ecology generally will not revise a fact sheet following public comment but will prepare a response to comments. This fact sheet does not contain any independently enforceable requirements. The PSNGP contains all of the requirements applicable to ***dischargers***. In case of any conflict between the fact sheet and the PSNGP, the terms of the PSNGP govern.

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INTRODUCTION

The Federal ***Clean Water Act*** (FCWA, 1972, and later modifications, 1977, 1981, and 1987) established ***water quality*** goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System permit program (NPDES permits), which is administered by the U.S. Environmental Protection Agency (EPA). The EPA has delegated responsibility to administer the NPDES permit program to the State of Washington on the basis of Chapter 90.48 of the Revised Code of Washington (RCW), which defines the Department of Ecology's authority and obligations in administering the wastewater discharge permit program.

The regulations adopted by the state include procedures for issuing general permits (Chapter 173-226 of the Washington Administrative Code [WAC]), water quality criteria for surface waters (Chapters 173-201A WAC), and sediment management standards (Chapter 173-204 WAC). These regulations require a permit to be issued before discharge of wastewater to ***waters of the state*** is allowed. The regulations also establish the basis for effluent limitations and other requirements, which are to be included in the permit. One of the requirements (WAC 173-226-110) for issuing a general permit under the NPDES permit program is the preparation of a draft permit and an accompanying fact sheet. The regulations also require public notice of the draft permit for at least 30 days before the permit is issued (WAC 173-226-130). The fact sheet and draft permit are available for review (see *Appendix A – Public Involvement* of the fact sheet for more detail on the Public Notice procedures).

After the public comment period has closed, Ecology will summarize the substantive comments and prepare a response to each comment. The summary and response to comments will become part of the file on the permit. Parties submitting comments will receive a copy of Ecology's response. Comments and the resulting changes to the permit will be summarized in an appendix to this fact sheet, *Appendix C – Response to Comments*.

BACKGROUND INFORMATION

HISTORY

Following extensive, scientific investigations regarding existing dissolved oxygen (DO) impairments from excess nutrient loading to Puget Sound, Ecology issued a public notice of a Preliminary Determination to develop a Puget Sound Nutrient General Permit (PSNGP) on August 21, 2019. During the 60 day period which closed October 21, 2019, Ecology received public comments on whether the Agency should move forward with the development of a general permit to control nutrient discharges from existing municipal wastewater treatment plants (WWTPs or POTWs) in ***Washington Waters of the Salish Sea*** that contribute to impairments within the greater Puget Sound region.

Ecology received 49 comment letters during the Preliminary Determination period. Overall, comments received in support of the PSNGP carried a message that WWTPs should implement nutrient controls in a timely fashion, regardless of permitting approach. While not all comments were favorable to the GP approach, a theme of conditional support of a collaborative effort to reduce nutrients emerged.

After carefully considering comments received, Ecology announced a preliminary determination to develop a general permit for municipal treatment plants discharging to Puget Sound at the ***Puget Sound Nutrient Forum (PSNF)*** on January 30, 2020. As part of that announcement, Ecology also led a stakeholder engagement exercise to receive input on the type of collaborative approach the agency should use to develop the permit. Ecology proposed using an Advisory Committee and solicited feedback on the composition and roles of that committee during the January 2020 PSNF. After receiving that feedback, Ecology released a follow up online nomination survey for volunteers willing to represent the different regional interests on the PSNGP's Advisory Committee (AC).

In March 2020, Ecology convened a 14 person permit Advisory Committee representing regional treatment plants, state agencies (including Ecology), the EPA and the environmental community. Ecology invited Tribal involvement in the advisory committee and left a seat at the table for a representative. However, the Tribes preferred to engage directly with the Governor's office and through staff level meetings held by the Northwest Indian Fisheries Commission's Coordinated Tribal Water Quality Program. Table 1, below, shows the original AC members selected to help advise Ecology on conceptual permitting concepts and conditions.

Table 1. Original PSNGP Advisory Committee Members

Name	Affiliation	Role	Geography
Mark Sadler	City of Everett, Public Works	Operations Superintendent	North Central

Name	Affiliation	Role	Geography
Joe Grogan	Town of Coupeville	Utility Superintendent	North Central
Dan Thompson	City of Tacoma	Division Manager	South Central
Rebecca Singer	King County DNRP, Wastewater Treatment Division	Resource Recovery Manager	South Central
Patrick Kongslie	Pierce County Planning and Public Works –Sewer Division/PNCWA Olympia Section	Sewer Division Maintenance and Operations Manager	South Central
Wendy Steffensen	LOTT Clean Water Alliance	Environmental Project Manager	South Sound
Pete Tjemsland	City of Sequim	Utilities Manager and Operator	Strait of Juan de Fuca
Jeff Clarke	Washington Association of Sewer and Water Districts	Past President	Puget Sound Wide
Bruce Wishart	Puget Soundkeeper	Policy Lead	Puget Sound Wide
Mindy Roberts	Washington Environmental Council	Puget Sound Program Director	Puget Sound Wide
Jenny Wu	EPA	Engineer, Permit Writer	Puget Sound Wide
Valerie Smith	Department of Commerce	Senior Planner	Puget Sound Wide
Chip Anderson	Lummi Tribal Water and Sewer District	District Manager	North Sound

Name	Affiliation	Role	Geography
Tribe - Unfilled			

Ecology hosted virtual AC meetings monthly from March 2020 through October 2020. Each meeting worked towards producing a Final Recommendations document that captured agreements and dissenting opinions on each of the conceptual approaches discussed. In addition to AC meetings, different caucuses formed to discuss the permit concepts during separate meetings. The four separate caucus groups included: one for environmental groups, state agencies, federal agencies and utilities. The utility caucus provided Ecology with an alternative permitting proposal that spanned several permit cycles. Ecology did not use this proposal in developing the draft permit but appreciates the effort utilities participating in that caucus made to get their opinions to the agency. The primary reason Ecology did not use this proposal stems from the Agency's immediate need to address nutrients in ***domestic wastewater*** discharges, starting with the first permit cycle.

On January 27, 2021, Ecology released the preliminary draft of the PSNGP to the public and started a 47-day informal comment period that ended on March 15, 2021. Ecology received sixty-seven individual comment letters on the preliminary draft in addition to multiple copies of identical form letters from various action networks. The comments illustrated the different perspectives of the commenters, which included individuals, organizations, Tribes, municipalities and other interested parties. Ecology carefully reviewed the comments and feedback from the public and made revisions to the permitting concepts released in the preliminary draft. The revisions constitute the formal draft of the PSNGP.

Ecology released the formal draft of the Puget Sound Nutrient General Permit, the accompanying fact sheet providing the statement of basis, and the ***Notice of Intent*** (application) on June 16, 2021. This release starts the formal comment period that ends on August 2, 2021. The comment period includes two virtual public hearings. Please see Appendix A – Public Involvement Information for more information about the public hearings. Ecology will consider the comments made on the formal draft before making a permit issuance decision on the first general permit in late summer or fall 2021. A formal response to comments will accompany the final permit.

GENERAL PERMIT APPROACH

A general permit to address multiple point source discharges from municipal wastewater treatment plants in a specific geographic area is an appropriate permitting approach for the following reasons:

- A general permit is an efficient method to establish the essential regulatory requirements appropriate for controlling total inorganic nitrogen in municipal wastewater.

- A general permit allows Ecology to handle permit applications within the state of Washington more efficiently.

- A general permit is consistent with EPA's four-tier permitting strategy, the purpose of which is to use the flexibility provided by the Clean Water Act in designing a workable and reasonable permitting system.

In addition, critical benefits to a general permit for municipal dischargers include an equitable roll out of nutrient controls in the region and a shared basis for working together to develop treatment solutions that may ultimately include a water quality trading framework. Implementing nutrient controls through existing, individual NPDES permits would stagger the rollout across the region placing dischargers on different timelines and delaying improvements in water quality.

A general permit is designed to provide coverage for a group of related facilities or operations of a specific industry type or group of industries. It is appropriate when the discharge characteristics are sufficiently similar, and a standard set of permit requirements can effectively provide environmental protection and comply with ***water quality standards*** for discharges. Ecology determined that discharge of total inorganic nitrogen from municipal WWTPs is best controlled by coverage under a General Permit with the Preliminary Determination. All ***marine point sources*** proposed for coverage under this General Permit are located in the same geographic region (i.e., Washington waters of the Salish Sea). Discharges from these plants are similar in nature as they are all generated by the treatment of municipal wastewater. Therefore, this general permit will appropriately implement a similar application of narrative effluent limits and monitoring requirements for this class of point sources. If Ecology determines that pollutants from a specific ***facility*** are not managed or controlled by the general permit to protect state water quality standards, then Ecology may elect to use the individual permit as the preferred regulatory mechanism.

WASTEWATER CHARACTERIZATION AND SUBJECT DISCHARGERS

This draft general permit proposes to cover municipal WWTPs that own and operate secondary and advanced secondary wastewater treatment facilities as described in their individual NPDES permits. Municipal sewage includes wastes generated by residential and commercial buildings, institutions and some industries within a municipality's sewer shed. It contains nutrients (nitrogen and phosphorus), suspended solids, and bacteria in addition to having an oxygen demand that varies depending on the strength of the wastewater. Domestic wastewater may also contain toxic pollutants due to pass through from household chemicals, industrial sources or individual use of pharmaceuticals and personal care products. If not properly treated, these pollutants can enter the ***receiving water*** causing impacts to water quality. This permit authorizes the discharge of treated municipal effluent containing total inorganic nitrogen. Existing individual NPDES permits held by all ***Permittees*** contain requirements to restrict other pollutants found in the wastewater effluent.

The draft general permit supersedes effluent requirements related to total inorganic nitrogen in the individual NPDES permits with the exception of ammonia effluent limitations developed for control of ammonia toxicity.

Dischargers that must apply for coverage under this draft general permit are listed in Table 2, below. Ecology has prioritized permit reissuance schedules in the Northwest and Southwest Regions working towards minimizing the current permit backlog. Updating individual NPDES permits for Permittees proposed for coverage under the PSNGP is a priority for the agency.

Table 2. Proposed PSNGP Permittees

Wastewater Treatment Plant	Individual NPDES Permit Number	Individual Permit Issuance Date
Alderwood STP	WA0020826	11/27/2018
Anacortes WWTP	WA0020257	11/9/2017
Bainbridge Island WWTP	WA0020907	6/29/2017
Birch Bay Sewage Treatment Plant (STP)	WA0029556	1/29/2021
Boston Harbor STP	WA0040291	12/15/2011
Bremerton WWTP	WA0029289	10/30/2018
Chambers Creek WWTP	WA0039624	5/1/2008
Clallam Bay WWTP	WA0024431	11/19/2018
Clallam Bay Corrections Center WWTP	WA0039845	1/25/2017
Coupeville STP	WA0029378	6/19/2019
Eastsound Orcas Village WWTP	WA0030911	12/11/2015
Eastsound Sewer and Water District WWTP	WA0030571	6/29/2016
Edmonds STP	WA0024058	10/24/2014

Wastewater Treatment Plant	Individual NPDES Permit Number	Individual Permit Issuance Date
Everett STP	WA0024490	9/30/2015
Fisherman Bay STP	WA0030589	2/1/2017
Friday Harbor STP	WA0023582	8/21/2017
Gig Harbor WWTP	WA0023957	3/13/2015
Hartstene Pointe STP	WA0038377	12/31/2017
King County Brightwater WWTP	WA0032247	2/26/2018
King County South WWTP	WA0029581	7/1/2015
King County Vashon WWTP	WA0022527	1/16/2017
King County West Point WWTP	WA0029181	12/19/2014
Kitsap County Central Kitsap WWTP	WA0030520	6/29/2017
Kitsap County Kingston WWTP	WA0032077	9/30/2015
Kitsap County Manchester WWTP	WA0023701	1/19/2018
Kitsap County Sewer District #7 Water Reclamation Facility (WRF)	WA0030317	6/24/2016
La Conner STP	WA0022446	2/19/2019
Lake Stevens Sewer District WWTP	WA0020893	10/6/2017
Lakota WWTP	WA0022624	9/17/2018
Langley STP	WA0020702	7/30/2014
Lighthouse Point WRF/Blaine STP	WA0022641	6/25/2019

Wastewater Treatment Plant	Individual NPDES Permit Number	Individual Permit Issuance Date
LOTT Budd Inlet WRF	WA0037061	2/16/2018
Lynnwood STP	WA0024031	2/8/2019
Marysville STP	WA0022497	11/1/2017
McNeil Island Special Commitment Center WWTP	WA0040002	7/1/2016
Midway Sewer District WWTP	WA0020958	11/4/2015
Miller Creek WWTP	WA0022764	10/1/2018
Mt Vernon WWTP	WA0024074	1/31/2017
Mukilteo Water and Wastewater District WWTP	WA0023396	10/31/2018
Oak Harbor STP	WA0020567	4/27/2018
Penn Cove WWTP	WA0029386	12/5/2014
Port Angeles WWTP	WA0023973	1/7/2016
Port Orchard WWTP (South Kitsap WRF)	WA0020346	11/11/2018
Port Townsend STP	WA0037052	11/13/2015
Post Point WWTP (Bellingham STP)	WA0023744	6/19/2014
Redondo WWTP	WA0023451	9/26/2018
Rustlewood WWTP	WA0038075	10/8/2014
Salmon Creek WWTP	WA0022772	6/1/2018
Sekiu WWTP	WA0024449	9/4/2014

Wastewater Treatment Plant	Individual NPDES Permit Number	Individual Permit Issuance Date
Sequim WRF	WA0022349	3/18/2014
Shelton WWTP	WA0023345	3/14/2008
Skagit County Sewer District 2 Big Lake WWTP	WA0030597	1/29/2021
Snohomish WWTP	WA0029548	5/21/2018
Stanwood STP	WA0020290	9/23/2016
Tacoma Central No. 1 WWTP	WA0037087	10/6/2010
Tacoma North No. 3 WWTP	WA0037214	6/4/2009
Tamoshan STP	WA0037290	10/26/2017
WA Parks Larrabee WWTP	WA0023787	10/13/2016

SEPA COMPLIANCE

State law exempts the issuance, reissuance, or modification of a wastewater discharge permit for an existing discharge from the ***State Environmental Policy Act*** (SEPA) process as long as the permit contains conditions that are no less stringent than Federal and State rules and regulations (RCW 43.21C.0383). This exemption applies to the issuance of this general permit and to existing discharges, not to new discharges.

ADDITIONAL SEPA REVIEW FOR PERMITTEES

A modification of permit coverage for physical alterations, modifications, or additions to the wastewater treatment process that are substantially different from the original design and/or expands the existing treatment footprint requires SEPA compliance. Optimization does not require additional SEPA review. Additional SEPA review may be necessary if Ecology determines that the modification is outside of the scope of the initial SEPA evaluation conducted. WAC 197-11-880 allows for exemption from SEPA review for actions that must be undertaken to avoid an imminent threat to public health or safety, to prevent an imminent danger to public or private property, or to prevent an imminent threat of serious environmental degradation.

PERMIT LIMITS

Section 502(11) of the CWA defines "effluent limitation" as *any restriction on the quantity, rate, and concentration of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean, including schedules of compliance*. Effluent limitations are among the permit conditions and limitations prescribed in NPDES permits issued under Section 402(a) of the Act, 33 U.S.C. §1342(a).

Federal and state regulations require that discharges from existing facilities must, at a minimum, meet technology-based effluent limitations reflecting, among other things, the technological capability of Permittees to control pollutants in their discharges that are economically achievable. Specifically, state laws (RCW 90.48.010, 90.52.040 and 90.54.020) require the use of "all known, available and reasonable methods of prevention, control and treatment" (***AKART***).

Water quality-based effluent limits (WQBELs) are required by CWA Section 301(b)(1)(C) and, in Washington State, are based on compliance with the Surface Water Quality Standards (Chapter 173-201A WAC), Ground Water Standards (Chapter 173-200 WAC), Sediment Quality Standards (Chapter 173-204 WAC) or the Federal water quality criteria applicable to Washington (40 CFR Part 135.45). Ecology chooses the more stringent of these two limits (technology or water quality-based) for each of the parameters of concern when drafting NPDES permits. [CWA sections 301(a) and (b)].

Effluent limits in NPDES permits may be expressed as numeric or non-numeric discharge requirements. Under EPA's regulations, non-numeric effluent limits are authorized in lieu of numeric limits, where "[n]umeric effluent limitations are infeasible." [40 CFR 122.44(k)(3).] Courts have recognized that there are circumstances when numeric effluent limits are infeasible and have held that EPA may issue permits with conditions (for example, BMPs) designed to reduce the level of effluent discharges to acceptable levels:

> *Natural Res. Def. Council, Inc. v. EPA, 673 F.2d 400, 403 (D.C. Cir. 1982)* (noting that "*section 502(11)* defines 'effluent limitation' as *'any restriction' on the amounts of pollutants discharged, not just a numerical restriction*"; holding that section of CWA authorizing courts of appeals to review promulgation of "*any effluent limitation or other limitation*" did not confine the court's review to the EPA's establishment of numerical limitations on pollutant discharges, but instead authorized review of other limitations under the definition) (emphasis added).
>
> In *Natural Res. Def. Council, Inc. v. Costle, 568 F.2d 1369 (D.C. Cir. 1977)*, the D.C. Circuit stressed that when numerical effluent limitations are infeasible, EPA may issue permits with conditions designed to reduce the level of effluent discharges to acceptable levels.

TECHNOLOGY-BASED LIMITATIONS

TECHNOLOGY-BASED EFFLUENT LIMITATIONS FOR DOMESTIC WASTEWATER FACILITES

Federal and state regulations define secondary treatment requirements for domestic wastewater treatment plants. These effluent limits are provided in 40 C.F.R. §133 (Federal) and in chapter 173-221 WAC (state).

Secondary treatment requirements are the minimum level of control that must be imposed in a permit for a publicly owned treatment work (POTW)(40 CFR § 125.3(a)). State domestic wastewater discharge standards based on secondary treatment in chapter 173-221 WAC include minimum effluent quality requirements for five-day biochemical oxygen demand (BOD_5), ***total suspended solids*** (TSS), pH and fecal coliform. The state regulation supplements 40 C.F.R. §133 and takes precedence over the federal regulation because it is more stringent in its application.

Since the promulgation of the rule, Ecology's permit writers have applied requirements in Chapter 173-221 WAC to all domestic WWTPs. When developing an NPDES permit, permit writers must consider technology-based limitations and also water-quality based effluent limitations and select the more stringent of the two (40 CFR §122.44(a)(1) and 125.3). Additional water quality based effluent limits (WQBEL) are developed when they are necessary to protect the receiving water.

Municipal Wastewater Discharges and AKART

While Ecology believes that the requirements in Chapter 173-221 WAC do constitute a level of treatment that is reasonable for domestic WWTPs, the concept of Washington's AKART rule for domestic WWTPs has started to evolve. This is primarily due to advancements in treatment technology that are capable of removing some pollutants at a higher level than traditional secondary treatment.

At the same time, DO deficits caused by nutrient pollution in surface waters across the state of Washington have become much more pervasive. While this comes from a combination of point and non-point sources, domestic WWTPs discharging at secondary treatment levels contribute to the nutrient over enrichment. This is because the conventional secondary treatment system design does not substantially remove enough nutrients (e.g., nitrogen and phosphorus) from the effluent to avoid over enrichment of the receiving water.

The prevalence of ***303(d)*** listings related to depleted dissolved oxygen levels from increased levels of nitrogen and phosphorus requires Ecology to reconsider the basis of AKART for domestic WWTPs. It is apparent that the agency must start to consider refining what constitutes AKART for this treatment category. The AKART provision needs evaluation on a case-by-case basis given its direct ties to economic impact. What constitutes AKART at one facility may be different at the next. This is especially true when considering the size differences between WWTPs, available space for expansion at the existing location, costs of

additional treatment processes, the rate payer base and any identified hardship that may exist due to the median household income in the community.

All POTWs proposed for coverage under this general permit currently discharge under the conditions of individual NPDES permits and are, at a minimum, required to meet TBELs as defined in 173-221 WAC. Ecology is not proposing additional TBELs as part of this general permit coverage. However, the proposed permit will require each facility to evaluate AKART for nitrogen removal and to submit a report documenting this evaluation to Ecology. Specific requirements for the analysis can be found later in this fact sheet in the Description of Special Conditions section and in Special Conditions S4.D and S5.D in the draft permit.

Non-Routine Discharges

Municipal wastewater discharges are fairly predictable in nature. This permit does not authorize non-routine or unanticipated discharges. Permittees must follow procedures listed in their individual permit in the event of a non-routine discharge.

SURFACE WATER QUALITY LIMITS

In order to protect existing water quality and preserve the designated ***beneficial uses*** of Washington's surface waters, WAC 173-201A-510 states that waste discharge permits shall be conditioned such that the discharge will not cause a violation of established Surface Water Quality Standards. The Washington State Surface Water Quality Standards (Chapter 173-201A WAC) is a state regulation designed to protect the ***designated uses*** of the surface waters of the state. Surface water quality-based effluent limitations may be based on an individual waste load allocation (WLA), a WLA developed during a basin-wide ***total maximum daily loading*** study (TMDL) or on a WLA developed as part of an ***alternative restoration plan***.

NUMERIC CRITERIA FOR THE PROTECTION OF AQUATIC LIFE

"Numeric" water quality criteria are numerical values set forth in the State of Washington's Water Quality Standards for Surface Waters (Chapter 173-201A WAC). They specify the maximum levels of pollutants allowed in receiving waters to be protective of aquatic life. Numeric criteria set forth in the Water Quality Standards are used along with chemical and physical data for the wastewater and receiving water to derive the effluent limits in a discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limitations, they must be used in a discharge permit.

NUMERIC CRITERIA FOR THE PROTECTION OF HUMAN HEALTH

The EPA has promulgated numeric water quality criteria for the protection of human health that are applicable to Washington State (40 CFR 131.45) in addition to human health criteria listed in Chapter 173-201A WAC. These criteria are designed to protect humans from cancer and other diseases, primarily from fish and shellfish consumption and drinking water from

surface waters. This proposed permit does not contain any numeric effluent limits for the protection of human health. Each POTW's individual NPDES permit contains a facility specific assessment of the facility's potential to violate human health criteria. Any necessary effluent limits for these pollutants are located in the Permittee's individual NPDES permit.

NARRATIVE CRITERIA

In addition to numeric criteria, "narrative" water quality criteria (WAC 173-201A-260) limit toxic, radioactive, or deleterious material concentrations below those which have the potential to adversely affect characteristic water uses, cause acute or chronic toxicity to biota, impair aesthetic values, or adversely affect human health. Narrative criteria protect the specific beneficial uses of all fresh water and marine water in the state of Washington.

ANTIDEGRADATION

The purpose of Washington's ***Antidegradation*** Policy (WAC 173-201A-300-330; 2006) is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.
- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply all known, available, and reasonable methods of prevention, control, and treatment (AKART).
- Apply three Tiers of protection (described below) for surface waters of the state.

Tier I ensures existing and designated uses are maintained and protected and applies to all waters and all sources of pollutions. Tier II ensures that waters of a higher quality than the criteria assigned are not degraded unless such lowering of water quality is necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities. Tier III prevents the degradation of waters formally listed as "outstanding resource waters," and applies to all sources of pollution.

Ecology considered Tier I and Tier II in this permit and determined there are no discharges under this permit to formally designated "outstanding resource waters."

Ecology always considers Tier I when it issues a permit. Applying both technology based permit limits and water quality-based limits to point source discharges meets Tier 1 requirements and the fact sheet describes how this permit meets those requirements.

Tier II requirements for general permits are given in 173-201A-320(6) as follows:

(a) Individual activities covered under these general permits or programs will not require a Tier II analysis.

(b) The department will describe in writing how the general permit or control program meets the antidegradation requirements of this section.

(c) The department recognizes that many water quality protection programs and their associated control technologies are in a continual state of improvement and development. As a result, information regarding the existence, effectiveness, or costs of control practices for reducing pollution and meeting the water quality standards may be incomplete. In these instances, the antidegradation requirements of this section can be considered met for general permits and programs that have a formal process to select, develop, adopt, and refine control practices for protecting water quality and meeting the intent of this section. This adaptive process must:

(i) Ensure that information is developed and used expeditiously to revise permit or program requirements;

(ii) Review and refine management and control programs in cycles not to exceed five years or the period of permit reissuance; and

(iii) Include a plan that describes how information will be obtained and used to ensure full compliance with this chapter. The plan must be developed and documented in advance of permit or program approval under this section.

(7) All authorizations under this section must still comply with the provisions of Tier I (WAC 173-201A-310).

This fact sheet describes how the permit and control program meets the antidegradation requirement. Ecology used a formal process to develop the PSNGP and will do so every five years for reissuance. The process includes selecting, developing, adopting, and refining control practices to protect water quality and meet the intent of WAC 173-201A-320. All NPDES permits, including the PSNGP, are effective for a fixed term not to exceed five years (40 CFR §122.25). Each time Ecology reissues the PSNGP, the agency will evaluate the effluent limits and permit conditions to determine if the revised permit should incorporate additional or more stringent requirements. This evaluation includes a review of new data and input from the public.

CRITICAL CONDITIONS

Surface water quality-based limits are derived for the water body's ***critical condition***, which represents the receiving water and waste discharge condition with the highest potential for adverse impact on the aquatic biota, human health, and existing or characteristic water body uses. The factors include the flow and background level of toxic substances in the receiving water and the flow and concentration of toxic substances in the discharge.

Acute conditions are changes in the physical, chemical, or biological environment which are expected or demonstrated to result in injury or death to an organism as a result of short-term exposure to the substance or detrimental environmental condition.

Chronic conditions are changes in the physical, chemical, or biological environment which are expected or demonstrated to result in injury or death to an organism as a result of repeated or constant exposure over an extended period of time to a substance or detrimental environmental condition.

Ecology has not established a critical condition for the Puget Sound region at this time. Longer residence times occur in Puget Sound during summer months when ***watershed inflows*** subside. This period, which includes longer days and warmer temperatures generally create what Ecology considers a critical season. At present, Ecology is working to determine how to meet standards during all parts of the year everywhere within Puget Sound. The draft Nutrient Reduction Plan will address the definition of a critical condition for the receiving water. Narrative limits will apply for the entire first permit cycle and the critical condition for the receiving water will be considered as part of the second permit iteration.

MIXING ZONES

The Water Quality Standards allow Ecology to authorize ***mixing zones*** around a point of discharge in establishing surface water quality-based effluent limits. Ecology may authorize both "acute" and "chronic" mixing zones for pollutants as long as the discharge does not interfere with the designated uses of the receiving waterbody. The concentration of pollutants at the boundary of these mixing zones may not exceed the numerical criteria for that type of zone. Mixing zones can only be authorized for discharges that meet AKART and in accordance with other mixing zone requirements of WAC 173-201A-400.

The proposed permit does not authorize mixing zones specific to total inorganic nitrogen. Since a general permit must apply to a number of different ***sites***, precise mixing zones and the resultant dilution are not applicable to facilities covered under a general permit.

Mixing zone authorizations in accordance with WAC 173-201A-400 can be found in the POTW's individual NPDES permit.

DESCRIPTION OF THE RECEIVING WATER

The draft general permit applies to POTWs directly discharging to Washington waters of the Salish Sea that cumulatively contribute to impairments within the greater Puget Sound region. Discharges will enter waters assigned designated uses intended to protect aquatic life and human health.

DESIGNATED USES AND SURFACE WATER QUALITY CRITERIA

Sections 173-201A-200 through -260 WAC define the applicable surface water quality criteria for protection of aquatic biota. These criteria were established to protect existing and potential uses of the surface waters of the state. Consideration was also given to both the natural water quality and its limitations. The surface water quality criteria are an important component of the state's Surface Water Quality Standards (Chapter 173-201A WAC).

Washington's marine aquatic life uses are broken into four primary categories created to provide protection for indigenous fish and non-fish aquatic species living in waters of the state. Aquatic life designations in Puget Sound span each of the categories given the complexity of the receiving water and its sensitive ecoregions.

- Extraordinary quality salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning

- Excellent quality salmonid rearing and migration; other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

- Good quality salmonid migration and rearing; other fish migration, rearing and spawning; clam, oyster, and mussel rearing and spawning; crustaceans and other shellfish (crabs, shrimp, crayfish, scallops, etc.) rearing and spawning.

- Fair quality salmonid and other fish migration

Each of these aquatic life designations has associated numeric criteria for temperature, dissolved oxygen, turbidity and pH. This draft permit specifically regulates total inorganic nitrogen due to its impact on DO. See individual NPDES permits and their accompanying fact sheets for discussions regarding how each discharge meets numeric criteria for other parameters.

Table 3, below shows the lowest 1-day minimum DO criteria for each of the marine aquatic life uses as presented in Table 210(1)(d), in Chapter 173-201A WAC. The standards also include a provision to account for natural conditions. "*When a water body's DO is lower than the criteria in Table 210(1)(d) (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the DO of that waterbody to decrease more than 0.2 mg/L* (Chapter 173-201A-210(1)(d)(i) WAC)."

Table 3. Marine Aquatic Life Uses and Corresponding DO Criteria

Designated Use	DO Criteria, 1 day min
Extraordinary Quality	7.0 mg/L
Excellent Quality	6.0 mg/L
Good Quality	5.0 mg/L
Fair Quality	4.0 mg/L

Ecology established marine DO standards at levels that support healthy and robust aquatic species and limit the cumulative impacts of human actions to prevent measurable depletion of DO from the natural condition. This draft permit supports the goals of the overall Puget Sound Nutrient Reduction Project by establishing requirements based on attaining the numeric marine DO criteria and minimizing cumulative human impacts.

Figure 1, shows where numeric water quality standards for DO apply for the Washington Waters of the Salish Sea, including Puget Sound.

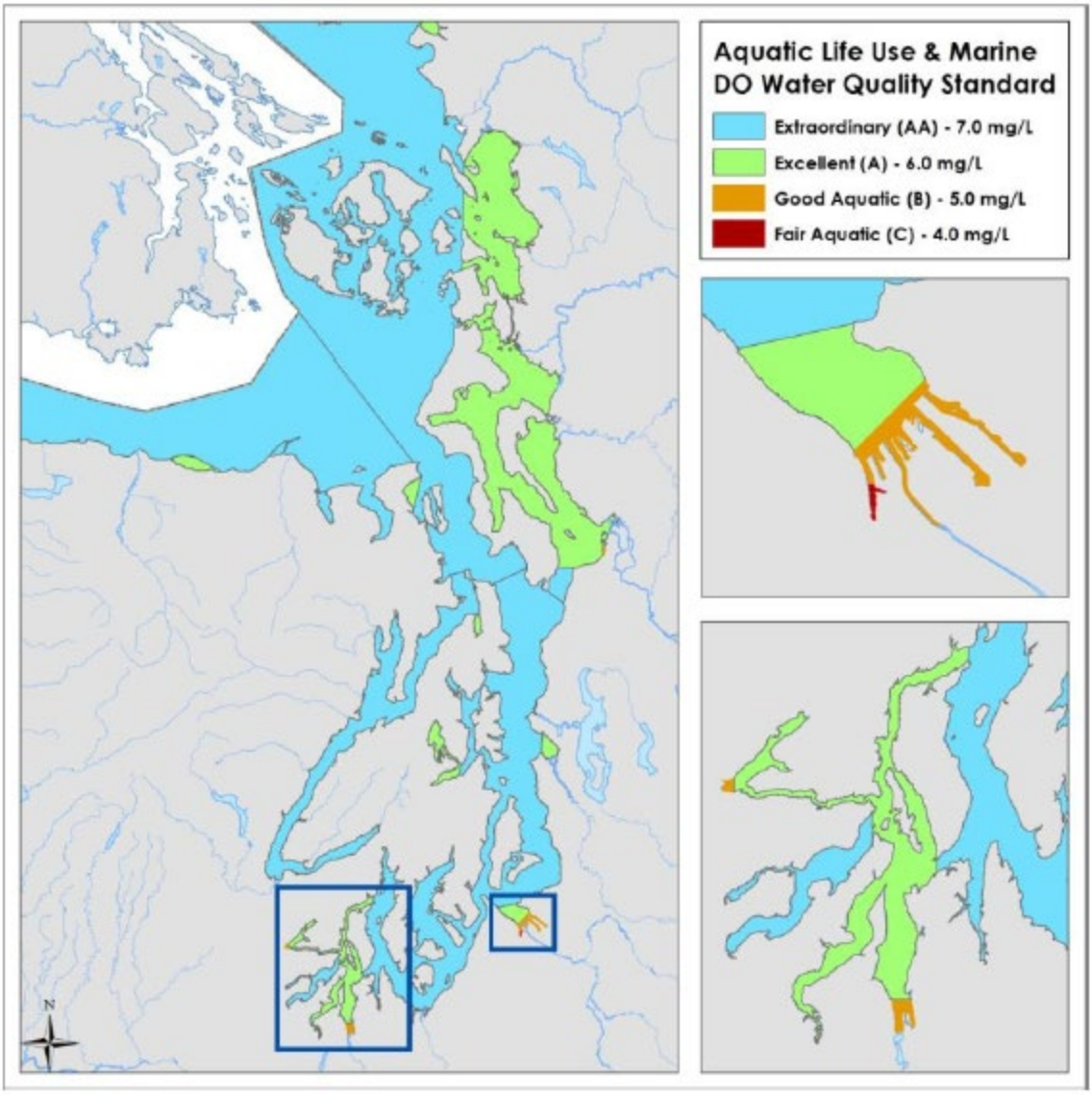

Figure 1. Dissolved Oxygen Standards in Puget Sound

Application of the numeric marine DO surface water quality criteria to a discharge requires site-specific analysis of the discharge and the receiving water. This analysis is part of the modeling work being completed by Ecology and will inform future numeric water quality based permit limits for nutrients that impact DO concentrations. See the Consideration of Narrative Water Quality Based Effluent Limits for Numeric Criteria section of this fact sheet for more information about narrative water quality effluent limits proposed for the first permit cycle.

HISTORY OF DISSOLVED OXYGEN IMPAIRMENTS AND INVESTIGATIONS

The 1996/1998 Water Quality Assessment included the first 303(d) DO listings for portions of Southern Puget Sound based on failure to meet the numeric portion of the DO standard. Following this initial listing, Ecology began to study how nutrients from both point and non-

point sources affected DO in the south sound region (Roberts, et al., 2008). Recent studies led Ecology to determine that anthropogenic (human) sources of nutrients lead to instances of low DO concentrations throughout Puget Sound (Khangaonkar et al., 2018, Pelletier et al., 2017, Ahmed et al., 2014, Roberts et al., 2014, Khangaonkar et al., 2012 b, Albertson et al., 2002) exacerbating those effects in areas that may have naturally occurring lower DO and creating additional conditions (areas or duration) where water quality standards are not met.

Newton and Van Voorhis (2002) documented that nitrogen is a limiting nutrient for Puget Sound. While other nutrients like carbon and phosphorus may drive some algal productivity, the available amount of nitrogen primarily controls the rate of algae and aquatic plant growth. The open ocean boundary will always deliver the highest nitrogen load to the ***Salish Sea***. The additional nitrogen load from human inputs, above the natural background, exacerbates the nutrient over- enrichment and leads to ***eutrophication***.

The Salish Sea's shallow bays and terminal inlets, like Budd Inlet in South Puget Sound, are the most sensitive to eutrophication due to diminished flushing rates when compared to other basins with higher rates of water exchange (Ahmed et al., 2017, Khangaonkar et al., 2012 b, Sutherland et al., 2011). Eutrophication will continue to worsen as the regional population increases if actions to reduce human nutrient sources from domestic wastewater, agricultural runoff and other land-use activities are not taken (Khangaonkar et al., 2019, Roberts et al., 2014). The SSM Year 1 Tech Memo (currently in publication) found that failure to address human nutrient loads from domestic WWTPs will increase both the number of days and the size of areas that do not meet the numeric DO standard in both high and low population estimates for 2040 (Ahmed et al., 2021). Figure 2, shows the percent increase from projected low and high flow estimates based on 2040 population.

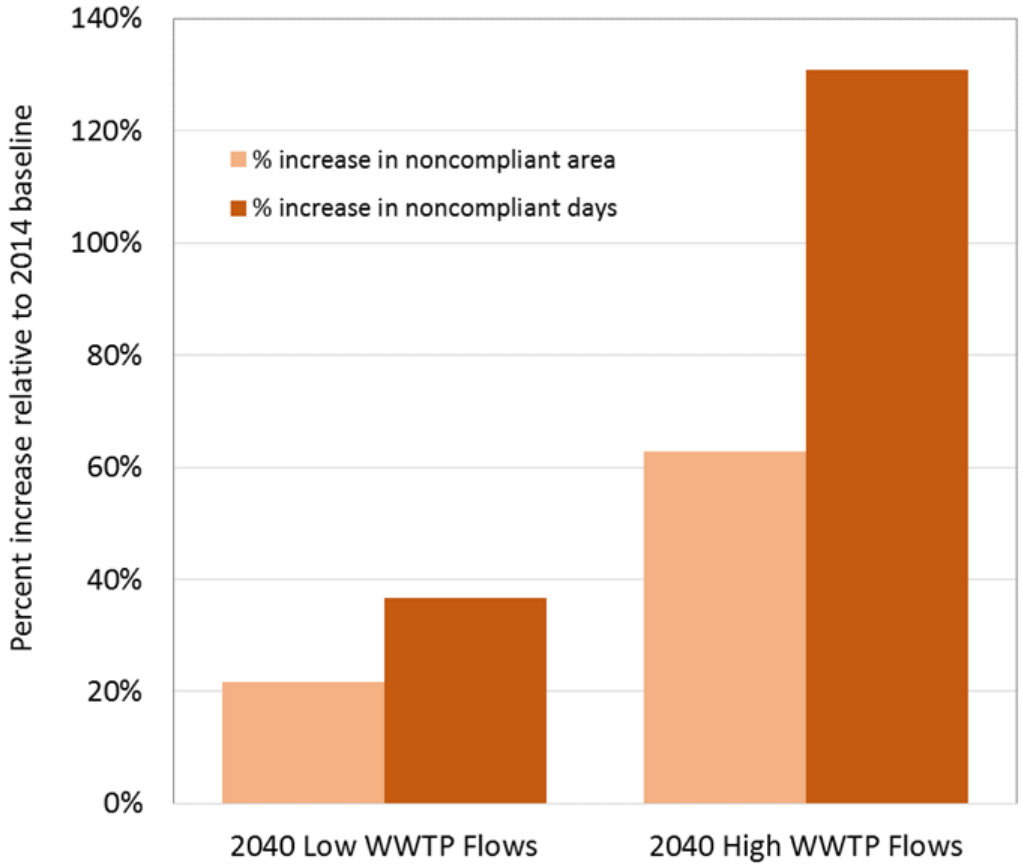

Figure 2. Predicted increase in the DO noncompliant areas and days in Washington Waters of the Salish Sea from projected 2040 low and high WWTP flows.

These projections, on top of the existing DO impairments currently observed in Puget Sound, indicate a trajectory that will disrupt the already fragile ecosystem. After years of working to develop and understand the science, Ecology started the ***Puget Sound Nutrient Source Reduction Project (PSNSRP)*** in 2018. The PSNSRP aims to collaboratively address reducing point and nonpoint sources of nutrients in our region so that the DO water quality criteria and aquatic life designated uses are met by 2040.

The Salish Sea Model (SSM)

As previously discussed, nitrogen is the limiting nutrient driving eutrophication and DO impairment within inlets and embayments in Washington's portion of the Salish Sea. In addition to nitrogen, discharges of organic carbon into marine waters may also directly reduce DO from aerobic bacteria decomposition. Without numeric surface water quality standards for nitrogen or organic carbon, Ecology uses DO as the indicator pollutant to monitor the deleterious effects of excess nitrogen and organic carbon loading in marine waters. Ecology used water quality monitoring data to identify waters on the 303(d) list, but separating the impairment due to

cumulative human nutrient loads requires use of a mechanistic model to determine impacts to marine water quality in a complex system like the Salish Sea.

Originally developed as the Puget Sound Model (PSM), the state of the art ***Salish Sea Model*** (SSM) developed by Pacific Northwest National Labs (PNNL) in collaboration with Ecology has become the computer modeling tool used by Ecology to evaluate the physical, chemical and biological relationships within the Salish Sea. This modeling tool provides Ecology with the ability to predict compliance with marine water quality standards and evaluate nutrient (nitrogen and organic carbon) reduction options for improving and restoring Washington waters of the Salish Sea to meet water quality goals (McCarthy, 2018, Ahmed, et. al, 2019). Over its various development phases, the SSM has endured extensive internal and external peer reviews and constitutes the best available science for regulatory decisions made by Ecology.

On March 9, 2021, Ben Cope (2021) from EPA Region 10 discussed regulatory models with the Puget Sound Nutrient Forum (PSNF) and more specifically, the application of the SSM for regulatory purposes. According to EPA, mechanistic models have a history of being used for regulatory decision making as they provide the scientific basis for quantifying impacts from pollution sources upon source identification. Use of a mechanistic model also allows for the evaluation of different outcomes based on different pollutant reduction alternatives. Models also enable scientists to make predictions of future conditions and system changes such as impacts from increased populations or climate.

A well-developed model is one that has thorough documentation through both development and application. This includes making sure that all data review processes, equations and assumptions are clearly identified. Input data also needs to be comprehensive in nature for all sources being evaluated. Peer review and public review are very important steps when using a model for regulatory purposes. These review processes work to increase transparency about the model's limitations and identify any uncertainty that may result from its application. A summary of the model development and application approach, with its inherent transparency and peer review phases is described below.

During the first phase of model development, Ecology convened a technical advisory committee (TAC) comprised of representatives from interested groups and agencies including NOAA, USGS, EPA, King County, People for Puget Sound, and University of Washington. The TAC participated in a series of events, including a workshop. Appendix A of the first QAPP (2009) for this effort contains details about what was covered on the November 4, 2008 TAC workshop, which, along with recommendations from PNNL, set the direction for the long-term project. In 2010, TAC members offered peer review comments about a November 2009 report which provided details about the first version of the intermediate scale model. In addition, EPA contracted with Tetra Tech as an independent third party to peer review the intermediate scale hydrodynamic version of the model. In 2012, Khangaonkar et al., 2012 a,b published a report and an article in a scientific, peer reviewed journal focused on the water quality calibration of the intermediate scale model. At this point, the project team acknowledged that incorporation of a dynamic

sediment diagenesis module would result in a more robust modeling system. The project team also decided to incorporate prediction capability for carbonate system parameters. In 2014, QAPPs were developed for that purpose, and feedback was solicited from internal and external regional scientists. In 2017, the project team completed incorporation of sediment diagenesis and the carbonate system module (Pelletier et al., 2017, Khangaonkar et al., 2018). Additionally, PNNL began work on expanding the model domain. Altogether, over twenty reports (in some instances externally reviewed as well as internally reviewed) and independently peer reviewed scientific papers have been published that cover all the updates to the modeling system that is now the intermediate scale model SSM that Ecology applies.

Following standard practices and methods, Ecology has traditionally used mechanistic models for TMDL development linking point and non-point nutrient sources to both DO and ***pH*** impacts in receiving waters. Model results form the basis of ***wasteload allocations*** and ***load allocations*** for point and non-point sources in the TMDL which, in turn, inform water quality based effluent limits for point sources. The SSM is a typical regulatory model in that sense and has gone through several development steps since starting out as the PSM. What sets the SSM apart from the other regulatory models used by Ecology is the large scale and complexity of the waterbody lending its name to the tool. Models this size are not typical; however, according to EPA, they have been used in regulatory decision making for other large, complex bodies of water with DO impairments like the Chesapeake Bay. As described above, multiple SSM-related publications have documented the complexities, refinements, predictive skill and assumptions of the SSM and its improvements since its early days as the PSM.

EPA also addressed model uncertainties and acceptance in detail during the presentation to the PSNF (Cope, 2021). All water quality models have inherent levels of uncertainty. While the goal is to strive for a model's output to match observations there will always be some amount of model error. Matching patterns of freshwater input volume, vertical mixing and interbasin mixing is one way to understand the scale of the model error when comparing results to observations. It is important to note that no numeric state or federal guidelines exist for "acceptable" model error. EPA does have general guidelines for what constitutes a quality model for decision making in their *Guidance on the Development, Evaluation, and Application of Environmental Models* (CREM, 2009). Ultimately, the regulatory agency has the authority to determine what constitutes the best available science for decision making purposes. Ecology has determined that the SSM constitutes the best available science for determining the suite of point and non-point source reductions necessary to meet numeric water quality standards for DO. External opportunities to comment on and review the application of the SSM and the overall Puget Sound Nutrient Source Reduction Project occur in a separate process from the development of the draft PSNGP.

Documenting Reasonable Potential

Ecology documented review of the calibration, sensitivity analyses, and precision of the SSM in the Puget Sound Nutrient Source Reduction Project Volume 1: Model Updates and Bounding Scenarios ("Bounding Scenarios"), a report developed by the Environmental Assessment

Program. The goals of the modeling project were 1) to run the SSM with enhancements and updates while checking the calibration of the model and 2) use the calibrated model to run and evaluate the bounding scenarios to inform the overall nutrient reduction strategy for Washington waters of the Salish Sea (Ahmed et al., 2019). At a high level, the Bounding Scenarios report evaluated the regional impacts of cumulative human nutrient sources on DO concentrations both over time and space/area for the 2006, 2008, and 2014 model years, as well as the model predicted changes due to improved treatment at domestic WWTPs.

The results from the Bounding Scenarios report led Ecology to make the ***reasonable potential*** determination for domestic WWTPs discharging directly to the Washington waters of the Salish Sea. Specifically, the following key findings from the Bounding Scenarios report led Ecology to make this determination:

1. The estimated breakdown of the land-based inflows for dissolved inorganic nitrogen (DIN), on an annual basis, is the following: marine domestic point sources (WWTPs) contribute around 30,540 kg/day compared to rivers which contribute around 25,240 kg/day. WWTPs are the dominant land-based dissolved inorganic nitrogen (DIN) source during the low flow (summer) months.
2. Consistent with the findings from Mohamedali, et.al (2011), WWTPs contribute a much larger proportion (92%) of the anthropogenic DIN loads to Washington waters of the Salish Sea during the low flow season.
3. In addition to localized impacts from direct discharges, excess nutrients discharged from these domestic WWTPs in one location cumulatively contribute to DO impairments in other locations due to the water exchange that occurs between basins.

When a permitting authority makes the determination that a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the numeric water quality standards for an individual pollutant, the permit must contain an effluent limit for that parameter (40 CFR § 122.44(d)(1)(iii)). Ecology determined for the first permit control of total inorganic nitrogen is an appropriate first step to address nutrient pollution from domestic WWTPs as inorganic nitrogen (the sum of nitrate-nitrite and ammonia) is the form of nitrogen more available for algal growth driving eutrophication and the existing DO impairments. For purposes of this permit, Ecology will use TIN as a conservative measure of DIN as the SSM did not use a ratio, or other method, to calculate an assumed dissolved component from existing TIN discharge monitoring report (DMR) data. Future permit cycles may include effluent limitations for other nutrient parameters (e.g., carbon) when modeling results show that additional reductions are necessary to meet DO standards in the receiving water.

Modeling work continues with the SSM in order to determine the scale of reductions necessary to meet numeric water quality standards for DO. As of Spring 2021, Year 1 Optimization scenarios are still being analyzed. In addition to the need to offset nutrient loads from population growth mentioned previously in this fact sheet, early results indicate greater need for water quality improvement from annual point source load reductions and also confirm the

need for watershed reductions to attain standards. Ecology will review these results internally prior to sharing results at the PSNF. When the analysis is complete, Year 1 results will help to scope further refinements for the Year 2 optimization scenarios with the PSNF.

Ecology plans to use the Year 2 optimization scenarios to evaluate targets for individual basin load reductions, watershed inflow load reductions and point source wasteload allocations for different basins. These Year 2 scenarios will constitute the basis from which numeric WQBELs will be developed. Ecology will combine both the Year 1 and 2 optimization results into a Volume 2 SSM Report which will go through an external review process. Following that review, Ecology will use the draft Puget Sound Nutrient Reduction Plan (NRP) to assign the applicable allocations, possibly at the basin level. See the Puget Sound Nutrient Reduction Project webpage (https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Helping-Puget-Sound/Reducing-Puget-Sound-nutrients/Puget-Sound-Nutrient-Reduction-Project) for more information and an opportunity to receive updates on the project.

Puget Sound Nutrient Reduction Plan

The 2014 Water Quality Assessment found 136 impaired area 303(d) listings for DO in the Salish Sea and 331 Category 2 listings indicating waters of concern. With at least 10 years dedicated to the technical work and development of water quality models, Ecology has reached the point where the science clearly demonstrates that cumulative point and nonpoint sources deplete DO resulting in nonattainment of standards within Washington waters of the Salish Sea. In a traditional approach, Ecology would develop a formal Total Maximum Daily Load (TMDL) to address the impairments. Instead, Ecology elected to develop the Puget Sound Nutrient Reduction Plan (NRP) to comprehensively address reduction for all human nutrient sources to our valuable receiving water. The benefits of this alternative restoration plan approach include achieving cleaner water more quickly than a traditional TMDL and improved opportunities for stakeholder input throughout the document development.

Participants in the PSNF provided feedback in 2020 on a draft outline of high-level elements that Ecology intends to include in the NRP. Ecology will use the NRP to explain why nutrient reduction is vital to improving water quality and protecting the designated uses detailed in Chapter 173-201A-210 and this fact sheet. In addition to documenting Puget Sound's nitrogen loading capacity and both the point source and watershed inflow nutrient reduction targets, the publication will detail the strategy for addressing watershed point and nonpoint sources to meet watershed nutrient reduction targets. It will also describe the effectiveness monitoring and adaptive management approaches that Ecology will use to iteratively meet these reduction targets and develop a watershed nutrient reduction strategy. The rationale for all regulatory decisions contained in the NRP must also be included.

Ecology will consult the PSNF for feedback and input on parts of the NRP, especially as it pertains to the watershed reduction strategy. Once drafted, the NRP will also go through an extensive public review and comment period. Ecology will also invite Tribal consultation. Visit the Puget Sound Nutrient Reduction Project's Webpage (https://ecology.wa.gov/Water-Shorelines/Puget-Sound/Helping-Puget-Sound/Reducing-Puget-Sound-nutrients/Puget-Sound-

Nutrient-Reduction-Project) for the most up to date information on this plan and other collaborative efforts.

AUTHORITY TO INCLUDE NON-NUMERIC WATER QUALITY-BASED LIMITS

Under EPA's regulations, non-numeric effluent limits are authorized in lieu of numeric limits, where "[n]umeric effluent limitations are infeasible." 40 CFR 122.44(k)(3). As far back as 1977, courts have recognized that there are circumstances when numeric effluent limitations are infeasible and have held that EPA may issue permits with conditions (e.g., Best Management Practices or "BMPs") designed to reduce the level of effluent discharges to acceptable levels. Natural Res. Def. Council, Inc. v. Costle, 568 F.2d 1369 (D.C.Cir.1977).

Through the Agency's NPDES permit regulations, EPA interpreted the CWA to allow BMPs to take the place of numeric effluent limitations under certain circumstances. 40 C.F.R. §122.44(k), entitled "Establishing limitations, standards, and other permit conditions (applicable to State NPDES programs ...)," provides that permits may include BMPs to control or abate the discharge of pollutants when: (1) "[a]uthorized under section 402(p) of the CWA for the control of stormwater discharges"; or (2) "[n]umeric effluent limitations are infeasible." 40 C.F.R. § 122.44(k).

More recently, the U.S. Court of Appeals for the Sixth Circuit also held that the CWA does not require the EPA to set numeric limits where such limits are infeasible. Citizens Coal Council v. United States Environmental Protection Agency, 447 F3d 879, 895-96 (6th Cir. 2006). The Citizens Coal court cited to Waterkeeper Alliance, Inc. v. EPA, 399 F.3d 486, 502 (2d Cir. 2005), stating "site-specific BMPs are effluent limitations under the CWA." "In sum, the EPA's inclusion of numeric and non-numeric limitations in the guideline for the coal remining subcategory was a reasonable exercise of its authority under the CWA."

Additionally, the Sixth Circuit cited to Natural Res. Def. Council, Inc. v. EPA, 673 F.2d 400, 403 (D.C.Cir.1982) noting that "section 502(11) [of the CWA] defines 'effluent limitation' as '*any* restriction' on the amounts of pollutants discharged, not just a numerical restriction."

EPA has substantial discretion to impose non-quantitative permit requirements pursuant to Section 402(a)(1)), especially when the use of numeric limits is infeasible. See *NRDC* v. *EPA,* 822 F.2d 104, 122-24 (D.C. Cir. 1987) and 40 CFR 122.44(k)(3).

RATIONALE FOR NON-NUMERIC WATER QUALITY-BASED EFFLUENT LIMITS

As discussed in this fact sheet Ecology's application of the Salish Sea Model (SSM) has shown that nutrients, particularly inorganic nitrogen, discharged from domestic wastewater treatment plants contribute to low dissolved oxygen concentrations in Puget Sound that do not meet state water quality criteria. As previously stated, the "Bounding Scenarios" report confirmed that circulation within the inner basins of Puget Sound distributes pollutant throughout the waters in the Puget Sound region. The circulation patterns showed how discharges in one basin can

affect the water quality in other basins. Thus, all wastewater discharges to the greater Puget Sound area containing nitrogen cumulatively contribute to existing DO impairments meeting the threshold for reasonable potential under 40 C.F.R. 122.44(d)(1)(iii).

When Ecology establishes reasonable potential for a discharge or group of discharges to violate surface water quality standards, the agency must implement a water quality based effluent limit (WQBEL) for that pollutant. While Ecology has enough information to determine reasonable potential exists, additional modeling work is still necessary to establish numeric WQBELs. Traditional effluent limit calculation tools for point sources are not appropriate in this instance for two reasons. First, these tools are based on limiting toxic pollutants that typically have more acute toxicity than nutrients and criteria with 1-day and 4-day averaging periods (durations). Comparatively, nutrients have much longer averaging periods on the order of weeks to months or longer (EPA, 2004). Second, Washington State uses numeric criteria for DO. The cause of depressed DO requires modeling to determine levels of nutrients that will not cause a violation of the DO criteria as allowed in 40 C.F.R. 122.44(d)(vi)(c). In a receiving water as complex as Puget Sound, the modeling work necessary to develop numeric WQBELs for each discharge is comprehensive and requires extensive internal and external review.

In accordance with 40 C.F.R. 122.44(k)(3), ***best management practices (BMPs)*** are appropriate to control or abate the discharge of pollutants when numeric effluent limits are infeasible. This permit through its requirements for ***optimization*** of current treatment processes to abate nutrient loads through the permit term, the use of an ***action level*** and treatment performance metrics serve as an indicator for optimization success, the requirement for dominant loaders to pursue additional nutrient reduction actions if the action level is exceeded, and early planning constitute a suite of BMPs that meet the intent of the federal regulation for this first permit cycle.

Ecology continues to review model results from the first year of optimization scenarios and scope future model runs through the Puget Sound Nutrient Forum. Additional model runs will be defined in 2021 to further quantify far and near field effects of wastewater discharges to marine waters along with the anthropogenic nutrient loads from Puget Sound watershed. Once Ecology can establish a nutrient loading capacity that meets DO criteria in the marine waters of Puget Sound, allocations that will lead to numeric WQBELs can be established. The NRP will include draft allocations for point sources and watershed inflows. After internal and external review, the allocations will be finalized and numeric WQBELs will no longer be infeasible. It is anticipated that for the second iteration of this permit the approach will shift to working towards compliance with those numeric limits.

CONSIDERATION OF NARRATIVE SURFACE WATER QUALITY-BASED LIMITS FOR NUMERIC CRITERIA

As previously stated, 40 CFR §122.44 requires the permit to contain effluent limits to control all pollutants or pollutant parameters which are, or may be, discharged at a level which will cause, have the reasonable potential to cause, or contribute to an excursion above any water quality standard.

Ecology documented reasonable potential with the determination that domestic wastewater discharges may cause or contribute to a violation of surface water quality standards for dissolved oxygen. Therefore, the draft permit includes BMP based, narrative water quality-based effluent limits to control discharges as necessary to meet applicable water quality standards for DO as allowed under 40 CFR § 122.44(k).

Ecology proposes two sets of narrative limits for two categories of dischargers. Proposed narrative limits for all plants require Permittees to actively reduce their contribution as much as possible during the permit term. However, the group of Permittees that constitute the dominant TIN load into Puget Sound must do more than the Permittees with the smallest TIN loads. Ecology determined that the dominant loads from eligible Permittees constitute approximately 99% of the total domestic point source load discharged to Puget Sound. TIN loads exceeding 100 lbs/day qualify as dominant loads.

All Permittees must monitor their influent and effluent, optimize existing treatment and begin planning for the future. Dominant loaders also have a facility specific action level that represents the current discharge condition and drives corrective actions when the level is exceeded for two consecutive years or three times during the permit term. If the dominant loader triggers the corrective action, they must reduce their effluent load by 10%. If a jurisdiction with a bubbled action level triggers a corrective action, the 10% reduction applies to the bubbled total. Unless the corrective action selected by the Permittee includes a design previously approved by Ecology, qualifying Permittees must submit an abbreviated engineering report or a technical memo signed and stamped by a professional engineer detailing the proposed solution with the Annual Report submittal following the initial action level exceedance.

Ecology proposes to implement a less aggressive approach for the Permittees with the smallest TIN loads given that they collectively represent approximately 1% of the domestic point source anthropogenic load. Ecology calculated average daily TIN loads for Permittees using 2019 DMR data to determine the categorization. This approach differs from what Ecology proposed in the Preliminary Draft. The Preliminary Draft included a more universal approach for all Permittees with no consideration of requirements based on TIN load magnitudes. While the smallest loaders must still work to reduce their effluent TIN loads, the proposed requirements in the draft permit now better reflect their minimal contribution to the existing impairments.

This proposed general permit supplements the individual NDPES permits held by the dischargers proposed for coverage. The individual NPDES permits supply the technology-based and water quality-based effluent limits as well as requirements for controlling other pollutants in the facility's discharge. Ecology anticipates that implementing the optimization requirements in the draft permit and the application of adaptive management through the BMP approach will result in wastewater discharges that minimize cumulative contributions to violations of the state's Surface Water Quality Standards (Chapter 173-201A WAC) during the permit term. Numeric limits remain infeasible because modeling is not yet complete. Therefore, the draft permit includes narrative water quality-based effluent limits (WQBELs) to control discharges as

necessary to meet applicable water quality standards for DO. The provisions of S3 Compliance with Standards, provisions of S4 and S5 Requirements for Permittees (Dominant and Small), S6 Monitoring Schedules and Sampling Requirements, and S7 Discharges to 303(d) or TMDL Water Bodies constitute the narrative WQBELs in the draft permit.

Condition S3. Compliance with Standards

Condition S3 prohibits discharges that cause or contribute to violations of Surface Water Quality Standards (Chapter 173-201A WAC), Sediment Management Standards (Chapter 173-204 WAC), and human health-based criteria in the Federal water quality criteria applicable to Washington (40 CFR §135.45).

Each Permittee must control its discharge as necessary to meet applicable water quality standards. Ecology considers compliance with the narrative conditions in the draft permit (e.g., action levels, optimization, planning, monitoring, and any necessary corrective actions) as adequate control necessary for dischargers to meet applicable water quality standards during the permit term.

The Permittee must take corrective action if they become aware, or if Ecology issues a determination through a notice of non-compliance, that the discharge causes or contributes to a water quality standards exceedance. In addition, Ecology may require additional monitoring at any time during the permit term if information suggests that the discharge lacks the controls necessary to meet applicable water quality standards.

Condition S4. Requirements for WWTPs with Dominant TIN Loads

Authorized Discharges – Discharges conditionally authorized by the permit include wastewater discharges from POTWs constituting greater than 99% of the current domestic point source anthropogenic TIN load to Washington Waters of the Salish Sea.

Domestic Wastewater Discharges constituting the largest TIN loads – The narrative water quality-based limits for domestic wastewater discharges includes a suite of BMPs required over the duration of the permit term. These BMPs include:

- monthly monitoring requirements;
- a numeric action level for total inorganic nitrogen (lbs/year) that require implementation of treatment optimization to stay under the action level;
- an annual Nitrogen Optimization Plan; and,
- early planning through the Nutrient Reduction Evaluation that includes an AKART analysis and evaluating alternatives to meeting 3 mg/L TIN (or the equivalent load) both annually and seasonally.

The suite of BMPs that constitute narrative WQBELs are unique to this permit term. They require the permittee to document and assess the adaptive management procedures used to

reduce nutrients in their effluent. The TIN action level is used in the draft general permit as this is the primary pollutant of concern as identified through investigations into existing DO impairments in the greater Puget Sound area. All domestic wastewater discharges contain inorganic nitrogen with human urine being the primary source.

Condition S5. Requirements for WWTPs with Small TIN Loads

Authorized Discharges – Discharges conditionally authorized by the permit include wastewater discharges from POTWs constituting less than 1% of the current domestic point source anthropogenic TIN load to Washington Waters of the Salish Sea.

Domestic Wastewater Discharges with the Smallest TIN loads– The narrative water quality-based limits for domestic wastewater discharges includes a suite of BMPs required over the duration of the permit term. These BMPs include:

- monthly monitoring requirements;
- treatment optimization requiring submittal of an optimization report; and,
- an AKART analysis specific to nitrogen removal.

The suite of BMPs that constitute narrative WQBELs are unique to this category of discharger during the permit term. They require the permittee to document, quantify, and analyze the adaptive management procedures used to reduce nutrients in their effluent.

Condition S6 Monitoring Schedules and Sampling Requirements

Ecology has included monitoring requirements as part of the narrative water quality based effluent limits for Permittees listed in Conditions S4 and S5. Required influent and effluent monitoring will inform the adaptive management component of the draft permit and support the optimization requirements for all Permittees.

Condition S7 Discharges to 303(d) or TMDL Water Bodies

Ecology cannot allow a new discharge to a listed waterbody (issuance of permit is prohibited) if the discharge will cause or contribute to a violation of water quality standards. Ecology may allow a new discharge if it meets the applicable water quality criteria. The applicable federal regulation is 122.4(i) Sec. 122.4 Prohibitions. *No permit may be issued: i) To a new source or a new discharger, if the discharge from its construction or operation will cause or contribute to the violation of water quality standards.*

The draft PSNGP establishes narrative water quality-based numeric effluent limits for domestic WWTPs as identified in S4 and S5. These limits will also apply to any discharges to certain waters that are listed as impaired under Section 303(d) of the Clean Water Act. Numeric effluent limits will replace these narrative effluent limits after establishing a facility specific compliance period once Ecology completes the alternative restoration plan (e.g., Nutrient Reduction Plan) or EPA approves a TMDL.

All references and permit requirements associated with Section 303(d) of the Clean Water Act pertain to the most current EPA-approved 303(d) listing of impaired waters that exists when a complete application for coverage is submitted to Ecology. Ecology has determined that domestic WWTPs have the potential to cause or contribute to violations of water quality standards in waterbodies that are 303(d) listed for DO, and must comply with the narrative effluent limit(s) in S4 and S5 of the permit.

SEDIMENT QUALITY

Ecology has promulgated Sediment Management Standards (Chapter 173-204 WAC) to protect aquatic biota and human health. These standards state that Ecology may require Permittees to evaluate the potential for the discharge to cause a violation of applicable standards (WAC 173-204-400). The permit requires adaptive management to limit discharge of total inorganic nitrogen. This general permit contains no requirements for protecting sediment quality. Impacts to sediments are assessed during the development of the individual permits currently held by all POTWs proposed for coverage under this general permit. Specific facility requirements for meeting sediment management standards can be found in the POTW's individual NPDES permit.

GROUND WATER QUALITY LIMITATIONS

Ecology has promulgated Ground Water Quality Standards (Chapter 173-200 WAC) to protect beneficial uses of ground water. Permits issued by Ecology prohibit violations of those standards (WAC 173-200-100). This permit does not authorize any discharges to groundwater.

ANTI-BACKSLIDING

NPDES permits may not be reissued, renewed, or modified with less stringent limitations or conditions than those defined in a previous permits unless the changes comply with anti-backsliding requirements in 40 CFR 122.44(l)(1-2). Technology based effluent limits, water quality based effluent limits, and applications of best professional judgement are subject to anti-backsliding provisions.

DESCRIPTION OF SPECIAL CONDITIONS

This section follows the structure of the draft Puget Sound Nutrient General Permit (PSNGP), but does not restate language used in the permit. The information presented below is intended to help the public understand the intent and basis of the draft permit.

S1. PERMIT COVERAGE

A. Coverage Area and Eligible Discharges. The PSNGP is a regional permit. It provides permit coverage for discharges of domestic wastewater from publicly owned treatment works (POTWs) known to contain inorganic nitrogen within Washington's waters of the Salish Sea, excluding federal land, tribal land and certain tribal waters.

A definition of "Permittee" is not provided in chapter 90.48 RCW, 173-220, or 173-226 WAC, nor is one provided in 40 CFR 122 (EPA NPDES Permit Program) or State NPDES Permit Programs. Based upon the usage of Permittee in federal and Washington State law, Ecology takes the term "Permittee" to mean the person or entity that discharges or controls the discharge of pollutants to waters of the state and holds permit coverage allowing that specific discharge. For the Puget Sound Nutrient General Permit, Ecology is clarifying that the permit may be held by Washington State municipalities who currently hold an individual NPDES permit and are represented as a discrete, domestic point source in the Salish Sea Model (SSM).

This PSNGP identifies the municipal POTWs that must seek permit coverage. "POTW" is defined as a sewage treatment plant that is owned and usually operated by a local government agency designed to treat domestic sewage.

This PSNGP addresses discharges from POTWs into Puget Sound's marine and estuarine waters that are known to contain inorganic nitrogen. Permittees are divided into two categories. While the type of discharge is the same amongst the domestic dischargers, the current TIN loads vary widely. This permit mandates more stringent requirements for the dominant loaders (those constituting 99% of the current domestic point source TIN load) due to their contribution to the existing nitrogen over enrichment. Smaller plants, those that discharge less than 1% of the TIN load must also work towards reducing nitrogen in their discharge; however, requirements for these facilities take into account the scale of their contribution. Categories for domestic WWTPs that must apply for coverage under the draft permit are identified using (D) and (S) for dominant and small TIN loads in draft permit section S1.A, Table 3. Ecology determined these categories by ranking cumulative average daily TIN loads for each of the 58 WWTPs using 2019 DMR data. See Appendix D in this fact sheet for the cumulative ranking results.

B. Limits on Coverage. This section identifies the types of discharges that are not authorized by the permit. These include discharges from:

1. WWTPs that are federally owned or operated, or located on tribal land, or discharge to tribal waters with EPA approved water quality standards.

2. Privately owned WWTPs currently permitted by Ecology with an individual NPDES permit.

3. POTWs located in tributary watersheds feeding Puget Sound

4. Industrial WWTPs discharging to Puget Sound.

Ecology does not have authority to write NPDES permits for federal and tribal facilities. EPA is the responsible permitting authority for these plants in Washington State. Conditions for nutrient controls will be implemented for these facilities through the 401 Water Quality Certification process.

In 2000, Ecology modified the Washington Administrative Code that provides terms and conditions for NPDES permits, Chapter 173-220-150(4). This rule change requires permits for domestic wastewater facilities be issued only to public entities after the modification date. Private facilities excluded from coverage under the PSNGP all have individual NPDES permits issued prior to the rule change. These plants must incorporate into a public entity such as a sewer district in the event of a treatment process change or expansion. Because Ecology does not issue new NPDES permits to private entities any longer, these private plants are excluded from coverage under the PSNGP. Nutrient controls will be implemented at the time of individual permit reissuance for these private treatment plants. Ecology has developed a permit issuance schedule for these plants prioritizing those that discharge to more sensitive ecoregions of Puget Sound.

Twenty-six (26) POTWs discharge to rivers that feed into Puget Sound at locations currently outside of the SSM grid. Ecology accounts for the nutrients from these plants as part of the aggregated watershed loads in the model. Determining the impact of these discharges on Puget Sound dissolved oxygen requires additional modeling tools. Ecology plans to develop these additional watershed modeling tools during the first PSNGP five year term. Coverage may expand to include these facilities during the second permit term. Some of these POTWs have wasteload allocations for nutrients based on DO TMDLs in their respective watersheds. Any future general permit coverage would take into account these EPA approved wasteload allocations.

Ecology must limit coverage general permit to a similar category of discharges. Industrial treatment plant discharges have a different characterization than domestic sewage. They primarily discharge carbon, not nitrogen. Ecology plans to implement nutrient controls for industrial treatment plants through the individual permitting process.

Ecology has not included a termination condition in the draft permit because each Permittee currently has an active individual NPDES permit. Termination of coverage under the draft general permit can only occur if the Permittee removes all discharges from Washington waters of the Salish Sea by redirecting treated effluent to ground (as authorized under a State Waste Discharge Permit) or any other means subject to Ecology's approval.

S2. APPLICATION FOR COVERAGE

A. Obtaining Permit Coverage. In accordance with WAC 173-226-200, each eligible POTW must submit a complete permit application to obtain coverage under the Puget Sound Nutrient

General Permit. Applicants must submit the Notice of Intent (NOI) no later than 90 days after the issuance date of the general permit.

B. How to Apply for Permit Coverage. Each Permittee must submit an electronic NOI through the Water Quality Permitting Portal unless the Permittee has an electronic reporting waiver.

Applicants must satisfy the public notice requirements of WAC 173-226-130(5). This permit applies to existing facilities, only. Therefore, no public notice is required for coverage under this permit.

C. When Permit Coverage is Effective. Ecology will respond to the permit applicant in writing. If the NOI is incomplete or more information is needed Ecology will notify the applicant in writing and identify the issues that must be resolved before a decision on permit coverage can be reached.

If Ecology approves the application, permit coverage in an ***active status*** under the general permit will begin on the date specified in the permit coverage letter.

D. Modification of Permit Coverage. If the Permittee requests a modification in coverage a completed Modification of Coverage form must be submitted to Ecology at least 60 days prior to the needed modification. Examples of when a Permittee needs a coverage modification include any adjustments to an action level or a reduction in monitoring. Changes to treatment processes resulting from optimization do not require a modification of permit coverage. Treatment alterations resulting from a corrective action or facility upgrade may require coverage modification if treatment processes are substantially altered. Ecology will evaluate coverage modifications for these situations on a case-by-case basis. Public notice requirements under WAC 173-226-130(5) must be completed as part of this modification request. SEPA may be required if the modification requested is related to a major process upgrade.

S3. COMPLIANCE WITH STANDARDS

Condition S3 of the permit is covered in this fact sheet under Consideration of Surface Water Quality-Based Limits for Numeric Criteria, above.

S4. REQUIREMENTS FOR WWTPS WITH DOMINANT TIN LOADS

The discharge limits in S4 are described above in *Rationale for Narrative Water Quality-Based Effluent Limitations* and *Consideration of Narrative Water Quality-Based Limits for Numeric Criteria.*

ACTION LEVEL CALCULATION

This draft permit proposes a total inorganic nitrogen action level for each of the permittees listed in Condition S4, which constitute 99% of the current domestic point source anthropogenic load. The action level, AL_0, forms the baseline value representing current TIN

loading and drives treatment optimization requirements. Ecology developed a calculation tool for AL_o that uses a non-parametric method called "bootstrapping" to calculate the annual load from facility data that represents a load that would only have a 1% chance of exceeding if the loads are consistent with existing loading. Bootstrapping is a statistical test that uses random sampling with replacement meant to mimic the sampling process ("Bootstrapping(statistics)," 2021). As opposed to parametric methods that make assumptions about an underlying distribution of a data set to determine future observations, the bootstrapping method assumes the original data set represents possible future observations in the absence of changing conditions.

Confidence intervals for simulated means using the bootstrapping method can be derived by first randomly selecting values from the original observation data (with each selected value being returned to the original set for potential reselection) in order to create a new "bootstrapped" sample of observations. The mean of each resampled data set is then determined and those means create a probability distribution. Ecology calculated AL_o using the 99% upper confidence level (UCL) from the probability distribution of means. Members of the Environmental Caucus expressed a desire for Ecology to use the 95% UCL from the same probability distribution of means for the AL_o calculation. However, use of the 95% UCL actually results in a 23% chance of at least one exceedance over the permit term. The 99% UCL more accurately represents the discharge condition at each of the qualifying facilities and is sufficient to drive meaningful nutrient reduction progress during the permit term. While Ecology is confident that this 99% UCL bootstrapping calculation represents a 1% chance of exceedance for a given year, it does not take into account inter-annual variability related to cool and wet weather. For this reason, permittees must exceed the action level two consecutive years before triggering the corrective action requirement discussed below. Permittees with a "bubbled" action level will trigger the corrective action requirement when the cumulative annual loads for all applicable plants exceeds the value in draft Condition S4.A. Bubbled action levels sum the individual action levels for each WWTP owned and operated by the same ***jurisdiction***. Ecology will evaluate the combined, reported annual TIN loads for each WWTP included in the bubbled action level at the end of each 12 month monitoring period. If the loading from the applicable WWTPs exceeds the bubbled action level, the corrective action requirement applies.

Ecology strived to accurately represent existing discharges with the action level calculation. Where possible Ecology used at least 3 years of data (36 data points) in the AL_0 calculation. More data was used if it was available and representative. TIN loads were calculated using day of flow measurements paired with single sample ammonia and nitrate/nitrite concentrations. Where ammonia and nitrate/nitrite were not measured on the same day, the missing concentration was extrapolated from the most representative measurement. Periodic samples are assumed to represent the month or quarter in which a sample was taken. If there are multiple samples in a period, new data replaces old as best representation for subsequent days in the period. Most Permittees had monthly data available for these individual load calculations. Some Permittees had only quarterly data which required extrapolation to better represent the variability. The representative concentration was paired with the first flow

measurement in the months not sampled to estimate load variation over the course of the quarter.

Ecology verified whether enough data for each facility exists to make a reasonable representation of the unmeasured data by using the shape of the cumulative distribution functions (CDF) as a check. The CDF plot for bootstrapped averages appears as a smooth line if the observations cover the full range of possible results. Bumpy curves or steep slopes in the CDF indicate an insufficient amount of data or data that does not accurately represent the discharge condition. All facilities listed in S4 had a sufficient amount of DMR data for the action level calculation except for Blaine's Lighthouse Point WRF. This facility specific action level is based on a shorter period than other facilities due to COVID related closures which impacted the availability of representative data. See Appendix E for calculation information related to the data range used for each S4 permittee's AL_o.

This action level calculation serves as Ecology's best representation of each Permittee's existing discharge condition given the DMR data available. Sampling requirements in Condition S6 will increase the sampling density for all Permittees. In some cases, this increased sampling density may result in a better effluent characterization which could impact the estimate of existing loads. Permittees may request an action level reassessment after completing one year of sampling. In order for Ecology to accept this request to reassess the action level, Permittees must show that the overall loading to the facility has not increased by providing an influent BOD_5 load comparison. Ecology cannot reassess the action level if influent loads increased during the first year of the draft general permit. Any recalculated action levels would be implemented through a permit coverage modification (see draft Condition S2.D for more details about the coverage modification).

DRAFT CONDITION S4.C NITROGEN OPTIMIZATION PLAN

The draft permit requires optimization of existing treatment processes as a best management practice (BMP) to stay below the facility specific nutrient action level and to reduce nitrogen to the greatest extent possible during the permit term. Optimization, as required by this permit, is the suite of activities or a single activity that result in improved nitrogen removal at an existing treatment plant, regardless of the treatment type. It does not include activities that result in costly upgrades or large capital infrastructure improvements. Optimization serves as the mechanism to bridge the period between this first permit issuance and compliance with final, numeric WQBELs, which Ecology will calculate after completing the modeling to support the NRP.

For the largest loaders, submittal of the annual Nitrogen Optimization Plan (NOP) via the Annual Report requirement constitutes a portion of the narrative WQBEL for this 5 year permit term as it represents an adaptively managed BMP. All Permittees specified in Special Condition S4 must develop, implement, and maintain a NOP for purposes of maximizing removal of nitrogen. The NOP must be submitted to Ecology via the Annual Report requirement.

Permittees must begin to identify optimization strategies starting upon the effective date of the PSNGP, following receipt of the coverage letter from Ecology with implementation occurring as soon as possible during permit year 1. In the Annual Report, Permittees must document optimization opportunities at their WWTP, implementation process, the success of the implemented strategy compared to expected performance, any necessary refinements to improve performance, and the application of adaptive management. Permittees must use monitoring data collected under this permit in addition to process modeling to quantify and evaluate results. A number of different optimization strategies exist and Ecology understands implementation opportunities will vary across all POTWs that must seek coverage under the propose permit. Ecology expects that the year round quantifiable BMP requirement to optimize treatment will assist Permittees listed in S4 in keeping annual TIN effluent loads as low as possible.

Optimization Approaches

The preliminary draft permit released by Ecology in January 2021 contained different tiers of actions for optimizing biological treatment to remove nitrogen. This permit does not differentiate between the tiers of optimization requirements leaving the Permittee to determine what strategies are best suited for reducing nitrogen with the existing treatment process. The following categories of optimization strategies are meant to help be a guide for Permittees to improve biological nitrogen removal but in no way are they exhaustive. Permittees can implement optimization strategies not listed in this fact sheet provided they document the selection process in the Annual Report. As previously stated, optimization should not result in major capital improvements at each Permittee's WWTP (although, some implementation costs are expected).

Permittees may exclude optimization strategies that exceed a reasonable implementation cost or timeframe. Any impacts resulting in exclusion must be documented in the Annual Report per condition S4.C.1.b. Ecology attempted to collect feedback on what Permittees would evaluate when making decisions about applicable optimization approaches and their financial impact during the preliminary draft stage. No clear response emerged from the comments received on that permit draft. If excluding a viable optimization strategy due to financial reasons, Permittees must provide the anticipated implementation cost and describe the justification for why they cannot cover and/or absorb that cost. Justifications may include immediate impacts to operational, equipment or capital budgets and an explanation of why the jurisdiction cannot make accommodations to cover these costs through future budgeting adjustments. When excluding a strategy due to the implementation timeframe, include documentation that how long procurement and installation will take to occur and any other pertinent information.

EPA's *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants* (2015) is a resource recommended for optimizing activated sludge plants. The following optimization strategies reflect the document's suggestions for

improving nitrogen removal at WWTPs. Plants that do not use an activated sludge process are encouraged to focus more on influent load reductions and effluent management alternatives.

Process Control Modifications

Process control optimization strategies include the various operational approaches used to control the treatment process and respond to changing operational conditions. Many different factors can affect process performance. Permittees shall consider modifications to the solids retention time, mixed liquor suspended solids concentrations and F/M ratios. Improved flow equalization, changes to internal recycle rates, side stream return flow controls, online analyzers (e.g., oxidation reduction potential, DO, etc.), improved process control monitoring, primary sludge fermentation, and sequencing batch reactor cycle modifications are all examples of process control optimization actions. Septage receiving and handling modifications can also be implemented to help regulate influent loads at the WWTP Many of these process control changes can be made using existing infrastructure helping to keep implementation costs low.

Aeration Modifications

Removing nitrogen biologically requires maintaining specific biological populations that have variable needs for oxic (nitrification) and anoxic (denitrification) conditions. Modification of aeration controls through diffuser improvement, DO probe settings, blower motor variable frequency drive settings, and improved air valve actuation settings are examples of optimization through aeration modifications. Mixer modifications to prevent entraining oxygen in an anoxic zone are another example of this optimization strategy.

Configuration Changes

Altering the way wastewater flows through the treatment plant is a physical way to alter a process configuration, which has the potential to reduce nitrogen. These can include adding baffles for creation of anoxic zones, step feeding influent to encourage consistent F/M ratios, additional recycle piping, use of gates or channel changes, or plug flow conversions to create aerobic and anoxic zones. These can be similar to process control modifications; however, configuration changes can be costly and generally require investment in some new infrastructure or equipment. Therefore, Ecology recommends investigation of configuration changes only if the POTW can implement the optimization strategy with existing infrastructure and minimal procurement of equipment.

Chemical Addition

Chemical addition may be necessary to help drive biological nitrification and denitrification. Alkalinity and carbon are the two parameters that can improve a treatment plant's ability remove nitrogen. Alkalinity feeds can help improve nitrification if background alkalinity concentrations are low and unable to maintain the pH range necessary for biological nitrification. Supplemental carbon may be necessary to drive denitrification if there is an

insufficient carbon source from influent soluble BOD. Chemical feed systems to regulate delivery of supplemental alkalinity or carbon will require an investment from the Permittee as will the purchase of the chemicals themselves. Ecology recommends chemical addition as an optimization strategy only after working to improve other treatment process performance through control and configuration strategies. This strategy is also most applicable to POTWs originally designed for nitrification/denitrification where operators cannot achieve adequate treatment efficiency.

Effluent Management

Changes in effluent management to reduce nitrogen loads to the water environment can occur several different ways. Primarily, this approach redirects effluent from reaching surface water through increasing the volume of reclaimed water produced (if previously permitted for reclaimed water production), discharge to a polishing wetland, or other alternate disposal methods where the effluent can be discharged to ground. Groundwater Quality Standards in Chapter 173-216 WAC include criteria for total nitrogen (TN) at 10 mg/L. Most Permittees subject to draft permit condition S4 discharge well above 10 mg/L TN. This criteria may preclude use of discharge to ground as an optimization strategy; however, it shall be considered as part of the Nutrient Reduction Evaluation. Ecology recommends effluent management strategies apply to Permittees that already produce reclaimed water or have approved alternate disposal methods due to the complexity and implementation costs that accompany this approach.

Nitrogen Optimization Report Requirements

Ecology understands that there may be many different approaches to optimization and does not want Permittees to focus reporting on daily process microadjustments. Rather, the Annual Report documenting optimization must focus on the one or two primary strategies implemented at the treatment plant over the 12 month reporting period. The adaptive management process begins with the requirement to conduct an existing treatment performance assessment after permit coverage notification. Submittal of the electronic Annual Report (Special Condition S9) through the WQWebPortal satisfies the Nitrogen Optimization Plan requirement. See Appendix C in the draft permit for Annual Report Questions that document optimization for dominant loaders.

Draft Condition S4.C.1 Treatment Process Performance Assessment

First, Permittees must conduct a process evaluation to establish current treatment performance and the existing TIN removal rates. This process evaluation may be conducted through process modeling or an equivalent analysis. This initial assessment is required to help Permittees evaluate viable optimization approaches at the WWTP prior to implementation. Initially, each Permittee must also develop an optimization goal and determine the three most viable optimization strategies capable of achieving the goal. The goal may simply be to stay under the action level. Other goal examples include meeting a specific TIN concentration target

or improving treatment process efficiencies. After initial selection, Permittees must maintain a prioritized list of optimization strategies at all times and update that list as part of the Annual Report requirement.

Prior to implementing the preferred optimization strategy, Permittees must develop an anticipated performance metric. Ecology suggests using % removal for this performance metric; however, Permittees may propose a different criteria and detail the approach in the Annual Report. The performance metric must provide the Permittee with the ability to compare expected vs. actual treatment improvement from optimization.

Draft Condition S4.C.2 Optimization Implementation

Permittees must also document how they implemented the preferred optimization strategy including costs, the time required for full implementation, the start date of the preferred strategy, unanticipated challenges, and impacts to the overall treatment performance as a result of any process changes.

Permittees will document the annual average TIN concentrations and loads from the reporting period in the Annual Report in addition to the TIN removal rate observed (or other performance metric if identified by the Permittee). The observed results must be compared to the performance metric developed in condition S4.C.1.c. These results inform the adaptive management required at the WWTP. While permit required monitoring must be used to track optimization progress, Permittees may need to use internal process control sampling locations in addition to influent and effluent monitoring. Laboratory accreditation is not required for process control monitoring and should not be reported on DMRs.

The facility specific action level represents the current discharge condition at each of the treatment plants. Ecology intends for the implemented optimization strategies to help each Permittee stay below their facility specific action level. This prevents additional nitrogen loading into Puget Sound during the period while Ecology completes modeling necessary to determine numeric WQBELs. Permittees can maintain the optimization strategy implemented provided they met the self-identified performance metric and stayed below the action level. Adaptive management is required if Permittee stayed below the action level but did not meet the performance metric. In this case, the Permittee can refine the implementation of the selected alternative or, they can elect to pursue a different optimization strategy for the next 12-month period. Exceeding the facility specific action level requires the Permittee to execute a corrective action to reduce the effluent nutrient load per S4.D.

Draft Condition S4.C.3 Influent Nitrogen Reduction Measures/Source Control

In addition to identifying opportunities to reduce effluent TIN loads through optimization, Permittees must also develop a program to reduce influent TIN loads. Permittees must review non-residential sources of nitrogen, septage handling practices (if applicable) and any opportunities for pre-treatment. Elimination of RV and boat pump out services are not applicable to this condition. However, Permittees may investigate changes to wastestream

management practices related to RV and boat pump out services. Given that the primary source of nitrogen in domestic wastewater is from urine, influent reduction opportunities may be limited. Therefore, in addition to reviewing pre-treatment opportunities, Permittees must also begin to identify different approaches for reducing TIN from new dense residential development and commercial buildings.

Draft Condition S4.D Action Level Exceedance Corrective Actions

The existing ***303(d)*** listings for DO throughout Puget Sound requires Ecology to prevent additional pollutant loadings that create the impairment. An action level compliance assessment occurs at every 12-month interval following the permit effective date. Ecology will use the monitoring data required under this permit and submitted via WQWebDMR to determine whether the Permittee exceeded the action level over the previous 12-month period. Permittees must also document action level exceedances in their Annual Report. Following documentation of the first exceedance, Permittees must begin to develop a strategy for reducing their effluent load by 10%. The most recent documented annual average load must be the basis for the 10% reduction. This level of reduction is consistent with the need to offset increased loads due to population growth while Ecology works to determine final effluent limits for the regional permittees. For Permittees with "bubbled" action levels, Ecology will evaluate exceedances using the cumulative TIN load totals from each WWTP owned and operated by the Permittee. If a corrective action is triggered for a jurisdiction with a bubbled action level, the Permittee must apply the 10% reduction to the bubbled total.

Strategies considered for reducing loading must include increasing production volumes of reclaimed water (if applicable to the facility), implementing side stream treatment for a portion of return flows from solids treatment, reducing influent nitrogen loads, alternative effluent disposal options and any other intermediate treatment alternative which results in decreased nitrogen loads into Puget Sound prior to major facility upgrades. Water quality offsets under Chapter WAC 173-201A-450 cannot be used for this purpose as final, numeric WQBELs have not been established.

The proposed approach to reduce effluent loads will be due in conjunction with the next annual report, 12 months after self-reporting the first action level exceedance. Permittees must submit a proposal to reduce the TIN load that addresses how to meet this 10% reduction requirement within the 1st and 2nd permit cycles (5-10 years). This proposal may need meet requirements for an engineering report (Chapter 173-240-040 WAC). An engineering report would be required for side stream treatment design and other major treatment process additions. An engineering report is not required for solutions that have been previously approved by Ecology but not yet constructed, influent load reduction, increased reclaimed water production (for a previously identified beneficial use), or other alternatives that do not result in a major process addition or change.

A second, consecutive action level exceedance requires the Permittee to immediately begin implementation of the proposal to reduce effluent loading by 10% upon Ecology's approval. The two consecutive year exceedance requirement results from acknowledgement that the

action level calculation does not include a provision to account for inter annual weather variability. When a second exceedance falls in the last year of the permit, the Permittee must still implement the preferred alternative as this requirement will bridge the period between this first permit cycle and the end of a compliance schedule for meeting final WQBELs, once established. An update to the WWTP's Operation and Maintenance manual must be provided to Ecology no later than 30 days after implementation so that facility records are kept current. Non-consecutive exceedances do not require immediate corrective action. Rather, Permittees must submit the plan for reduction by the date specified in S4.D and then implemented following a third action level exceedance during the permit term.

An action level exceedance does not constitute a permit violation provided the Permittee follows through with the corrective action requirements and satisfies the other narrative effluent limits listed in Special Condition S4.A in the draft permit, including the Annual Report requirement documenting optimization.

Annual Reporting

Ecology has developed an electronic annual report to standardize the optimization reporting requirements for Permittees. The Annual Report submittal will describe the well-documented approach the Permittee used to select and evaluate the effectiveness of the optimization strategy including a comparison of actual vs. anticipated results and the adaptive management necessary to stay below the WWTP's action level. Questions for Permittees can be found in Appendix C of the permit. Ecology encourages Permittees to begin the Annual Report several weeks ahead of the March 31st submittal date to allow plenty of time for adequate completion.

Draft Condition S4.E Nutrient Reduction Evaluation

Ecology considers planning for meeting future water quality based effluent limitations to be a BMP and part of the narrative effluent limit for this permit cycle. Compliance with this narrative limit requires submittal of the Nutrient Reduction Evaluation (NRE) by the date listed in the draft permit. LOTT does not need to complete the NRE requirement described in Condition S4.E. This treatment plant already has an effluent limit below 3 mg/L TIN in their individual NPDES permit for TIN during the critical season of April through October. In addition, the Budd Inlet TMDL, scheduled for completion in early 2022, will require compliance with the individual facility wasteload allocation upon EPA approval. No additional planning for LOTT WWTP is required at this time.

The treatment infrastructure improvements necessary to achieve final effluent limits capable of protecting water quality will require a stepwise process over several 5 year permit cycles. This is due to the time required for alternative selection, engineering design, and construction of new treatment processes in addition to financial planning. Completion of a planning exercise during this first permit term is necessary to minimize the time required to ultimately achieve final numeric effluent limits once developed.

Ecology intends to provide flexibility and incentives to address nutrients comprehensively on a watershed scale. Water quality trading as allowed under Chapter 173-201A-450 WAC will likely be part of the final solution upon establishment of numeric WQBELs for each Permittee. The NRE may include a water quality offset framework as part of the required alternatives analysis. However, Ecology must approve any formal water quality-trading framework in consultation with Tribes who have an interest in its development.

As proposed with the January 2021 preliminary draft, the NRE must consider different final treatment concentration targets for TIN. Ecology expects final numeric effluent limits for domestic WWTPs in the region to be a mix of technology and water quality based limits. Therefore, all plants subject to permit condition S4 must consider two treatment thresholds in the NRE. Unlike the preliminary draft, Ecology is not providing the upper level effluent limitation for this analysis. Permittees must determine the upper limit, analogous to a technology based effluent limitation, through the identification of AKART for nitrogen removal at their WWTP. Permittees must also assess treatment alternatives capable of meeting 3 mg/L TIN (or the equivalent load) on average, annually and seasonally, which represent possible future water quality based-effluent limits.

This planning document also requires an assessment of current treatment technology including site specific flows, loads, and population growth projections within the sewer service area for a 20 year planning period. Site-specific constraints and other treatment implementation challenges must be part of the analysis. Ecology will review and approve this plan. This report must be prepared for each WWTP specified under draft permit special condition S4. Entities that own and operate more than one WWTP may submit one comprehensive plan to satisfy this permit condition. Permittees that would like to work together may also submit a combined report that satisfies all requirements in draft condition S4.E.

The current body of knowledge regarding nutrient treatment technologies continues to evolve as researchers develop and study new microbial populations and advanced treatment processes. Section G1-5.4 of the *Criteria for Sewage Works Design* (Ecology, 2019) contains information for permittees when selecting a new or developmental treatment technology as a preferred treatment alternative. Permittees interested in evaluating a non-traditional treatment approach shall work closely with the Ecology permit manager for their individual permit early on in the scoping phase to ensure development of an appropriate pilot study that satisfies the Agency's needs for future plan approval. Ecology recommends that permittees also work with any interested third parties during scoping, project development and pilot testing. This increases situational awareness and provides an avenue for information sharing, which may help decrease risk when exploring efficacy of a new or developmental technology. Ecology encourages creative approaches to reducing nutrient loads in Puget Sound and understands the Agency will need to support any permittee that elects to pursue innovative solutions that have not yet seen full-scale implementation in the state.

Treatment Technology Analysis

First, the Permittee must conduct an AKART analysis to determine a reasonable level of treatment for nitrogen removal. The term "reasonable", in the context of AKART directly relates to affordability of an engineered treatment solution. AKART reflects the level of treatment most suited to a technology based effluent limitation.

As discussed earlier in this fact sheet, Ecology's AKART approach for nutrient removal, specifically nitrogen removal for the Puget Sound area, continues to evolve. All treatment plants must meet AKART under 90.48.010 RCW. Secondary standards in Chapter 173-221 WAC do not include nutrient requirements. All plants when initially designed and constructed met the secondary treatment regulation; however, a site-specific evaluation is now required in light of the existing DO impairments related to nutrient over enrichment in Puget Sound.

In addition to making an AKART determination, which will represent a technology based approach for controlling nitrogen, the NRE must evaluate treatment alternatives for meeting the lower limit of technology for nitrogen removal both year round and seasonally. This lower limit of technology, which Ecology estimates to be approximately 3 mg/L TIN, reflects modeling scenarios and represents a concentration Permittees may expect if required to meet a WQBEL. Early Year 1 modeling results currently in publication indicate that some treatment plants will need to meet this level of treatment to protect the receiving water. Alternative effluent management options (e.g., disposal to ground, identification of reclaimed water beneficial uses) can be considered for this alternative. As with the AKART determination, this treatment assessment must include an economic evaluation for each technology considered.

Economic Evaluation

In order to satisfy this permit condition, Permittees must develop capital, operation and maintenance costs, and net present value estimates using real discount rates in the most recent Appendix C of The White House's Office of Management and Budget Circular No. A-94 for each treatment alternative evaluated for meeting AKART and 3 mg/L TIN (or the equivalent load) on average both annually and seasonally. A cost per pound of nitrogen removed for each treatment technology is also required. The *Permit Writers Manual* (2018) contains limited guidance on how to conduct an economic evaluation for deriving effluent limits when applying AKART in Chapter 4, Section 3.12. Permit conditions to develop associated costs for proposed treatment alternatives reflect this guidance.

Permittees must also provide details regarding the basis for the current utility rate structure used to support the existing level of wastewater treatment provided to the service area. In the review of the current rate structure, Permittees need to indicate how allocations of direct costs for operation and capital expenditures are recovered from payment of utility fees, how often the rate structure is reviewed to ensure financial solvency, and the last time wastewater rates were either increased or decreased and the impetus for that change. In addition, impacts to the current rate structure for each treatment technology evaluated must be provided.

Environmental Justice Review

Ensuring environmental justice (EJ) is a priority in Washington State (SB5141 Final Bill Report) and Ecology is committed to making decisions that do not place disproportionate burdens on ***overburdened communities*** and vulnerable populations. Permittees must conduct a demographic analysis using the best available population data (such as US Census data, EPA's EJSCREEN, or DOH's WTN) within their sewer service area to identify communities color, low income populations, Tribes, and indigenous populations. And, after this analysis, Permittees must conduct an affordability assessment to identify whether wastewater utility rate increases would disproportionately impact populations with environmental justice considerations. Ecology recommends using EPA's *Financial Capability Assessment for Clean Water Act Obligations* (2021) when looking at options for assessing financial capabilities to implement requirements under the Clean Water Act.

Opportunities to set alternative wastewater rates must also be considered as part of the planning requirement in the draft permit. Permittees must propose how an alternative rate structure can be used to prevent the low-income communities identified in the initial screening from being adversely affected by rate changes. This can include an evaluation of a tiered rate structure to offset adverse effects to the lowest income populations within the sewer service area or other innovative rate structure measures (e.g., fixed vs. variable charges, efficiency oriented rate design, or usage based rates) that ensure affordability when adopting a new rate structure to support treatment upgrades. Identification of overburdened communities and barriers to affordability do not absolve jurisdictions from upgrading treatment processes to meet water quality standards. Jurisdictions must develop a solution that accommodates the need to protect the receiving water while also providing a level of service to all residents within their community. Lastly, the EJ Review must include any positive community effects that may be the result of treatment improvements identified as the preferred alternatives; these may include positive impacts to fishing and harvesting through preservation of Tribal Treaty rights, enhanced opportunities for recreation, and other improvements that may result from decreased nitrogen loads into Puget Sound.

S5. REQUIREMENTS FOR WWTPS WITH SMALL TIN LOADS

The discharge limits in S5 are described above in Rationale for Narrative Water Quality-Based Effluent Limitations and Consideration of Narrative Water Quality-Based Limits for Numeric Criteria.

Condition S5 in the draft permit pertains only the WWTPs that constitute the minority of the domestic point source nutrient load to Puget Sound. The treatment plants that are in this category are generally smaller than the largest loaders and/or have more advanced treatment in place which drives down their effluent nutrient load.

Ecology received comments on the preliminary draft permit regarding revising requirements for these WWTPs. As a result, Ecology reconsidered the approach for these plants. While the

narrative limit approach is the same for these facilities, the BMPs which constitute a narrative water quality based effluent limit under 40 CFR 122.44(k) are slightly different. Overall, Ecology found that these plants have limited capacity to implement the same BMPs as the dominant loaders. And, given the magnitude of the TIN effluent load in relation to the plants in Condition S4, Ecology determined that the requirements in the draft permit for plants in Condition S5 could be implemented at a different pace while making incremental progress in TIN load reductions.

MONITORING

Permittees subject to requirements under S5 have a monitoring schedule listed in S6.B that more accurately reflects the size of plants in this category. Monitoring frequency is limited to 1-2 times per month, depending on the parameter. Compliance with the monitoring portion of the narrative limit requires timely submittal of each discharge monitoring report.

NUTRIENT OPTIMIZATION PLAN

Permittees subject to requirements under S5 must submit the once per permit cycle Nitrogen Optimization Plan to Ecology through the electronic report requirement in S9.D by March 31, 2026. Compliance with this narrative limit requires timely submittal of a complete report. Ecology encourages Permittees to begin the electronic optimization reporting several weeks ahead of the March 31st submittal date to allow plenty of time for adequate completion. See the Optimization Approaches section under S4 of this fact sheet for suggestions of different optimization strategies available for Permittees. Permittees may work together to satisfy this requirement; however, each Permittee must complete the one-time report documenting individual facility progress through Ecology's WQWebPortal.

Action levels are not part of the narrative effluent limit for Permittees in Condition S5; therefore, there are no corrective actions for this group of Permittees. As a group, they constitute less than 1% of the cumulative domestic point source TIN load into Puget Sound. Permittees must still review their existing treatment performance, select a suite of optimization strategies for their facility, set a performance goal, implement the strategy and evaluate the implementation and document any adaptive management used to refine implementation.

AKART ANALYSIS

Permittees subject to draft permit condition S5 must complete an engineering analysis to determine what constitutes all known and reasonable treatment (AKART) for nitrogen removal at their treatment facility. Compliance with this narrative limit requires submittal of the AKART analysis by the date listed in the draft permit. Permittees may elect to complete this planning task together or separately. If electing to work together, one document may be submitted by the date listed in the permit. Also, a jointly developed document must address AKART treatment alternatives for each type of treatment plant owned and operated by Permittees working together to satisfy this permit condition.

Each of these treatment plants has an approved engineering report for their existing level of treatment, which currently meets secondary treatment requirements under Chapter 173-221 WAC. Ecology's *Permit Writer's Manual* (2018) states that AKART is "a technology based approach to limiting pollutants from wastewater discharges which requires an engineering judgement and an economic judgement."

As previously stated, Ecology expects that domestic point sources subject to coverage under this permit will be required to meet a range of final effluent TIN concentrations. While some S5 permittees may need to meet a stringent effluent concentration to address a localized impact directly associated with a specific discharge most will need to implement a less rigorous treatment technology that still goes beyond secondary requirements listed in Chapter 173-221 WAC. At this time, Ecology does not know which S5 Permittees will have to meet the lower effluent limit, which is why this grouping will be held to an AKART analysis in the draft permit, only.

This AKART analysis must include a review of current treatment technologies at the WWTP, including influent volumes and regional growth trends for the next 20 years. Alternatives for reducing effluent TIN loads must be assessed as part of this analysis. Ecology has not provided an effluent treatment target because each discharger must make the determination regarding what constitutes a 'reasonable' level of treatment for nitrogen removal.

Permittees may use elements from a previously approved planning document to satisfy this permit condition. A technical memo that references applicable sections of a previously approved document and also provides the other required plan elements may be submitted to Ecology in this instance. See the Environmental Justice Review section in this fact sheet for a description of how to meet the EJ requirements for the AKART Analysis.

S6. MONITORING REQUIREMENTS

The monitoring approach outlined in S6 is consistent with the monitoring, recording, and reporting requirements of WAC 173-220-210 and 40 CFR 122.41 and includes consideration of the certainty, risk, cost, and the objectives of the permit. Certainty provides a level of confidence that the data are representative of the pollutants in the discharge. The risk is an assessment of the environmental impacts of pollutants. The monitoring cost considers all associated monitoring expenses, such as time to sample, expense of sampling and analysis, any accreditation expenses, training and equipment requirements. The objectives define the purpose of the sampling which are to track optimization progress and better quantify total inorganic nitrogen (TIN) loads to Puget Sound.

The monitoring frequency established in this permit is consistent with WAC 173-220-210(1)(b) and 40 CFR § 122.48(b). Ecology set sampling frequencies to characterize the nature of the discharge reasonably using recommendations from the Advisory Committee convened in March 2020. Sampling frequencies based on facility size have changed from what Ecology proposed in the preliminary draft. Ecology reduced the number of monitoring categories from three to two

and reduced the required sampling based on feedback from commenters. The revised monitoring schedules will adequately characterize the discharge from both categories of WWTPs covered by the draft permit.

WASTEWATER SAMPLING REQUIREMENTS

Conditions S6.A. and S6.B. requires representative sampling of influent and effluent and authorizes sampling at locations currently defined in the permittee's individual NPDES permit to satisfy this requirement. The frequency of the analysis is broken down into different categories based on plant's size. A primary factor influencing this facility size based monitoring approach were the recommendations from the PSNGP Advisory Committee. The monitoring requirements in the draft permit gives Ecology the ability to assess the characteristics of the facility's effluent and the effectiveness of select nutrient reduction activities identified in the Nutrient Optimization Plan. If the permittee does not have an effluent flow meter, report flows following the same method used for individual permit reporting.

In addition to volumetric flow so that each Permittee can calculate loading, the draft permit contains requirements for influent and effluent monitoring of five core parameters. These include: 5-day carbonaceous biochemical oxygen demand ($CBOD_5$), total ammonia, nitrate-nitrite, total Kjeldahl nitrogen (TKN) and total organic carbon.

$CBOD_5$, a subset of BOD_5, measures the amount of dissolved oxygen required for biological oxidation of carbon compounds in a wastewater sample. Unlike BOD_5, the $CBOD_5$ analysis excludes the oxygen demand for nitrogen species and is more appropriate where plants have an incomplete conversion of ammonia to nitrate. When coupled with the BOD_5 monitoring requirement in permittee's individual NPDES permits, this parameter provides a more complete picture of the treatment performance and carbon removal. Permittees can use BOD_5 and $CBOD_5$ to track operation efficiencies by calculating percent removal using influent and effluent concentrations. This parameter can be used for optimization reporting and in future SSM scenarios.

Total ammonia the sum of ammonia (NH_3) and ammonium (NH_4^+) is the most common form of inorganic nitrogen in raw domestic wastewater. Raw domestic wastewater predominately contains ammonia due to the presence of urine. Most treatment plants oxidize ammonia into nitrate through the addition of oxygen.

Nitrate plus Nitrite when added to total ammonia yields total inorganic nitrogen (TIN), the parameter subject to regulation in the draft permit. The treatment process oxidizes inorganic nitrogen from ammonia to nitrite and nitrate, and reduces inorganic nitrogen from nitrate to nitrite, ammonia, or nitrogen gas. The treatment system biota converts inorganic nitrogen into organic nitrogen. Settled solids retain the biota in the treatment system. Wasting sludge removes settled solids with organic nitrogen from the treatment system. TIN in the effluent represents readily available nutrient that the treatment system has removed. Very little nitrate + nitrite is found in wastewater influent which is why the draft permit proposes a reduced

influent monitoring frequency. Plants must use influent and effluent TIN concentrations to help support optimization and influent source reduction. Cumulative TIN loading must also be calculated on a running monthly basis for all permittees. Dominant loaders must use this cumulative TIN load as part of the annual action level assessment in the Nitrogen Optimization Plan requirement (See draft Condition S4.C).

Total Kjeldahl Nitrogen (TKN) is an important parameter for understating nitrification efficiency and provides Permittees with the ability to evaluate the biological treatment system. Comprised of ammonia plus total ***organic nitrogen***, TKN allows the amount of organic nitrogen in a wastewater sample to be quantified. Generally, the secondary treatment process converts most of the dissolved organic nitrogen to ammonia where it is available to the biota of the treatment system. Settling removes most of the particulate organic carbon. This parameter is also valuable to Ecology for use in SSM scenarios as little to no organic nitrogen data exists for most permittees. Ecology proposes infrequent (1/month) influent and effluent TKN monitoring for all permittees in the draft permit.

Total organic carbon (TOC) provides Ecology with the ability to quantify the amount of organic, carbon containing pollution discharged from each WWTP. The Environmental Assessment Program has identified carbon as a secondary nutrient driving eutrophication in the Salish Sea. Currently, Ecology has no data on TOC from the domestic WWTPs proposed for coverage under the draft permit. Ecology intends this once per month effluent monitoring to supplement model inputs and to develop correlations with BOD_5/$CBOD_5$. SSM scenarios utilize BOD as a surrogate for available carbon. Measurements of TOC will help to refine the relationship between BOD/CBOD and available carbon.

ANALYTICAL METHODS AND QUANTITATION LEVELS

Historically, the method detection limit (MDL) was used to determine compliance as all data at or above the MDL were considered adequate for assessing compliance and supporting environmental actions. The MDL, however, is the level at which a chemical's presence or absence can be detected, and provided limited information with regard to actual concentration. Ecology uses the term "quantitation level" as equivalent to the term "minimum level of quantitation (ML)" which is used by EPA. The ML is defined by EPA as the lowest concentration of an analyte that can be measured with a defined level of confidence. This may also be called the reporting level by some laboratories. Based on Ecology's *Permit Writers Manual* (2018), the draft PSNGP defines the quantitation level as the lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that all method-specified sample, weights, volumes, and clean up procedures have been employed.

All NPDES permits require that EPA approved analytical procedures listed in 40 C.F.R. § 136 be used for permit limit compliance sampling and analysis. Permittees must also comply with the NPDES *Use of Sufficiently Sensitive Test methods for Permit application and Reporting Rule* (Federal Register 49001). This requirement mandates that when an EPA-approved method exists, the most sensitive method must be used when quantifying the pollutant in a discharge.

The draft permit requires specific analytical methods and establishes quantitation levels, consistent with Ecology's *Permit Writer's Manual.* If an alternate analytical method from 40 CFR § 136 is sufficient to produce measurable results from the sample, the Permittee may use that method for analysis. If a facility uses a contract laboratory to monitor wastewater, it must ensure that the laboratory uses the method and meets or exceeds the method detection levels required by the permit. The permit describes what to do in certain situations when the laboratory encounters matrix effects. When a facility uses an alternative method as allowed by the permit, it must report the test method and quantitation level (QL) on the discharge monitoring report.

Condition S6.C requires documentation of both influent and effluent sampling to track nutrient loads entering Washington waters of the Salish Sea and quantify results of optimization. The draft PSNGP specifies routine sampling and analysis requirements to provide Ecology with continued, representative information on the pollutants of concern in the domestic wastewater discharges.

Where the monitoring requirements of the draft permit overlap with the monitoring requirements in the individual permit, the same analytical result may be applied to both permits if the Permittee elects to use the influent and effluent monitoring locations identified in the individual permit.

Condition S6.D requires the Permittees to maintain flow measurement calibration at the frequency established by the manufacturer. Permittees must maintain calibration to ensure effluent loading nutrient load calculations are as accurate as possible.

Condition S6. E. Ecology requires facility to use a laboratory registered or accredited under provision of Chapter 173-50 WAC, Accreditation of Environmental Parameters, to prepare all monitoring data.

The 2007 Methods Update Rule (MUR) provided some flexibility to modify EPA approved method listed in 40 CFR § 136.6. This portion of the rule describes potentially allowable method modifications and requirements that analysts need to meet to use methods that incorporate some of these modifications for NPDES compliance monitoring without prior EPA approval. EPA no longer accepts applications for approval of methods that fall within the flexibilities promulgated with the 40 CFR 136.6 rule revision. According to EPA, "any method that relies on the same underlying chemistry and determinative techniques as other methods approved at 40 CFR § 136 for measurement of a given parameters is acceptable for use in NDPES compliance monitoring provided that the requirements for establishing equivalent performance documentation specified at 40 C.F.R. § 136.6 are met." Often these are referred to as EPA-Equivalent methods. Permittees must receive accreditation for these EPA equivalent methods in order to use them for monitoring and reporting required by this permit. Use of these methods for internal process control information does not require accreditation.

Condition S6.E allows for the Permittee to request a reduction of the sampling frequency after (12) months of monitoring. Permittees must submit a written request to Ecology outlining

which monitoring parameters they propose to reduce and the basis for that reduction. Ecology will look at the DMR data submitted from the beginning of the permit term to the data of the request. Ecology will grant the request only if the DMR data appear representative, consistent, and the Permittee has demonstrated that the distribution of concentrations will not change with a lower sampling frequency. Parameters with highly variable results will not be subject for reduction. If granted, Ecology will address the Permittee's monitoring change through a coverage modification rather than modifying the permit. Permittees must follow public notice requirements described in S2.D at least 60 days prior to the intended reduction effective date.

S7. DISCHARGES TO 303(D) OR TMDL WATERBODIES

The basis for the non-numeric water quality based effluent limitation approach for all Permittees is covered under *Authority to Include Non-Numeric Water Quality Based Limits.*

If EPA approves an applicable Total Maximum Daily Load (TMDL) for WWTPs owned and operated by a Permittee covered by the general permit, Ecology will address any permit requirements related to the approved TMDL in the Permittee's individual permit or through a permit modification.

S8. SOLID AND LIQUID WASTE DISPOSAL

This section is intended to ensure that handling and disposal of solid or liquid wastes do not result in a violation of applicable water quality regulations (40 CFR 122.44(k)(2), 40 CFR 125.3(g), and RCW 90.48.080., and WAC 173-216-110(1)(f)).

This permit does not require the development of a solid waste control plan nor does it authorize discharge of leachate from solid waste material.

S9. REPORTING AND RECORDKEEPING REQUIREMENTS

The reporting and recordkeeping requirements of Special Conditions S9 are based on Ecology's authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges. Reporting of monitoring results are specified in 40 CFR 122.44(i)(3 and 4) and WAC 173-226-090(3). Discharge Monitoring Reports must be submitted to Ecology even if there was no discharge. Recordkeeping requirements in the draft permit are specified in 40 CFR 122.41(j)(2) and WAC 173-220-210(2)(b). The requirements of Condition S9 will assure that Ecology records are maintained and demonstrate compliance with sampling requirements by the facility.

DRAFT CONDITION S9.C ANNUAL REPORT FOR DOMINANT LOADERS

Ecology proposes Permittees subject to condition S4 submit an Annual Report documenting optimization and adaptive management for the 2022-2027 Permit term, which is a report for

the previous calendar year to be submitted by March 31, annually. The first year Annual Report due by March 31, 2023 will cover the period from January 1, 2022 – December 31, 2022. Submittal of the Annual Report will occur through Ecology's WQWebPortal. Permittees will report on optimization strategies, treatment performance assessments and adaptive management implemented at the WWTP during each reporting period. Questions for the Annual Report pertaining to dominant loaders will document the Nitrogen Optimization Plan requirements and can be found in Appendix C of the draft permit.

DRAFT CONDITION S9.D SINGLE REPORT FOR SMALL LOADERS

Ecology proposes Permittees subject to condition S5 submit a single report documenting optimization and adaptive management for the 2022-2027 Permit term. This Report due by March 31, 2026 will cover the period from January 1, 2022 – December 31, 2025. Submittal of the Report will occur through Ecology's WQWebPortal. Permittees will report on optimization strategies, treatment performance assessments and adaptive management implemented at the WWTP during each reporting period. Draft questions for the Single Report pertaining to smallest loaders will document the Nitrogen Optimization Plan requirements and can be found in Appendix D of the draft permit.

S10. PERMIT FEES

RCW 90.48.465 requires Ecology to recover the cost of the water quality permit program. Wastewater fees are established through a rule development process that includes the input of stakeholders, interested parties, and an advisory committee and includes an outreach process. Any new fee proposal will provide public comment opportunity in amending the existing fee regulation (Chapter 173-224 WAC).

GENERAL CONDITIONS

General Conditions are based directly on state and federal law and regulations and have been standardized for all NPDES permits issued by Ecology.

CONDITION G1 requires discharges and activities authorized by the draft permit to be consistent with the terms and conditions of the permit in accordance with 40 CFR 122.41.

CONDITION G2 requires responsible officials or their designated representatives to sign submittals to Ecology in accordance with 40 CFR 122.22, 40 CFR 122.22(d), WAC 173-220-210(3)(b), and WAC 173-220-040(5).

CONDITION G3 requires the Permittee to allow Ecology to access the facility and conduct inspections of the facility and records related to the permit in accordance with 40 CFR 122.41(i), RCW 90.48.090, and WAC 173-220-150(1)(e).

CONDITION G4 identifies conditions that may result in modifying or revoking the general permit in accordance with 40 CFR 122.62, 40 CFR 124.5, and WAC 173-226-230.

CONDITION G5 identifies conditions for revoking coverage under the general permit in accordance with 40 CFR 122.62, 40 CFR 124.5, WAC 173-226-240, WAC 173-220-150(1)(d), and WAC 173-220-190.

CONDITION G6 requires the Permittee to notify Ecology when facility changes may require modification or revocation of permit coverage in accordance with 40 CFR 122.62(a), 40 CFR 122.41(l), and WAC 173-220-150(1)(b).

CONDITION G7 prohibits the Permittee from using the permit as a basis for violating any laws, statutes or regulations in accordance with 40 CFR 122.5(c).

CONDITION G8 requires the Permittee to reapply for coverage 180 days prior to the expiration date of this general permit in accordance with 40 CFR 122.21(d), 40 CFR 122.41(b), and WAC 183-220-180(2).

CONDITION G9 identifies the requirements for transfer of permit coverage in accordance with 40 CFR 122.41(l)(3) and WAC 173-220-200. When control or ownership of the facility from which the authorize discharge emanates changes, the new ***owner*** must obtain permit coverage, either through a transfer of permit coverage per Condition G9, or by applying for the permit per Condition S2.

CONDITION G10 prohibits the reintroduction of removed substances back into the effluent in accordance with 40 CFR 125.3(g), RCW 90.48.010, RCW 90.48.080, WAC 173-220-130, and WAC 173-201A-240.

CONDITION G11 requires Permittees to submit additional information or records to Ecology when necessary in accordance with 40 CFR 122.41(h).

CONDITION G12 incorporates all other requirements of 40 CFR 122.41 and 122.42 by reference.

CONDITION G13 notifies the Permittee that additional monitoring requirements may be established by Ecology in accordance with 40 CFR 122.41(h).

CONDITION G14 describes the penalties for violating permit conditions in accordance with 40 CFR 122.41(a)(2).

CONDITION G15 provides the regulatory context and definition of "***Upset"*** in accordance with 40 CFR 122.41(n).

CONDITION G16 specifies that the permit does not convey property rights in accordance with 40 CFR 122.41(g).

CONDITION G17 requires the Permittee to comply with all conditions of the permit in accordance with 40 CFR 122.41(a).

CONDITION G18 requires the Permittee to comply with more stringent toxic effluent standards or prohibitions established under Section 307(a) of the Clean Water Act in accordance with 40 CFR 122.41(a)(1), WAC 173-220-120(5), and WAC 173-201A-240.

CONDITION G19 describes the penalties associated with falsifying or tampering with monitoring devices or methods in accordance with 40 CFR 122.41(j)(5).

CONDITION G20 requires Permittees to report planned changes in accordance with 40 CFR 122.41(l)(1).

CONDITION G21 requires Permittees to report any relevant information omitted from the permit application in accordance with 40 CFR 122.41(l)(8).

CONDITION G22 requires Permittees to report anticipated non-compliances in accordance with 40 CFR 122.41(l)(2).

CONDITION G23 defines appeal options for the terms and conditions of the general permit and of coverage under the permit by an individual discharger in accordance with RCW 43.21B and WAC 173-226-190.

CONDITION G24 invokes severability of permit provisions in accordance with RCW 90.48.904.

CONDITION G25 prohibits ***bypass*** unless certain conditions exist in accordance with 40 CFR 122.41(m).

PERMIT ISSUANCE PROCEDURES

PERMIT MODIFICATIONS

Ecology may modify the PSNGP to impose numerical limitations, if necessary to meet water quality standards for surface waters based on new information obtained from sources such effluent monitoring and model scenario results.

Ecology may also modify this permit as a result of new or amended state or federal regulations.

RECOMMENDATION FOR PERMIT ISSUANCE

The draft PSNGP meets all statutory requirements for authorizing a wastewater discharge, including those limitations and conditions believed necessary to protect human health, aquatic life, and the beneficial uses of waters of the State of Washington. Ecology proposes that this permit be issued for five (5) years.

ECONOMIC IMPACT ANALYSIS

In accordance with WAC 173-226-120, Ecology did not prepare an economic impact analysis for the draft general permit as the permit does not propose to directly cover small business.

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Significant agency actions from Ecology's Water Quality Program prepared after June 12, 2014 must follow requirements in RCW 34.05.272 and categorize all references used during development. A bracketed number indicating the source category follows each individual reference. Document categories are as follows:

1. Peer review is overseen by an independent third party.
2. Review is by staff internal to Department of Ecology.
3. Review is by persons that are external to and selected by the Department of Ecology.
4. Documented open public review process that is not limited to invited organizations or individuals.
5. Federal and state statutes.
6. Court and hearings board decisions.
7. Federal and state administrative rules and regulations
8. Policy and regulatory documents adopted by ***local governments***.
9. Data from primary research, monitoring activities, or other sources, but that has not been incorporated as part of documents reviewed under other processes.
10. Records of best professional judgment of Department of Ecology employees or other individuals.
11. Sources of information that do not fit into one of the other categories listed.

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COURT CASES

Natural Resources Defense Council, Inc. v. Douglas M. Costle, 568 F.2d 1369 (D.C. Cir. 1977*)* [6]

Natural Resources Defense Council, Inc. v. EPA, 673 F.2d 400, 403 (D.C. Cir. 1982) [6]

Natural Resources Defense Council, Inc v. EPA, 822 F.2d 104, 122-24 (D.C. Cir. 1987) [6]

Waterkeeper Alliance, Inc. v. U.S.E.P.A, 399 F.3d 486 (2d Cir. 2005) [6]

Citizens Coal Council v. U.S.E.P.A, 447 F.3d 879 (6th Cir. 2006) [6]

FEDERAL PUBLICATIONS

40 CFR 122: EPA Administered Permit Programs: The National Pollutant Discharge Elimination System [7]

40 CFR 122.21: Application for a Permit[7]

40 CFR 122.41: Conditions Applicable to all Permits [7]

40 CFR 122.44: Establishing limitations, standards, and other permit conditions [7]

40 CFR 122.48: Requirements for recording and reporting of monitoring results [7]

40 CFR 122.62: Modification or revocation and reissuance of permits [7]

40 CFR 125.3: Technology-based treatment requirements in permits [7]

40 CFR 131.45: Revision of Certain Federal Water Quality Criteria Applicable to Washington [7]

40 CFR 136: Guidelines Establishing Test Procedures for the Analysis of Pollutants [7]

Federal Water Pollution Control Act. 33 USC 1251 et seq.: : http://www2.epa.gov/laws-regulations/summaryclean-water-act [7]

REVISED CODE WASHINGTON (RCW)

Chapter 34.05 RCW: Administrative Procedures Act [7]

Chapter 43.21B RCW: Environmental and Land Use Hearings Office – PCHB [7]

Chapter 43.21C RCW: State environmental policy [7]

Chapter 90.48 RCW: Water Pollution Control [7]

Chapter 90.52 RCW: Pollution Disclosure Act of 1971 [7]

WASHINGTON ADMINISTRATIVE CODE (WAC)

Chapter 173-50 WAC: Accreditation of Environmental Laboratories [5]

Chapter 173-200 WAC: Water Quality Standards for Groundwaters of the State of Washington [5]

Chapter 173-201A WAC: Water Quality Standards for Surface Waters of the State of Washington[5]

Chapter 173-204 WAC: Sediment Management Standards [5]

Chapter 173-216 WAC: State Waste Discharge Permit Program [5]

Chapter 173-220 WAC: National Pollutant Discharge Elimination System Permit Program [5]

Chapter 173-221 WAC: Discharge Standards and Effluent Limitations for Domestic Wastewater Facilities [5]

Chapter 173-224 WAC: Water Quality Permit Fees [5]

Chapter 173-226 WAC: Waste Discharge General Permit Program [5]

Chapter 173-240 WAC: Submission of Plans and Reports for Construction of Wastewater Facilities [5]

Chapter 197-11-855 WAC: SEPA Rules for the Department of Ecology [5]

Chapter 371-08 WAC: Pollution Control Hearings Board – Practices and Procedure [5]

APPENDIX A - PUBLIC INVOLVEMENT INFORMATION

Ecology has tentatively determined to issue the Puget Sound Nutrient General Permit for municipal wastewater discharges as identified in Special Condition S1, Permit Coverage.

Ecology publishes a Public Notice of Draft (PNOD) to inform the public that the draft permit and fact sheet are available for review and comment. Ecology will publish the PNOD on June 16, 2021, in the Washington State Register and on the Ecology web site (below). The PNOD informs the public that the draft permit and fact sheet are available for review and comment.

Ecology will also mail or email the notice to those identified as interested parties.

Copies of the draft general permit, fact sheet, and related documents are available for inspection and copying between the hours of 8:00 a.m. and 5:00 p.m. weekdays, by appointment, at Ecology's regional offices listed below or may be obtained from Ecology's website or by contacting Ecology by mail, phone, fax or email:

Internet: https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Nutrient-Permit

Contact Ecology:
Eleanor Ott
Department of Ecology
PO Box 47600
Olympia, WA 98504-7600
Telephone: (360) 407-6433 (office)
FAX: (360) 407-6426
E-mail: eleanor.ott@ecy.wa.gov

Southwest Regional Office

Water Quality Program
300 Desmond Drive
Lacey, Washington 98503
Phone: (360) 407-6300

Northwest Regional Office

Water Quality Program
3190 - 160th Avenue SE
Bellevue, Washington 98008
Phone: (425) 649-7000

Ecology will accept written comments on the draft Puget Sound Nutrient General Permit, Fact Sheet, and related documents from June 16, 2021 through August 2, 2021 (midnight); written comments must be postmarked or e-mailed no later than midnight August 2, 2021. Comments should reference specific permit conditions or text or when possible, and may address the following topics:

- Technical issues.
- Accuracy and completeness of information.

- The scope of proposed coverage.
- Adequacy of environmental protection and permit conditions.
- Any other concern that would result from issuance of the draft permit.

Ecology prefers comments be submitted by the eComment form located at:

https://wq.ecology.commentinput.com/?id=QFkVE

Written comments must be postmarked no later than midnight on August 2, 2021. Submit written comments to:

Eleanor Ott

Water Quality Program

Department of Ecology

PO Box 47600

Olympia, WA 98504-7600

eleanor.ott@ecy.wa.gov

Ecology will also conduct workshops and public hearings to provide an opportunity for interested parties to give formal oral testimony and comments on the draft permit. The public hearing will immediately follow the public workshop:

Tuesday, July 20, 2021 9:30 AM
Webinar* Join the webinar at
https://watech.webex.com/watech/onstage/g.php?MTID=e8eac5891993f6c06ee701b3dbf290f49

Wednesday, July 21, 2021 5:30 PM
Webinar* Join the webinar at
https://watech.webex.com/watech/onstage/g.php?MTID=e52cb968b9cc7ab3e15aa9f4f269e1ba2

*Both workshops and hearings will be offered via webinar where individuals may view the presentation and provide testimony via computer or mobile device.

Public notice regarding the hearing will be circulated at least thirty (30) days in advance of the hearings. Persons expressing an interest in this permit will be mailed an individual notice of hearing (WAC 173-220-100).

Further information may be obtained by contacting Eleanor Ott at Ecology, by phone at (360) 280-5624, by email at eleanor.ott@ecy.wa.gov, or by writing to Ecology's Olympia address listed above.

APPENDIX B - GLOSSARY

303(d) – Section 303(d) of the federal Clean Water Act requires states to develop a list of polluted waterbodies every two years. For each of those waterbodies, the law requires states to develop Total Maximum Daily Loads (TMDLs). A TMDL is the amount of pollutant loading that can occur in a given waterbody (river, marine water, wetland, stream, or lake) and still meet water quality standards.

40 CFR – Title 40 of the Code of Federal Regulations, which is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the federal government.

Action Level– An indicator value used to determine the effectiveness of best management practices at a WWTPs. Action levels are not water quality criteria or effluent limits by themselves but indicators of treatment optimization.

Active status - Refers to the permit coverage status when a Notice of Intent form has been submitted to and approved by Ecology.

AKART – An acronym for "all known, available, and reasonable methods of prevention, control, and treatment" AKART represents the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants and controlling pollution associated with a discharge. Described in chapters 90.48 and 90.54 RCW and chapter 173-201A, 173-204, 173-216, 173-220, and 173-221 WAC.

Alternative Restoration Plan – A near-term plan, or description of actions, with a schedule and milestones, that is more immediately beneficial or practicable to achieving water quality standards.

Antidegradation – The antidegradation policy of the state of Washington as generally guided by Chapters 90.48 and 90.54 RCW is applicable to any person's new or increased activity.

Beneficial Use – Identified uses of waters of the state shall include uses for domestic water, irrigation, fish, shellfish, game, and other aquatic life, municipal, recreation, industrial water, generation of electric power, and navigation.

Best Management Practices (BMPs) – Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs also include treatment systems, operating procedures, and practices to control: plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Bypass – The intentional diversion of waste streams from any portion of a treatment facility.

Clean Water Act (CWA) – The Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, 97-117; USC 1251 et seq.

Critical Condition – The time during which the combination of receiving water and waste discharge conditions have the highest potential for causing toxicity in the receiving water environment. This situation usually occurs when the flow within a water body is low, thus, its ability to dilute effluent is reduced.

Designated Uses – Those uses specified in this chapter for each water body or segment regardless of whether or not the uses are currently attained.

Discharge – The release of treated wastewater from a treatment plant outfall.

Discharger – An owner or operator of any facility or activity subject to regulation under Chapter 90.48 RCW or the Federal Clean Water Act.

Director – The Director of the Washington Department of Ecology or his/her authorized representative.

Dissolved Oxygen (DO) – A measure of how much free, non-compounded oxygen is present in water and available to living aquatic organisms.

Domestic Wastewater (Also municipal wastewater) - means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such ground water infiltration or surface waters as may be present.

Ecology – The Washington State Department of Ecology

Eutrophication – excessive richness of nutrient in a body of water, frequently due to human sources which cause a dense growth of plant life and death of animal life from lack of oxygen

Facility – A wastewater treatment plant or publicly owned treatment work.

General Permit – A permit which covers multiple dischargers of a point source category within a designated geographical area, in lieu of individual permits being issued to each discharger.

Greater Puget Sound Region – The term to describe the marine area where human nutrient loads, from Washington Waters of the Salish Sea, contribute to waters not meeting marine DO standards. The GPS region include the Northern Bays (Bellingham, Samish, and Padilla Bays) as well as Puget Sound Proper, which are the marine waters south of the entrance of Admiralty Inlet (Whidbey Basin, Main Basin, South Sound, and Hood Canal). Regional human nutrient loads discharged directly to the Strait of Juan de Fuca and Strait of Georgia contribute to impairments in GPS (Ahmed et al., 2019).

Ground Water – A saturated zone or stratum beneath the land surface or a surface water body.

Impaired Waters (also **303(d) listed waters** or **impairments) –** Listed waters refers to the specific segment of a waterbody listed as not meeting water quality criteria by the State as required under Section 303(d) of the Clean Water Act. The most current list of impaired waters is the applicable list.

Jurisdiction – A political unit such as a city, town or county; incorporated for local self-government.

Load Allocation - The portion of a receiving water's loading capacity that is allocated to one of its existing or future non-point sources of pollution.

Local Government – Any county, city, or town having its own government for local affairs.

Marine Point Source – Point sources (see "point source" definition below) that discharge specifically to, or in close proximity to, marine waters. Marine point sources are included as inputs into the Salish Sea Model and are "Permittees."

Mixing Zone – An area that surrounds an effluent discharge within which water quality criteria may be exceeded. The area of the authorized mixing zone is specified in a facility's permit and follows procedures outlined in state regulations (Chapter 173-201A WAC).

National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the state from point sources.

Notice of Intent (NOI) means the application for, or a request for coverage under this General Permit pursuant to WAC 173-226-200.

Noncompliance – The inability to comply with any of the terms and conditions of the permit which causes a threat to human health or the environment.

Operator – Any individual who performs routine duties, onsite at a wastewater treatment plant that affect plant performance or effluent quality.

Operator in Responsible Charge – The individual who is designated by the owner as the person routinely onsite and in direct charge of the overall operation and maintenance of a wastewater treatment plant.

Optimization (also treatment optimization) – A best management practice (BMP) resulting in the refinement of WWTP operations that lead to improved effluent water quality and/or treatment efficiencies.

Organic Nitrogen – Nitrogen chemically bound I organic molecules, such as proteins, amines, and amino acids. Can be measured as part of the Total Kjeldahl Nitrogen analysis.

Overburdened Communities – A geographic area where vulnerable populations face combined, multiple environmental harms and health impacts, and includes, but is not limited to, highly impacted communities as defined in RCW 19.405.020.

Owner – A town or city, a county, a sewer district, board of public utilities, association, municipality or other public body.

Permit – An authorization, license, or equivalent control document issued by the director.

Permittee – An entity that receives notice of coverage under this general permit.

pH – The pH of a liquid measures its acidity or alkalinity. A pH of 7 is defined as neutral. Large variations above or below this value are considered harmful to most aquatic life.

Point Source – Any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, and container from which pollutants are or may be discharged to surface waters of the state. This term does not include return flows from irrigated agriculture.

Pollutant - Means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, domestic sewage sludge (biosolids), munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste. This term does not include sewage from vessels within the meaning of section 312 of the CWA, nor does it include dredged or fill material discharged in accordance with a permit issued under section 404 of the CWA.

Pollution – The contamination or other alteration of the physical, chemical, or biological properties of waters of the state; including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare; or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish or other aquatic life.

Publicly Owned Treatment Work (POTW) – A sewage treatment plant that is owned and usually operated by a municipality or other public agency.

Puget Sound Nutrient Forum (PSNF) – Formed by Ecology in 2017 as a large public advisory group to support the Puget Sound Nutrient Source Reduction Project and discuss, learn, and provide input on how to reduce human sources of nutrients enters the greater Puget Sound region.

Puget Sound Nutrient Source Reduction Project (PSNSRP)– A collaborative effort with Puget Sound communities and stakeholder to address human sources of nutrients.

Reasonable potential – The likelihood of a pollutant to cause or contribute to an excursion of a water quality standard.

Receiving Water – The waterbody at the point of discharge.

Salish Sea – Puget Sound, Strait of Georgia, and Strait of Juan de Fuca, including their connecting channels and adjoining waters.

Salish Sea Model (SSM) (also *model*) **–** A predictive costal ocean model for estuarine research, restoration planning, water-quality management, and climate change response assessment developed by PNNL in conjunction with Ecology.

SEPA (State Environmental Policy Act) - The Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

Site – The land area where any "facility" is physically located.

Surface Waters of the State (also surface water) **–** Lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Technology-based Effluent Limit (TBEL)– A permit limit that is based on the ability of a treatment method to reduce the pollutant.

Total Daily Maximum Load (TMDL) – A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet State water quality standards, a TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources.

Total Inorganic Nitrogen (TIN) – The sum of ammonia, nitrate and nitrite. It includes dissolved and particulate fractions.

Total Kjeldahl Nitrogen (TKN) – The combined amount of organic and ammonia nitrogen.

Total Organic Carbon (TOC) – The amount of carbon bound in organic compounds in a sample. Because all organic compounds have carbon as the common element, total organic carbon measurements provide a fundamental means of assessing the degree of organic pollution.

Total Suspended Solids (TSS) – An analytical laboratory measurement of the concentration of solids suspended in water.

Upset – An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

USEPA (also EPA) – United States Environmental Protection Agency.

Washington Waters of the Salish Sea – Areas of the Salish Sea subject to Washington State's Water Pollution Control Act (Chapter 90.48 RCW).

Wasteload Allocation (WLA) – The portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation (40 CFR 130.2(h)).

Watershed inflow – A freshwater pathway that delivers nutrients and drains watershed areas and represent the delivery of flow and nutrient inputs into the Salish Sea Model. In the

model, these estimates are for the mouth of each river, stream or watershed and represent loading at the point at which the freshwater inflow enters the Salish Sea. These estimates include but do not distinguish between various upstream point and nonpoint sources in the watersheds that contribute to loading at the mouth.

Water Quality – The chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Water Quality-based Effluent Limit (WQBEL) – A limit on the concentration of an effluent parameter that is intended to prevent the concentration of that parameter from exceeding its water quality criterion after it is discharged into receiving water.

Water quality standards – The state of Washington's water quality standards for surface waters of the state, which are codified in chapter 173-201A WAC or ground waters of the state, which are codified in chapter 173-200 WAC.

Waters of the State – Those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the state" as defined in Chapter 90.48 RCW which include lakes, rivers, ponds, streams, inland waters, underground waters, salt waters and all other surface waters and water courses within the jurisdiction of the state of Washington.

APPENDIX C – RESPONSE TO COMMENTS

This Response to Comments addresses comments received on the formal draft of the Puget Sound Nutrient General Permit and addresses changes made to the formal draft based upon comments received. It is included as Appendix C to the Fact Sheet for the Puget Sound Nutrient General Permit and will be published as a separate document on the permit webpage.

The public comment period for this permit began on June 16, 2021 and lasted until 11:59 p.m. of August 2, 2021, as noted in Appendix A.

APPENDIX D – PERMITTEE CATEGORY DETERMINATION

Ecology used single sample 2019 DMR data to determine the average daily load for each Permittee subject to coverage under the proposed permit. This exercise determined whether Permittees qualify as either a dominant or a small TIN loader based on the TIN loading magnitude relative to all Permittees subject to permit coverage. Dominant loaders equate to approximately 99% of the total TIN load from domestic WWTPs and are subject to draft permit condition S4. Permittees under 100 lbs/day equate to approximately 1% of the total TIN load from domestic WWTPs and are subject to draft permit condition S5.

Wastewater Treatment Plant	Individual NPDES Permit Number	2019 Nutrient Loading, Lbs/Day	Cumulative Nutrient Loading, Lbs/day	% of Total Cumulative Load
Metro West Point	WA0029181	18,290	18,290	25.6%
King County South Treatment Plant	WA0029581	17,075	35,365	49.6%
Tacoma Central No. 1	WA0037087	6,058	41,423	58.1%
Chambers Creek WWTP	WA0039624	5,027	46,450	65.1%
King County Brightwater WWTP	WA0032247	4,982	51,432	72.1%
Everett STP	WA0024490	3,636	55,068	77.2%
Post Point Plant (Bellingham)	WA0023744	2,351	57,419	80.5%
Marysville City Public Works	WA0022497	1,362	58,781	82.4%
Lakota WWTP, Lakehaven Utility District	WA0022624	1,291	60,072	84.2%
Bremerton STP	WA0029289	1,095	61,167	85.8%

Wastewater Treatment Plant	Individual NPDES Permit Number	2019 Nutrient Loading, Lbs/Day	Cumulative Nutrient Loading, Lbs/day	% of Total Cumulative Load
Tacoma North No. 3	WA0037214	933	62,100	87.1%
Lynnwood City WWTP	WA0024031	879	62,979	88.3%
Midway Sewer District	WA0020958	877	63,856	89.5%
Mt Vernon WWTP	WA0024074	875	64,731	90.8%
Edmonds STP	WA0024058	864	65,595	92.0%
Miller Creek WWTP	WA0022764	616	66,211	92.8%
LOTT WWTF	WA0037061	601	66,812	93.7%
Port Orchard WWTP	WA0020346	506	67,318	94.4%
Blaine STP Lighthouse Point [1]	WA0022641	502	67,820	95.1%
Central Kitsap Treatment Facility	WA0030520	474	I 68,294	95.8%
Salmon Creek WWTP	WA0022772	467	68,761	96.4%
Port Angeles STP	WA0023973	466	69,227	97.1%
Redondo WWTP	WA0023451	440	69,667	97.7%
Anacortes WWTP	WA0020257	373	70,040	98.2%
Lake Stevens Sewer District WWTP	WA0020893	309	70,349	98.6%
Snohomish STP	WA0029548	185	70,534	98.9%

Wastewater Treatment Plant	Individual NPDES Permit Number	2019 Nutrient Loading, Lbs/Day	Cumulative Nutrient Loading, Lbs/day	% of Total Cumulative Load
Birch Bay STP	WA0029556	169	70,703	99.1%
Alderwood WWTP	WA0020826	96	70,799	99.3%
Oak Harbor STP	WA0020567	84	70,883	99.4%
Gig Harbor STP	WA0023957	71	70,954	99.5%
La Conner STP	WA0022446	55	71,009	99.6%
Shelton City WWTP	WA0023345	45	71,054	99.6%
Port Townsend City WWTP	WA0037052	38	71,092	99.7%
Eastsound Sewer And Water District WWTP	WA0030571	26	71,118	99.7%
Kitsap County Manchester	WA0023701	24	71,142	99.8%
Stanwood STP	WA0020290	20	71,162	99.8%
Coupeville Town STP	WA0029378	19	71,180	99.8%
Kitsap County Sewer Dist 7	WA0030317	18	71,198	99.8%
Mukilteo WWTP	WA0023396	17	71,215	99.9%
Sequim STP	WA0022349	15	71,230	99.9%
Friday Harbor STP	WA0023582	13	71,243	99.9%

Wastewater Treatment Plant	Individual NPDES Permit Number	2019 Nutrient Loading, Lbs/Day	Cumulative Nutrient Loading, Lbs/day	% of Total Cumulative Load
WA Doc McNeil Island STP	WA0040002	10	71,253	99.9%
Bainbridge Island City Of Bainbridge	WA0020907	10	71,263	99.9%
WA Doc Clallam Bay Corrections Center Cc	WA0039845	9	71,272	99.9%
Boston Harbor STP	WA0040291	7	71,279	100.0%
Langley STP	WA0020702	7	71,286	100.0%
Skagit Co. #2, Big Lake	WA0030597	6	71,292	100.0%
Tamoshan STP	WA0037290	5	71,297	100.0%
Penn Cove WWTP	WA0029386	4	71,301	100.0%
Sekiu STP	WA0024449	4	71,305	100.0%
Kingston WWTP Kitsap County	WA0032077	3	71,308	100.0%
Hartstene Pointe STP	WA0038377	2	71,310	100.0%
Vashon STP	WA0022527	2	71,312	100.0%
Fisherman Bay STP	WA0030589	1	71,313	100.0%
WA Parks Larrabee State Park	WA0023787	0.3	71,313	100.0%
Clallam Bay STP	WA0024431	-	71,313	100.0%

Wastewater Treatment Plant	Individual NPDES Permit Number	2019 Nutrient Loading, Lbs/Day	Cumulative Nutrient Loading, Lbs/day	% of Total Cumulative Load
Eastsound Orcas Village WWTP	WA0030911	-	71,313	100.0%
Rustlewood STP	WA0038075	-	71,313	100.0%

[1] The Lighthouse Point WRF DMR data included nutrients starting in mid-2019 so Ecology used part of 2020 data to allow evaluation of a full year.

APPENDIX E – DATA USED IN ACTION LEVEL CALCULATIONS

Ecology used all representative DMR data available for individual WWTPs subject to coverage under the proposed permit to determine the facility specific action level. Revisions to action levels between the preliminary draft and the formal draft reflect the reviews conducted by each WWTP and their permit manager.

Wastewater Treatment Plant	Action Level, TIN lbs/year	Data Range Used in Calculation	Notes
Anacortes WWTP	163,000	1/1/16-3/31/19	
Birch Bay Sewage Treatment Plant (STP)	64,600	1/4/17-1/1/20	
Blaine STP (Lighthouse Point WRF)	18,200	7/2/2019 – 6/2/2020	2020 data included to complete 12 months
Bremerton WWTP	577,000	12/1/18-12/31/19	
Kitsap County Central Kitsap WWTP	250,000	8/1/17-12/31/19	
Chambers Creek WWTP	1,880,000	10/1/13-3/31/18	Data after 3/2018 excluded due to pilot testing at facility
Edmonds STP	419,000	6/1/2014-3/1/2020	Data range to capture historic variability, excluding flow from 2020 pandemic with outlier removed and missing value added per

Wastewater Treatment Plant	Action Level, TIN lbs/year	Data Range Used in Calculation	Notes
			City comments dated 3/15/21
Everett STP	1,530,000	11/1/15-3/1/20	Bootstrap set 2nd season Jul-Oct to prevent oversampling of seasonal monitoring data that had been collected at a higher frequency.
King County Brightwater WWTP	1,810,000	10/1/17-9/30/20	Date range with complete single sample data available in PARIS. Range provides 152 data points for all parameters.
King County South WWTP	7,340,000	10/1/17-9/30/20	Limited to most recent 36 months due to abundance of available data. Range provides 355 data points for ammonia and 268 data points for nitrate/nitrite.
King County West Point WWTP	6,670,000	10/1/17-9/30/20	Limited to most recent 36 months due to abundance of available data

Wastewater Treatment Plant	Action Level, TIN lbs/year	Data Range Used in Calculation	Notes
			and known treatment plant issues in early 2017. Range provides 136 data points for ammonia and 36 data points for nitrate/nitrite.
Lake Stevens Sewer District WWTP	118,000	1/5/16-11/3/20	
Lakota WWTP	583,000	1/1/17-10/31/20	
LOTT Budd Inlet WWTF	243,000	1/1/18-12/31/20	
Lynnwood STP	341,000	11/1/13-3/1/20	Data range to capture historic variability
Marysville STP	577,000	1/1/15-10/20/20	
Midway Sewer District WWTP	601,400	1/1/16-2/1/20	Did not include 2020 data due to unrepresentative airport flows during pandemic. Adjusted load to account for grab sampling method; Dual sample and reevaluate 1 year from effective.

Wastewater Treatment Plant	Action Level, TIN lbs/year	Data Range Used in Calculation	Notes
Miller Creek WWTP	289,900	10/22/13-10/13/20	
Mt Vernon WWTP	380,000	1/1/17-2/29/20	
Port Angeles WWTP	170,000	1/4/16-10/26/20	
Port Orchard WWTP (South Kitsap WRF)	208,000	1/1/17-12/31/19	
Post Point WWTP (Bellingham STP)	969,000	1/02/17-3/2/20	Normalized to end of March 2020
Redondo WWTP	241,000	8/1/13-10/31/20	
Salmon Creek WWTP	195,000	4/8/13-10/13/20	
Snohomish STP	78,900	7/1/13-9/30/20	Use all data to capture historic variability
Tacoma Central No. 1 WWTP	2,410,000	8/1/14-10/31/20	
Tacoma North No. 3 WWTP	336,000	9/1/14-10/31/20	

Appendix B
SEPA Checklist

City of Stanwood
10220 270th Street NW
Stanwood, Washington 98292

STATE ENVIRONMENTAL POLICY ACT
NOTICE OF DETERMINATION OF NONSIGNIFICANCE

Publish date:	July 29, 2025
Proposal name:	City of Stanwood General Sewer Plan & General Drainage Plan
File number:	25-0078 (Plan Adoption)
Documents available at:	City of Stanwood Community Development Department or www.stanwoodwa.org under Public Notice.
Applicant:	City of Stanwood
Lead Agency	City of Stanwood
Project Address:	Applies City Wide
Tax Parcel Numbers:	N/A
Date of SEPA Decision:	**Tuesday, July 29, 2025**
Written Comment Period:	**July 29, 2025 –Tuesday, August 12, 2025, at 4:30 pm**

Project Description: As the sewer and stormwater service provider for the Stanwood area, the City has initiated an update to it General Sewer and Stormwater Plans. General utility plans are intended to be updated approximately every 10 years to ensure they remain responsive to evolving community needs, regulatory requirements, population growth, and the condition of aging infrastructure.

Project Location: Applies city wide

Required Project Permits/Approvals: None

Existing Environmental Documents: SEPA Environmental Checklists (07/2025)

SEPA Threshold Determination: The lead agency for this proposal has determined that this project does not have a probable significant adverse impact on the environment. An environmental impact statement (EIS) is not required under RCW 43.21C.030(2)(c). This decision was made after review of a completed environmental checklist and other information on file with the City of Stanwood. This

information is available to the public on request. The Environmental Checklist and supporting documents are available at the Community Development Department, located at 10220 270th Street NW, Stanwood, WA 98292 and are available on the City's website at https://stanwoodwa.org.

This DNS is issued under WAC 197-11-340(2); the lead agency will not act on this proposal for 14 days from the date issued. Comments must be submitted to Tansy Schroeder, Senior Planner, at tansy.schroeder@ci.stanwood.wa.us, by **4:30 PM on Tuesday, August 12, 2025**. Please reference file number 25-0078.

SEPA Comment Period: Any person wishing to comment on the SEPA Notice of Determination of Non-Significance shall do so in writing by either mail or email prior to the scheduled comment deadline. The SEPA public comment period is open **Tuesday, July 29, 2025, through 4:30 pm on Tuesday, August 12, 2025.** Written comments must be submitted no later than **4:30 pm on Tuesday, August 12, 2025**, to the City of Stanwood Community Development Department at 10220 270th Street NW, Stanwood, WA 98292 or via email to Tansy Schroeder, Senior Planner, at tansy.schroeder@stanwoodwa.org.

SEPA Appeal Process: You may appeal this threshold determination by addressing those criteria and send to the lead agency at the address above. Appeals must be submitted by **Tuesday, August 12, 2025, at 4:30 pm**. Appeals must provide specific reasons for the appeal and be accompanied by a $500.00 non-refundable filing fee.

How to become a party of record: You may become a party of record by submitting written comments, including a (USPS) mailing address, to the City of Stanwood Community Development at the address listed below. E-mailed comments must include a return (USPS) mailing address in order for the sender to be considered a party of record. Questions about this proposal, requests to receive future notices of the decision, once made, and/or appeal procedures should be directed to the contact person listed below. The application and complete case file are available for review at the City of Stanwood Community Development Department. A decision on this application will be made within 120 days from the date of completeness.

Responsible Official: Patricia Love, Community Development Director

Contact Person: Tansy Schroeder, Senior Planner, (360) 454-5211;
tansy.schroeder@stanwoodwa.org
City of Stanwood, 10220 270th St. NW, Stanwood, WA 98292

Signature: _____
Patricia Love, Community Development Director

Published: June 29, 2025

2025-2044 General Sewer and Stormwater Plans
Project Narrative

As the sewer and stormwater service provider for the Stanwood area, the City has initiated an update to it General Plans. General Plans are intended to be updated approximately every 10 years to ensure they remain responsive to evolving community needs, regulatory requirements, population growth, and the condition of aging infrastructure. Regular updates help cities proactively manage capacity, address system deficiencies, plan for future development, and prioritize capital improvement projects to maintain reliable and efficient sewer service.

General utility plans also proactively address future growth needs of the City by evaluating current infrastructure capacity, forecasting population and development trends, and identifying the improvements needed to support anticipated demand. These plans ensure that essential services are expanded and upgraded in a timely and coordinated manner as growth occurs.

Sewer Plan:
The City's sewer system is a major infrastructure, most of which is invisible to the customers it serves. Sewage collection, treatment, and disposal are provided through a conventional gravity collection system and a treatment facility, including ultraviolet disinfection, sludge stabilization ponds, and river discharge of clean water. The primary purpose of the City's General Sewer Plan is to identify and schedule sewer system improvements that correct existing deficiencies and ensure a safe and reliable sewer system for current and future customers.

Stormwater Plan:
The purpose of the Stormwater Utility Plan is to establish a comprehensive and sustainable framework for managing stormwater runoff within the community. This plan aims to protect public and environmental health by reducing flooding, improving water quality, maintaining regulatory compliance, and supporting infrastructure maintenance and improvements. The includes a capital project list which identifies and prioritize stormwater infrastructure improvements and system upgrades necessary to manage stormwater effectively.

Adoption of the General Plans is classified as a **non-project action** under SEPA, as it does not directly authorize any specific construction or physical development. However, the plans includes both 10- and 20-year Capital Improvement Plans (CIPs) that identify future projects needed to address existing system deficiencies and accommodate projected growth in the sewer system.

The plans were prepared in accordance with state requirements and is organized into the following chapters:

General Sewer Plan	General Stormwater Plan
Chapter 1: Introduction	*Chapter 1: Introduction*
Chapter 2: Sewer System Description and Discharge Regulations	Chapter 2: Background
Chapter 3: Land Use and Population	Chapter 3: Regulatory Requirements
Chapter 4: Flow and Load Analysis	Chapter 4: Existing Stormwater System
Chapter 5: Policies and Design Criteria	Chapter 5: System Assessment
Chapter 6: Wastewater Collection System Evaluation and Deficiencies	Chapter 6: Capital Improvement Plan
Chapter 7: Existing Treatment Plant Evaluation	Chapter 7: Operation and Maintenance Program
Chapter 8: Treatment Plant Recommended Improvements	Chapter 8: Environmental Compliance Review
Chapter 9: Operations and Maintenance	Chapter 9: Municipal Ordinances and Design Guidelines Review
Chapter 10: Capital Improvement Plan	
Chapter 11: Financial Plan	

Complete copies of the plans are available for public viewing and download on the City of Stanwood's official website at www.stanwoodwa.org.

SEPA ENVIRONMENTAL CHECKLIST

Purpose of checklist

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization, or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

Instructions for applicants

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. **You may use "not applicable" or "does not apply" only when you can explain why it does not apply and not when the answer is unknown.** You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to **all parts of your proposal,** even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for lead agencies

Please adjust the format of this template as needed. Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of checklist for nonproject proposals

For nonproject proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of sections A and B, plus the Supplemental Sheet for Nonproject Actions (Part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in "Part B: Environmental Elements" that do not contribute meaningfully to the analysis of the proposal.

A. Background

1. **Name of proposed project, if applicable:**
   City of Stanwood 2025 - 2035 General Sewer Plan (GSP) Update

2. **Name of applicant:**
   City of Stanwood

3. **Address and phone number of applicant and contact person:**
   Kevin Hushagen, City of Stanwood Public Works Director
   10220 270th Street NW, Stanwood, WA 98292
   (425) 508-7829

4. **Date checklist prepared:**
   April 2025

5. **Agency requesting checklist:**
   City of Stanwood

6. **Proposed timing or schedule (including phasing, if applicable):**
   Once completed, the final draft of the General Sewer Plan (GSP) will be submitted to the Washington State Department of Ecology (Ecology) for review and comments. Final Ecology and City Council approval is expected in late 2025. The GSP will be in effect for 10 years from the date of final approval. The GSP proposed projects that will rehabilitate and replace aging sewer main and facilities.

7. **Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.**
   General Sewer Plans are intended to be updated approximately every 10 years to ensure they remain responsive to evolving community needs, regulatory requirements, population growth, and the condition of aging infrastructure. Regular updates help cities proactively manage capacity, address system deficiencies, plan for future development, and prioritize capital improvement projects to maintain reliable and efficient sewer service.

   This plan outlines both 10-year and 20-year Capital Improvement Plans (CIPs), as detailed in Chapter 10 of the General Sewer Plan (GSP). The implementation of these projects will be guided by system needs and the availability of funding. As projects move forward to the construction phase, each will be subject to individual permitting processes and, where applicable, will require separate State Environmental Policy Act (SEPA) reviews and approvals.

8. **List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.**

   The following were prepared for or support the findings and conclusions contained in the General Sewer Plan:

   - *2024 – 2044 City of Stanwood Comprehensive Plan, September 2024*
   - *2024 - 2044 Stanwood Comprehensive Plan Expanded SEPA Checklist and Determination of Non-Significance, May 2024*
   - *Nitrogen Optimization Plan, July 2023*
   - *Influent Flow, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS) Analysis, 2022*
   - *Liquid Stream Analysis (water flow, depth and velocity), October 2022*

9. **Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.**

   None.

10. **List any government approvals or permits that will be needed for your proposal, if known.**

    This plan will require approval from Ecology and the Stanwood City Council. The individual 10-year and 20-year CIP projects will be implemented based on need and available financing. Individual projects that proceed to construction will be individually permitted and will have individual SEPA applications as required.

11. **Give a brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)**

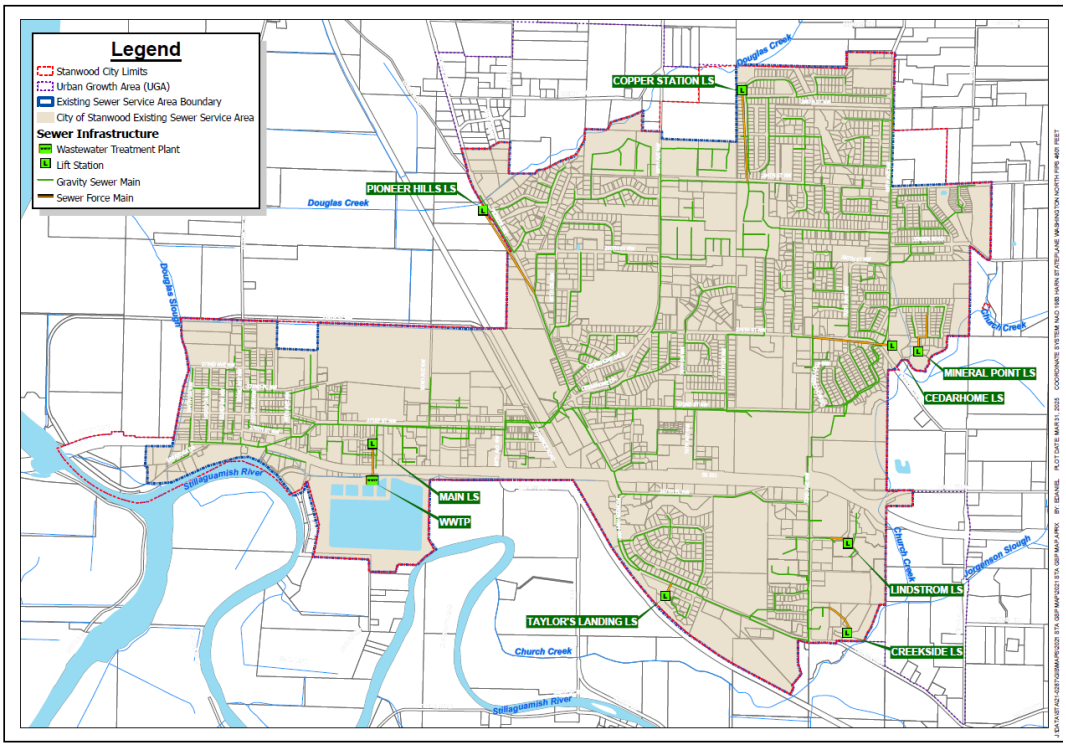
    As the sewer service provider for the Stanwood area, the City is required to update its General Sewer Plan every 10 years. This plan outlines how Stanwood will manage its wastewater collection, conveyance, and treatment systems through the year 2035. Adoption of the General Sewer Plan is classified as a ***non-project action*** *under SEPA, as it does not directly authorize any specific construction or physical development. However, the plan includes both 10- and 20-year Capital Improvement Plans (CIPs) that identify future projects needed to address existing system deficiencies and accommodate projected growth in the sewer system. These projects typically involve upgrades to sewer pipelines and related infrastructure. Each project will undergo separate environmental review at the time it is designed and permitted.*

    The plan was prepared in accordance with WAC 173-240-050 and is organized into the following chapters:

    - *Chapter 1: Introduction*
    - *Chapter 2: Sewer System Description and Discharge Regulations*
    - *Chapter 3: Land Use and Population*

- *Chapter 4: Flow and Load Analysis*
- *Chapter 5: Policies and Design Criteria*
- *Chapter 6: Wastewater Collection System Evaluation and Deficiencies*
- *Chapter 7: Existing Treatment Plant Evaluation*
- *Chapter 8: Treatment Plant Recommended Improvements*
- *Chapter 9: Operations and Maintenance*
- *Chapter 10: Capital Improvement Plan*
- *Chapter 11: Financial Plan*

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.



The City is located in north Snohomish County, Washington, north of the mouth of the Stillaguamish River within Township 32N, Ranges 3E and 4E. The City's corporate boundary encompasses an area of approximately 2.9 square miles. The City's existing sewer service area is comprised of five major sewer drainage basins and eight subbasins. Portions of the northern, southeastern, and southwestern areas of the Urban Growth Area (UGA) are not currently served by the City's existing sewer system. The sewer service area is based on the City's UGA which was established through a close partnership with the Snohomish County Planning Department to satisfy Washington State Growth Management Act guidelines. Reference Figure 2-2 of the GSP for the City's Sewer Service Area.

B. Environmental Elements

1. Earth

a. General description of the site:

The topography of the City varies greatly in elevation. The lowest areas served are located along the Stillaguamish River in western Stanwood and south of the City limits. The floodplains have an elevation between approximately 0 and 5 feet. The highest areas served are located near the City's Knittle and Cedarhome Reservoirs and have an elevation of approximately 270 feet.

Circle or highlight one: Flat, rolling, hilly, steep slopes, mountainous, other:

b. What is the steepest slope on the site (approximate percent slope)?

The steepest slopes in the City are associated with the Church Creek riparian corridor and are up to 65-percent in some areas.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them, and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The soils in the area include Puget-Sultan-Pilchuck soils (consisting primarily of Puget silty clay loam) in the flat alluvial portions of the City's service area, and Tokul-Pastik soils (mainly Bellingham silty clay loam and Tokul gravelly loam) in the higher elevations of the eastern portion of the City's service area. The Bellingham silty clay loam and Patsik silt loam, 0-t-8 percent slopes, are associated with lacustrine deposits mixed with alluvium and volcanic ash, respectively. Tokul gravelly loam, 8-to-15 percent slopes, and Tokul-Winston gravelly loam, 25-to-65 percent slopes, are both volcanic ash over basal till. The Tokul-Winston gravelly loam is found throughout the steeply incised Church Creek corridor. The checklists for individual projects will further address soils on a site-specific basis.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

Per the Slope Stability Map (Figure NF-7a) in the City's 2024-2044 Comprehensive Plan*, there is a zone of moderate landslide risk associated with moderate slopes of moderate erosion potential along the Church Creek corridor. Along much of Pioneer Highway and the Jorgenson Slough, there is a zone of high landslide risk associated with steep slopes of high erosion potential. Most of the western portion of the City has a high incidence of landslides. The eastern portion of the City has a low incidence of landslides. Most areas beyond the Church Creek and Pioneer Highway/Jorgenson Slough corridors are at a low landslide risk and are associated with slight slopes and slight erosion potential. Slopes, erosion, and landslide risks reflect US Department of Agriculture (USDA) data. The incidence of landslide hazards reflects US Geologic Survey (USGS) data. According to seismic hazard data gathered from the Washington State Department of Natural Resources (DNR), most of the western portion of the City is at high risk for seismic*

hazards, and much of the eastern portion of the City is at low or very low risk for seismic hazards. The checklists for individual projects will further address this on a site-specific basis.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

Checklists for individual projects will address this on a site-specific basis.

f. Could erosion occur because of clearing, construction, or use? If so, generally describe.

Yes, however, checklists for individual projects will address this on a site-specific basis.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Unknown at this time. Checklists for individual projects will address this on a site-specific basis.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any.

Checklists for individual projects will address this on a site-specific basis. Per City standards, projects will include typical best management practices (BMPs) such as installing silt fences, straw wattles, mulch, hydroseeding, erosion control blankets or check dams as needed for erosion control.

2. Air

a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known.

Temporary construction machinery and vehicle exhaust emissions are anticipated during construction of the proposed projects. Dust emissions during excavation may also occur. There shall be no emissions to the air resulting from the operation of the finished projects, with the exception of vehicle emissions generated during employee site visits. Indirect emissions of the project include those resulting from expanded development within the UGA, such as construction vehicle exhaust and dust, and personal vehicle exhaust and wood/pellet burning stoves. Checklists for individual projects will address this on a site-specific basis.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

None known. Checklists for individual projects will address this on a site-specific basis.

c. Proposed measures to reduce or control emissions or other impacts to air, if any.

Vehicle emissions shall be kept to a minimum by turning off construction equipment and other vehicles instead of allowing them to idle during periods when they are not being used. Appropriate dust control measures (sweeping, watering) will be implemented as part of each project's TESC plan to keep construction-generated dust to a minimum. Checklists for individual projects will address this on a site-specific basis.

3. Water

a. Surface Water:

1. **Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.**

   Church Creek and Freedom Creek flow through the eastern portion of the City's UGA, from north to south. Both flow into Jorgenson Slough which is tributary to the Stillaguamish River that flows along the southern edge of the UGA. Palustrine wetlands exist throughout the UGA. Similarly, the Stillaguamish River is associated with estuarine wetlands below the Jorgenson Slough confluence. Douglas Creek is located in the northern portion of the UGA and flows into Skagit Bay. The western portion of the City is also within the 100-year floodplain. Checklists for individual projects will address this on a site-specific basis.

2. **Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.**

   Potentially, however, checklists for individual projects will address this on a site-specific basis.

3. **Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.**

   No fill or dredge activities in water bodies or wetlands are anticipated. Checklists for individual projects will address this on a site-specific basis.

4. **Will the proposal require surface water withdrawals or diversions? Give a general description, purpose, and approximate quantities if known.**

   No surface water withdrawals or diversions are anticipated. Checklists for individual projects will address this on a site-specific basis.

5. **Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.**

   Downtown Stanwood from the western City limits to Pioneer Highway is in the floodplain. Checklists for individual projects will address this on a site-specific basis.

6. **Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.**

   The City's Wastewater Treatment Plant discharges treated effluent to the Stillaguamish River. Increases in capacity to handle the conveyance of raw influent to the wastewater treatment facility and subsequent increases in discharge effluent due to population increases in the City's UGA will result in the increased discharge of treated effluent. The mass of conventional pollutants such as biochemical oxygen demand, total suspended solids, and ammonia that will be discharged to the river will be less than or equal to the mass of the these pollutants currently allowed by the Wastewater Treatment Plant's NPDES permit.

b. Ground Water:

1. **Will groundwater be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give a general description, purpose, and approximate quantities if known.**

   Impacts to the City's groundwater sources are not anticipated. Localized areas may require dewatering for excavation during construction. Checklists for individual projects will address this on a site-specific basis.

2. **Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (domestic sewage; industrial, containing the following chemicals…; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.**

   Not applicable.

c. Water Runoff (including stormwater):

1. **Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.**

   Runoff control during construction will be prescribed in construction documents and individual project TESC plans. Checklists for individual projects will address this on a site-specific basis.

2. **Could waste materials enter ground or surface waters? If so, generally describe.**

   Potentially, however, checklists for individual projects will address this on a site-specific basis.

3. **Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe.**

   No impact to drainage patterns are anticipated. Checklists for individual projects will address this on a site-specific basis.

4. **Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any.**

   In all areas of special flood hazard, the provisions set forth in the Stanwood Municipal Code (SMC) Chapter 17.120 Critical Areas – Frequently Flooded Area – Specific Standards shall be met. In all wetlands and wetland buffers, the provisions set forth in the SMC Chapter 17.125 Critical Areas – Wetlands – Specific Standards shall be met. In all areas of aquifer recharge including Wellhead Protection Areas, the provisions set forth in the SMC Chapter 17.135 Critical Areas – Critical Aquifer Recharge Areas – Specific Standards shall be met.

   Construction would typically be performed during dry periods between May 1st and September 30th, followed by landscaping and restoration of existing ground contours, features, and substrates. TESC plans will need to be developed and approved by the

City prior to any construction project. The provisions set forth in SMC Chapter 17.140 Stormwater Management Performance Standards shall be met. Checklists for individual projects will address this on a site-specific basis.

4. Plants

a. Check the types of vegetation found on the site:

☒ **deciduous tree: alder, maple, aspen, other**
☒ **evergreen tree: fir, cedar, pine, other**
☒ **shrubs**
☒ **grass**
☒ **pasture**
☐ **crop or grain**
☐ **orchards, vineyards, or other permanent crops.**
☒ **wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other**
☐ **water plants: water lily, eelgrass, milfoil, other**
☐ **other types of vegetation**

Checklists for individual projects will address this on a site-specific basis.

b. What kind and amount of vegetation will be removed or altered?

CIP projects will generally occur in unvegetated improved rights-of-way or new rights-of-way cleared for road improvements. Some projects may require the removal of vegetation. Checklists for individual projects will address this on a site-specific basis.

c. List threatened and endangered species known to be on or near the site.

The proposed non-project action does not include any construction or development that would impact any listed threatened or endangered species. Potential impacts of future developments will be addressed through regulations and/or project specific environmental review.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any.

Landscaping and screening may be part of the requirements for facility projects. Any necessary landscaping shall utilize native plants when appropriate. Checklists for individual projects will address this on a site-specific basis.

e. List all noxious weeds and invasive species known to be on or near the site.

The Snohomish County Noxious Weed Control Board keeps information on noxious weeds in Snohomish County. The Weed Control Board lists: 40 Class A Weeds that pose a threat to all counties of the state and require eradication; 59 Class B Weeds that are required to be controlled in Snohomish County, and two Class C Weeds that the Weed Control Board has chosen to regulate control of within Snohomish County. Project-specific development projects will be reviewed for consistency with applicable provisions of Stanwood City Code and undergo separate SEPA review as applicable.

5. Animals

a. List any birds and other animals that have been observed on or near the site or are known to be on or near the site.

Examples include:

- **Birds: hawk, heron, eagle, songbirds, other:**
- **Mammals: deer, bear, elk, beaver, other:**
- **Fish: bass, salmon, trout, herring, shellfish, other:**

Checklists for individual projects will address this on a site-specific basis.

b. List any threatened and endangered species known to be on or near the site.

The Washington State Department of Fish and Wildlife (WDFW) Salmon Conservation and Reporting Engine (SCoRE) indicates the following threatened species presence within the Stillaguamish Resource Inventory Area and Snohomish County. Checklists for individual projects will address this on a site-specific basis.

- *Winter steelhead (*Oncorhyncus mykiss*)*
- *Summer steelhead (*O. mykiss*)*
- *Chinook (*O. tshawytscha*)*

*The Chinook salmon (*O. tshawytscha*) Puget Sound ESU and Steelhead (*O. mykiss*) Puget Sound DPS encompass City limits and are listed as threatened under the Endangered Species Act. Bull trout (*Salvelinus confluentus*) are listed as threatened and have designated critical habitat in the Stillaguamish River.*

c. Is the site part of a migration route? If so, explain.

Bald eagles (protected under the Migratory Bird Treaty and Bald and Golden Eagle Protection Act) have been reported in the City's UGA. The Puget Sound Lowlands are part of the Pacific Flyway for migratory birds, and birds regularly use areas within the City for resting and feeding during the migratory season.

d. Proposed measures to preserve or enhance wildlife, if any.

Construction work must occur within specific windows that do not interfere with the migration and spawning of listed salmonids and nesting bald eagles. Construction activities must meet the provisions set forth in SMW Chapter 17.130 Critical Areas – Fish and Wildlife Habitat Conservation Areas – Specific Standards.

e. List any invasive animal species known to be on or near the site.

None known, however, checklists for individual projects will address this on a site-specific basis.

6. Energy and Natural Resources

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Petroleum fuels and lubricants will be consumed by machinery used during construction. Operation of some sewer system facilities will require electricity and backup diesel or

gas-run generators that may be located on-site in the event of power outages. Checklists for individual projects will address this on a site-specific basis.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

No.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any.

Use of high-efficiency pumps and motors and sewer main of sufficient diameter to minimize pumping head losses and associated power usage.

7. Environmental Health

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur because of this proposal? If so, describe.

Wastewater would need to be routed around any active construction zone in temporary above-ground piping.

1. Describe any known or possible contamination at the site from present or past uses.

a. Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

None are anticipated. Checklists for individual projects will address this on a site-specific basis.

b. Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

None are anticipated. Checklists for individual projects will address this on a site-specific basis.

c. Describe special emergency services that might be required.

None are anticipated. Local police, fire, and aid should suffice during construction. Checklists for individual projects will address this on a site-specific basis.

d. Proposed measures to reduce or control environmental health hazards, if any.

All drains for chemicals will be secondarily contained for safe transport to a lined waste manhole in the event of a spill. All necessary safety equipment for chemical handling will be provided. Checklists for individual projects will address this on a site-specific basis.

b. Noise

1. What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

Stanwood is a typical small urban city with associated noise. Checklists for individual projects will address this on a site-specific basis.

2. What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site)?

Temporary construction noise may be expected during working hours. No long-term noise is anticipated with any of the identified improvements. Checklists for individual projects will address this on a site-specific basis.

3. Proposed measures to reduce or control noise impacts, if any.

Construction equipment will need to be properly maintained and muffled, and the hours of construction will be limited to coincide with the normal workday period (SMC 7.30, noise control). Pumps will be enclosed in a building or other structure to minimize noise impacts. Checklists for individual projects will address this on a site-specific basis.

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe.

Land use in the City's UGA is a mixture of residential, commercial, industrial, agricultural, farmland, and public facilities shoreline. Checklists for individual projects will address this on a site-specific basis.

b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses because of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

Portions of the planning area have been and continue to be used for agriculture. Checklists for individual projects will address this on a site-specific basis.

1. Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how?

Checklists for individual projects will address this on a site-specific basis.

c. Describe any structures on the site.

Stanwood is an urban city with a full range of residential, commercial, industrial, and institutional structures.

d. Will any structures be demolished? If so, what?

No demolitions are anticipated. Checklists for individual projects will address this on a site-specific basis.

e. What is the current zoning classification of the site?

Stanwood is an urban city with a full range of residential, commercial, and industrial uses. A copy of the adopted zoning map can be found on the City's website. Checklists for individual projects will address this on a site-specific basis.

f. What is the current comprehensive plan designation of the site?

Stanwood is an urban city with a full range of residential, commercial, and industrial uses. A copy of the adopted future land use map can be found on the City's website. Checklists for individual projects will address this on a site-specific basis.

g. If applicable, what is the current shoreline master program designation of the site?

The shoreline designation of the Stillaguamish River adjacent to the City is shoreline conservancy, isolated, high intensity, and public facility. A portion of Church Creek is designated shoreline conservancy and shoreline residential in the City limits. Checklists for individual projects will address this on a site-specific basis.

h. Has any part of the site been classified as a critical area by the city or county? If so, specify.

The City maintains Critical Area regulations and maps that specifically identify such areas within the City limits (SMC Chapters 17.144 through 17.135). Checklists for individual projects will address this on a site-specific basis.

i. Approximately how many people would reside or work in the completed project?

The City of Stanwood serves an existing sewer system population of approximately 8,865 people (2024 Washington State Office of Financial Management Estimate). The projects will provide essential sewer conveyance for the City sewer system, which is projected to serve a sewer system population of 10,426 by 2034 and 13,180 by 2044.

j. Approximately how many people would the completed project displace?

No displacements are anticipated. Checklists for individual projects will address this on a site-specific basis.

k. Proposed measures to avoid or reduce displacement impacts, if any.

No displacements are anticipated. The purpose of the plan is to ensure facility capacity for future growth. Checklists for individual projects will address this on a site-specific basis.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any.

The GSP was developed to ensure compatibility with the Growth Management Act, the City of Stanwood 2024-2044 Comprehensive Plan, and the Snohomish County Comprehensive Plan.

m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any.

Land within the City limits and UGA are intended to be developed to urban densities and intensities per the GMA and the City's 2024-2044 Comprehensive Plan. There are no agricultural or forest lands of commercial significance.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

N/A – housing type and density is determined by the Comprehensive Plan and Stanwood Municipal Code.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

None anticipated.

c. Proposed measures to reduce or control housing impacts, if any.

N/A – the purpose of this sewer plan is to ensure that the sewer system is capable of serving future growth.

10. Aesthetics

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

Residential, commercial, and industrial building heights are established by the Municipal Code. The tallest structure in the City of Stanwood is the 550,000 Cedarhome storage reservoir. This reservoir is a composite structure with a concrete base and an elevated steel tank. Structures taller than this reservoir are not anticipated to be constructed. Checklists for individual projects will address this on a site-specific basis.

b. What views in the immediate vicinity would be altered or obstructed?

None are anticipated. Checklists for individual projects will address this on a site-specific basis.

c. Proposed measures to reduce or control aesthetic impacts, if any.

Screen fencing and vegetation screening may be utilized at individual projects sites. Checklists for individual projects will address this on a site-specific basis.

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

N/A – non-project action.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

Not anticipated; checklists for individual projects will address this on a site-specific basis.

c. What existing off-site sources of light or glare may affect your proposal?

None expected; checklists for individual projects will address this on a site-specific basis.

d. Proposed measures to reduce or control light and glare impacts, if any.

For each individual project, a site-specific checklist will be developed to assess the appropriate BMPs. Checklists for individual projects will address this on a site-specific basis. To minimize light pollution and prevent unwanted light spillover onto adjacent properties, BMPs will be required such as adding light shields or installing angled lights that focus illumination on the intended areas.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

The CIP projects proposed in the GSP would allow for continued passive recreational opportunities that are consistent with the commercial and residential nature of the City's UGA. Checklists for individual projects will address this on a site-specific basis.

b. Would the proposed project displace any existing recreational uses? If so, describe.

None anticipated by the Plan.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any.

The first step in project analysis will involve evaluating alternatives to avoid, minimize, or offset potential impacts to City park and recreation facilities. If impacts cannot be avoided, the project will include appropriate mitigation measures, such as replacing affected facilities as needed to maintain recreational access and service levels. SEPA Checklists for individual projects will address this on a site-specific basis.

13. Historic and Cultural Preservation

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers? If so, specifically describe.

While this is a non-project action with no direct impact on cultural resources, it is noted that there are multiple buildings, structures and sites city-wide that could potentially be eligible for listing in historical preservation registries.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources.

Northwest Snohomish County and the modern City of Stanwood is located within the traditional territory of the of the stuləgʷábš, People of the River, Stoluck-wa-mish River Tribe, the Stillaguamish Tribe of Indians. The Stillaguamish people have inhabited these lands and waters since time immemorial and their descendants have remained in this territory to this day. The villages along the Stillaguamish River were known to be

significant economic and cultural centers that supported high population densities of the time where people practiced the traditional ways of fishing, hunting and gathering. As the GSP is a non-project action, a cultural resource report has not been prepared.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc.

None at this time as this is a non-project action. However, future developments will be required to send project notices to local Tribes and check the Department of Architectural and Historical Preservation (DAHP)'s WISAARD database to identify potential sites.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

This is a non-project action, however, if during future project construction any evidence of archeological or historic resources are found, all work will be stopped, and a qualified professional will be consulted. The Washington State Department of Archeology and Historic Preservation and the office of the Stillaguamish Tribes will also be contacted and consulted to determine the correct course of action. An Inadvertent Discovery Plan summarizing actions the developer may need to take in the event something is discovered during construction may be required if requested by the Department of Archaeology and Historic Preservation.

14. Transportation

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on site plans, if any.

Stanwood is an urban community characterized by a well-defined street network that includes a combination of arterial, collector, and local residential streets. This network supports a variety of transportation needs, from regional access to neighborhood connectivity. The city is bisected by State Route 532 (SR 532), a major east-west state highway that serves as a primary transportation corridor. SR 532 provides regional access between Interstate 5 and Camano Island, while also functioning as a main thoroughfare through the heart of Stanwood.

b. Is the site or affected geographic area currently served by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop?

Stanwood is served by several public transit providers that offer a range of transportation options for residents, commuters, and visitors. ***Community Transit*** *operates fixed-route bus service connecting Stanwood to nearby cities and regional destinations, including Everett and Lynnwood, with links to the broader Puget Sound transit network.* ***Island Transit*** *provides fare-free service between Stanwood and Camano Island, supporting mobility for island residents and offering connections to other regional transit systems. In addition, the* ***Snow Goose Transit*** *service offers specialized transportation for seniors and individuals with mobility challenges, enhancing accessibility and promoting independence for Stanwood's aging population. Together, these services support the multimodal travel needs of the Stanwood – Camano region.*

c. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle, or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private).

None anticipated; checklists for individual projects will address this on a site-specific basis.

d. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

None anticipated; checklists for individual projects will address this on a site-specific basis.

e. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?

The General Sewer Plan does not directly influence traffic demand or generate new vehicle trips. Instead, traffic impacts are typically driven by land use decisions, which are guided by the City's Comprehensive Plan. The Comprehensive Plan establishes the vision for future development, including the type, location, and intensity of land uses across Stanwood. The role of the General Sewer Plan is to ensure that the City's wastewater infrastructure has the capacity and reliability to support the growth and development envisioned in the Comprehensive Plan.

f. Will the proposal interfere with, affect, or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe.

The only potential impacts related to sewer projects may involve repairs or modifications to existing roadways, if necessary, during construction or maintenance activities. Any such impacts will be evaluated on a case-by-case basis at the project level, with appropriate mitigation measures identified and implemented as needed to minimize disruption to transportation infrastructure and public access.

g. Proposed measures to reduce or control transportation impacts, if any.

If any traffic impacts arise as a result of sewer construction or maintenance activities, the City will implement standard traffic control measures to ensure public safety and maintain traffic flow. These measures will be tailored to the specific site conditions and scope of work and may include:

- *Temporary signage and warning devices*
- *Lane closures or partial road closures*
- *Flaggers to direct traffic through work zones*
- *Detour routes to redirect vehicles around construction areas*
- *Reduced speed limits in construction zones*
- *Temporary pedestrian pathways and crossings to maintain accessibility*
- *Work hour restrictions to avoid peak traffic periods*

Any traffic control strategies will be designed in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and applicable City or state guidelines. A traffic control plan will be prepared for each project as needed, ensuring that impacts are effectively managed and minimized throughout the duration of the work.

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? If so, generally describe.

CIP projects proposed in this GSP will help ensure adequate and responsive sewer service for the residential and commercial growth projected in the City. Checklists for individual projects will address this on a site-specific basis.

b. Proposed measures to reduce or control direct impacts on public services, if any.

No impacts on public services are anticipated. Checklists for individual projects will address this on a site-specific basis.

16. Utilities

a. Circle utilities currently available at the site: electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other:

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

This GSP describes projects for the improvement of the City's existing sewer system.

C. Signature

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

X

SEPA Responsible Offical

Type name of signee: Patricia Love

Position and agency/organization: Community Development Director, City of Stanwood

Date submitted: 7/29/2025

D. Supplemental sheet for nonproject actions

IT IS NOT REQUIRED to use this section for project actions.

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. **How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?**

   Discharge to Water: During the construction of the proposed sewer main and facility projects, discharge of turbid water could occur. After the projects are constructed and in use, development in the City's UGA may be expanded into the new areas served by the City's sewer system. Without these utility improvements, development projects would be unable to occur at the housing density the City anticipates will be necessary to accommodate growth. More development and higher populations will produce more wastewater to be treated and discharged. Increased impervious surfaces will increase the discharge of stormwater to local water bodies such as the Stillaguamish River, which may also contribute to higher flood risks.

   Emissions to Air: Temporary construction emissions expected include exhaust from machinery and vehicles and dust. Personal vehicles belonging to the new homes built as a result of the improved sewer system and various heating methods (wood and pellet burning stoves) would contribute exhaust and greenhouse gas emissions to the air.

   Production, Storage, and Release of Toxic or Hazardous Substances: Untreated raw sewage is a hazardous substance, containing concentrated fecal bacteria, food scraps, cleaning and clog-removing chemicals, hormones, and often illegal substances not normally recommended for disposal in the sewer system. The collection and conveyance of sewage is a positive environmental investment because the wastewater treatment facility must meet water quality discharge standards. The other option for sewage disposal is septic systems, which are prone to failure and non-point pollution that is harmful to water quality and wildlife. The proposed CIP projects in the GSP will generally improve existing conditions by accommodating future growth and incorporating new technologies.

   Production of Noise: Temporary construction noise would be limited to daytime work-day hours. Subsequent development of residential and commercial structures will also result in temporary construction noise. The production of noise created in new residential and commercial areas should be equal to current ambient noise levels within the City limits.

Proposed measures to avoid or reduce such increases are:

Reducing Discharges to Water: TESC plans for each construction project will minimize and protect water bodies from turbid water discharge and runoff. Construction work will comply with near-water work windows to avoid disturbing sensitive and protected fish and wildlife.

Reducing Emissions to Air: Construction machinery and vehicle emissions shall be kept to a minimum by turning off equipment instead of idling during periods when equipment is not in use. Appropriate dust control measures (sweeping, watering) will be implemented as part of each project's TESC plan to keep construction-generated dust to a minimum. Green technologies and equipment should be utilized during the construction of the proposed projects when plausible.

Reducing the Production, Storage, and Release of Toxic or Hazardous Substances: All drains for these chemicals will be secondarily contained for safe transport to a lined waste manhole in the event of a spill. All necessary safety equipment for chemical handling will be provided.

Reducing the Production of Noise: Construction work will be limited to daytime work-day hours, Monday through Friday.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

Once completed, the sewer main projects will be fully buried within the road right-of-way. During construction, discharge of turbid water to streams may occur, which could disrupt salmonid life history stages. Staging of excavation and fill materials and equipment on land would affect any plants in the immediate area. Facility projects could have localized effects on plants, animals, and fish. These projects could require clearing of existing vegetation, which could affect wildlife that utilizes the vegetation for food or shelter. Clearing and grading for facilities may result in the discharge of turbid water to streams, which could disrupt migration of rearing of salmonids.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

TESC plans for each construction project will create a means to protect water bodies from turbid water discharge and runoff. Working during the summer month work-window presents less risk for turbid discharge since rain events are less frequent and severe. Staging materials and equipment should be located on impervious surfaces or in previously cleared or impacted areas if possible. There should be no further clearing of vegetation beyond what is needed for the construction of the projects.

3. How would the proposal be likely to deplete energy or natural resources?

Petroleum resources will be used for the construction of the proposed projects (fuel for construction machinery and vehicles) and subsequent construction of residential and commercial structures. Housing and other structures will require heating (natural gas and wood/pellet burning stoves) and electricity.

Proposed measures to protect or conserve energy and natural resources are:

Utilization of high-efficiency pumps and motors and sewer main of sufficient diameter to minimize pumping losses and associated power usage.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection, such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

CIP projects described in the GSP should have no direct effect on parks, wilderness, wild and scenic rivers, floodplains, or prime farmlands. The projects could directly affect sensitive areas such as federally listed threatened species habitat, cultural sites, and wetlands. As discussed, construction of these projects may discharge turbid water to water bodies including riparian wetland areas. Church Creek and the Stillaguamish River are salmon-bearing streams. Bull trout is federally listed as threatened and has designated critical habitat in the Stillaguamish River. Finally, any excavation near waterways in the Puget Sound Lowlands could result in the discovery of historic Native American cultural artifacts and sites.

The proposal could have indirect effects (via expanded clearing, grading, and building in the service areas) on federally listed threatened species habitat, cultural sites, wetlands, and floodplains. Discharge of turbid water to Church Creek and the Stillaguamish River could affect rearing and migrating bull trout and salmonids, critical habitat, and riparian wetlands associated with these water bodies. Excavation of structure foundations could uncover cultural sites. Impervious surfaces (buildings, parking lots, roads) result in increased stormwater runoff, which could contribute to flooding issues in the Stillaguamish floodplain.

Proposed measures to protect such resources or to avoid or reduce impacts are:

Compliance with critical area codes and providing mitigation if required. TESC plans for each construction project will create a means to protect water bodies from turbid water discharge and runoff. Working during the summer month work-window presents less risk for turbid discharge since rain events are less frequent and severe. Construction work will comply with near-water and migratory bird work windows to avoid disturbing federally listed salmonids and wildlife. Staging materials and equipment should be located on impervious surfaces or in previously cleared or impacted areas if possible. There should be no further clearing of vegetation beyond what is needed for the construction of the projects. If cultural artifacts or historic resources are uncovered during construction, project work should be suspended immediately. Appropriate authorities at the County and State levels should be notified and appropriate measures taken to protect these resources.

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

The proposed CIP projects in the GSP would allow for the expansion of residential and commercial uses within the City's UGA. The UGA was defined specifically to accommodate growth in the City.

Proposed measures to avoid or reduce shoreline and land use impacts are:

Compliance with Shoreline Management Plan (SMP) and mitigation as required. Minimize clearing and grading of vegetation to that directly needed to accomplish the proposed project. Ensure projects are consistent with City planning objectives and ordinances.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

The direct transportation effects of the proposed projects associated with the GSP could be temporary loss of sidewalks, on-street parking, lane closures, or detours near sewer main installation within road right-of-way. Bus stops may also be temporarily affected by work in the right-of-way. Sewer service and other utility services should not be affected during construction.

Indirect effects of the proposed projects on transportation would be increased road usage and the need to build new roads for new developments and potentially expand and make more frequent repairs to existing roads. Higher populations may result in increased ridership of community transit and expanded service route frequency and stops. The improvement of the sewer system will result in the ability to support new residential and commercial developments.

Proposed measures to reduce or respond to such demand(s) are:

Construction would take place in a timely manner to minimize obstructions and alternations of local traffic flow. City-approved traffic control detours will be provided during construction if needed.

7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

The proposed projects may conflict with environmental protection laws; however, all projects proposed will be required to obtain applicable local, state, and federal permits, which are intended to encourage avoidance, minimization, and mitigation for adverse environmental impacts. A preliminary list of potential permits needed for proposed sewer main and facility projects are listed below.

<u>City of Stanwood</u>

- *Building, Right-of-Way, and Site Development Permits*
- *Floodplain Development Permit*
- *Critical Areas Compliance*
- *Shoreline Conditional Use or Variance Permit (for structures within 200 feet landward of a water body)*

<u>State</u>

- *State Department of Ecology General Order of Approval for Diesel or Gas Emergency Electrical Generators (for back-up generators during power outages)*
- *Section 401 Water Quality Certification through State Department of Ecology (needed if Section 404 required).*

Federal

- *Federal permits for work within wetlands or waters of the State (i.e. Section 404 or Section 10 approval through the Army Corps of Engineers), including associated Endangered Species Act, Coastal Zone Management and National Historic Preservation Act Compliance.*

Legend

- Stanwood City Limits
- Urban Growth Area (UGA)
- Existing Sewer Service Area Boundary
- City of Stanwood Existing Sewer Service Area

Sewer Infrastructure

- Wastewater Treatment Plant
- Lift Station
- Gravity Sewer Main
- Sewer Force Main

COPPER STATION LS
PIONEER HILLS LS
MINERAL POINT LS
CEDARHOME LS
MAIN LS
WWTP
LINDSTROM LS
TAYLOR'S LANDING LS
CREEKSIDE LS
Douglas Creek
Douglas Slough
Stillaguamish River
Church Creek
Jorgenson Slough
SR 532
270TH ST NW
271ST ST NW
272ND ST NW
268TH ST NW
269TH ST NW
261ST ST NW
95TH PL NW
95TH AVE NW
HOBLE ROAD
HATFIELD ROAD
TIDE ROAD
PIONEER HWY

This map is a graphic representation derived from the City of Stanwood Geographic Information System. It was designed and intended for City of Stanwood staff use only; it is not guaranteed to survey accuracy. This map is based on the best information available on the date shown on this map.

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Vicinity Map

Figure 2-2
Sewer Service Area
City of Stanwood
General Sewer Plan

1 inch : 600 Feet

0 300 600 1,200 Feet

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"

NORTH

J:\DATA\STA\21-0287\GIS\MAPS\2021 STA GSP MAP\2021 STA GSP MAP.APRX BY: EDANIEL PLOT DATE: MAR 31, 2025 COORDINATE SYSTEM: NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET

Appendix C

City of Stanwood Standards for Sewer System Construction

CHAPTER 5

5.000 SANITARY SEWER

5A GENERAL CONSIDERATIONS

5A.010 General

Sanitary sewerage refers to waste water derived from domestic, commercial and industrial pretreated waste to which storm, surface, and ground water are not intentionally admitted. Pretreatment shall follow all the requirements as set forth by DOE.

Any extension of Stanwood's sanitary sewer system must be approved by the City and must conform to the City of Stanwood Comprehensive Sanitary Sewer Plan, City of Stanwood Wastewater Facilities Plan, Department of Ecology (DOE), and Snohomish County Health District requirements.

Anyone who wishes to extend or connect to the City's sewer system for new development should contact the Community Development Department. The proposed extension/connection will be reviewed in the context of the applicable permit process for the proposed development and is subject to the submission requirements and fees, including connection and plant investment fees, for that process. The Community Development Department will coordinate the required review with other City Departments through the permit process.

Questions about existing service improvements or repairs should be directed to Public Works. Prior to the release of any water meters, or occupancy, all improvements must be completed and approved, and all applicable fees must be paid in full.

5A. 015 Requirements for Connection to the Sanitary Sewer

Within the corporate city limits where a public sewer is available, it must be used. Connection to the public sewer shall occur when mandated by the Department of Health and/or Stanwood Municipal Code. 5A.020 Marking Side Sewers

The location of side sewers at the property line shall be marked by the Contractor with a 2-inch by 4-inch wooden stake 6-feet long buried in the ground a depth of 3-feet. The low end shall have a 2 by 4-inch cleat nailed to it to prevent withdrawal of the stake. The exposed end shall be painted green and the depth to the side sewer or tee shall be indicated in black paint on the 2 by 4. In addition, a length of 12-gage galvanized wire shall be provided to extend from the plugged end of the side sewer or tee. The upper end shall emerge at the 4-foot stake, but shall not be fastened to it.

5A.030 Sanitary Sewer/Water Main Crossings.

See Water Chapter 4.

5A.040 Staking

All surveying and staking shall be performed by an engineering or surveying firm capable of performing such work. The State of Washington shall license the engineer or surveyor directing such work as a professional engineer or professional land surveyor.

A preconstruction meeting shall be held with the City prior to commencing staking. The City shall inspect all construction staking prior to construction.

The minimum staking of sewer lines shall be as directed by the City Engineer or as follows:

A. Stake location of mainline pipe and laterals every 50 feet with cut or fill to invert of pipe.

B. Stake location of all manholes for alignment and grade with cut or fill to rim and invert of pipes.

5A.050 Trench Excavation.

See Water Chapter 4, except for the reference to the 36-inches of cover.

5A.060 Backfilling

See Transportation and Streets Chapter 2 and sewer details for requirements regarding trench backfill.

Where native soils are excavated from trenches and replaced with bedding that is more pervious (e.g. clay replaced with granular bedding), CDF or clay trench dams shall be provided every 300 feet along the sewer alignment to prevent the transport of groundwater.

5A.070 Street Patching and Restoration

See Transportation and Streets Chapter 2 for requirements regarding street patching and trench restoration.

5A.080 Testing

Prior to acceptance and approval of construction, the following tests shall apply to each type of construction:

A. Gravity Sewer

1. Air Test

   Prior to acceptance of the project, the gravity sewer pipe shall be subject to a low-pressure air test per WSDOT/APWA Standards. The contractor shall furnish all equipment and personnel for conducting the test under the observation of the City inspector. The testing equipment shall be subject to the approval of the City. The construction plans shall reflect the air test parameters and requirements.

   The contractor shall make an air test for his own purposes prior to notifying the City to witness the test. The acceptance air test shall be made after trench is backfilled and compacted and the roadway section is completed to subgrade.

   All wyes, tees and end of side sewer stubs shall be plugged with flexible joint caps, or acceptable alternates, securely fastened to withstand the internal test pressures. Such

plugs or caps shall be readily removable and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

Immediately following the pipe cleaning, the pipe installation shall be tested with low-pressure air. Tests shall be conducted per WSDOT Standards.

2. Television Inspection

Testing of the sewer main shall include a television inspection by the contractor. Television inspection shall be done after the air test has passed and before the roadway is paved. Immediately prior to a television inspection, enough water shall be run down the line so it comes out the lower manhole. A copy of the videotape and written report shall be submitted to the City. Acceptance of the line will be made after the tape has been reviewed and approved by the inspector. Any tap to an existing system needs to be televised as well.

3. Water Test or Vacuum Test

A water test of all manholes is also required. The water test shall be made by the contractor first by filling the manhole up with water and letting it sit for 24 hours to allow the water to saturate the concrete. After 24 hours the manhole shall be filled to the top of the cone. The water cannot drop more than 0.05 gallons in 15 minutes per foot of head above invert to pass. Upon completion of the water test, the water shall be pumped out of the manhole and not allowed to be released to the system. Vacuum testing, in accordance with ASTMC-1244-93, may be used in lieu of water testing.

4. Deflection Test

A deflection test in accordance with the Standard Specifications shall be required on all sewers except laterals.

B. Force Main

1. Prior to acceptance of the project, the pressure line and service lines shall be subjected to a hydrostatic pressure test of 150 pounds for four hours and any leaks or imperfections developing under said pressure shall be remedied by the contractor WSDOT/APWA Standards. No air will be allowed in the line. The main shall be tested between valves. Insofar as possible, no hydrostatic pressure shall be placed against the opposite side of the valve being tested. The pressure test shall be maintained while the entire installation is inspected.

The contractor shall provide all necessary equipment and shall perform all work connected with the tests.

Tests shall be made after all connections have been made. This is to include any and all connections as shown on the plan. The contractor shall perform all tests to assure that the equipment to be used for the test is adequate and in good operating condition and the air in the line has been released before requesting the City to witness the test.

2. A water test for all wet wells in accordance with the manhole water test for gravity sewer shall be required.

3. Pump operation, alarms, controls and electrical inspection of all lift stations is required.
4. The contractor shall provide all necessary equipment and shall perform all work connected with the tests. Tests shall be made after all connections have been made. The contractor shall perform all tests to assure that the equipment to be used for the test is adequate and in good operating condition.

5B GRAVITY SEWER

5B.010 General

All sewers shall be designed as a gravity sewer whenever physically feasible or as approved by the Public Works Director.

5B.020 Design Standards

The design of any sewer extension/connection shall conform to City Standards, Department of Ecology's "Criteria of Sewage Works Design", and any applicable standards as set forth herein.

The layout of extensions shall provide for the future continuation of the existing system as determined by the City.

New gravity sewer systems shall be designed on the basis of an average daily per capita flow of sewage of not less than 100 gallons per day. Generally, laterals and submain sewers should be designed to carry, when running full, not less than 400 gallons daily per capita contributions of sewage. When deviations from the foregoing per capita rates are used, a description of the procedure used for sewer design shall be submitted to the Department of Public Works for review and approval.

The General Notes that follow shall be included on any plans dealing with sanitary sewer design.

5B.030 Sanitary Sewer Construction General Notes

1. All workmanship and materials shall be in accordance with City of Stanwood standards and the most current copy of the State of Washington Standard Specifications for Road, Bridge and Municipal Construction (WSDOT/APWA).
2. The contractor, prior to the start of construction, shall obtain all approvals and permits required by the City of Stanwood.
3. If construction is to take place in the County right-of-way, the contractor shall notify the County and obtain all the required approvals and permits.
4. A preconstruction meeting shall be held prior to the start of construction.
5. The Stanwood Public Works Department shall be notified a minimum of 72 hours in advance of a tap connection to an existing main. The City shall be present at the time of the tap.
6. The contractor shall be fully responsible for the location and protection of all existing utilities. The contractor shall verify all utility locations prior to construction by calling the Underground Locate Line at 1-800-424-5555 a minimum of 48 hours prior to any excavation.

7. Gravity sewer main shall be PVC, ASTM D 3034 SDR 35.

8. Precast manholes shall meet the requirements of ASTM C 478. Manholes shall be Type 1-48" manhole unless otherwise specified on the plans. Joints shall be rubber gasketed conforming to ASTM C 443 and shall be routed from the inside. Lift holes shall be grouted from the outside and inside of the manhole.

9. Side sewer services shall be PVC, ASTM D 3034 SDR 35 with flexible gasketed joints. Side sewer connections shall be made by a tap to an existing main or a wye branch from a new main connected above the springline of the pipe.

10. All sewer mains shall be field staked for grades and alignment by a licensed engineering or surveying firm qualified to perform such work.

11. All sewer pipe and services shall be installed with detectable marking tape installed 18" above the pipe crown, or 12" below finished grade (whichever is deeper). Detectable marking tape shall conform to WSDOT/APWA Standard Specifications. In addition, force mains and curvilinear sewers shall be installed with 14 gauge coated copper wire wrapped around all plastic pipe, brought up and tied off at valve body. On a curvilinear sewer, the wire shall be brought up, bared and wrapped three times around the manhole ring. Tape shall be per WSDOT/APWA Standards. The contractor shall furnish and install the tape and wire.

12. All buried power for pump systems shall be installed with continuous tracer tape installed 12" above the buried power. The marker shall be plastic non-biodegradable, metal core backing marked "power". Contractor shall furnish tape per WSDOT/APWA Standards.

13. Bedding of the sewer main and compaction of the backfill material shall be required in accordance with WSDOT/APWA Standards.

14. A three-foot square by six-inch thick concrete pad shall be installed around all cleanouts that are not in a pavement area.

15. Temporary street patching shall be allowed for as approved by the City Engineer. Temporary street patching shall be provided by placement and compaction on one-inch maximum asphalt concrete cold mix. Contractor shall be responsible for maintenance as required.

16. Erosion control measures shall be taken by the contractor during construction to prevent infiltration of existing and proposed storm drainage facilities and roadways.

17. Provide traffic control plan(s) in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) as required.

18. It shall be the responsibility of the contractor to have a copy of these approved plans on construction site at all times.

19. Any changes to the design shall first be reviewed and approved by the project engineer and the City of Stanwood.

20. All lines shall be high velocity cleaned and pressure tested prior to paving in conformance with WSDOT/APWA Standards. Hydrant flushing of lines is not an acceptable cleaning method. Testing of the sanitary sewer main shall include TVing of the main by the contractor. Immediately prior to TVing, enough water shall be

run down the line so it comes out the lower manhole. A copy of the videotape shall be submitted to the City of Stanwood. Acceptance of the line will be made after the tape has been reviewed and approved by the inspector. A water or vacuum test of all manholes in accordance with Stanwood standards is also required. Testing shall take place after all underground utilities are installed and compaction of the roadway subgrade is completed.

21. All pressure mains shall be hydrostatically tested in conformance with the WSDOT/APWA Standards. In addition, all pressure mains shall be pigged or flushed in the presence of the City Inspector prior to placing pressure main in service.

22. Prior to backfill all mains and appurtenances shall be inspected and approved by the City of Stanwood Construction Inspector. Approval shall not relieve the contractor for correction of any deficiencies and/or failures as determined by subsequent testing and inspections. It shall be the contractor's responsibility to notify the City of Stanwood for the required inspections.

5B.040 Main Line Gravity

A. Size. Sewer mains shall be sized for the ultimate development of the tributary area. Nothing shall preclude the City from requiring the installation of a larger sized main if the City determines a larger size is needed to meet the requirements for future service.

The minimum size for submains and mains shall be 8-inch inside diameter. The minimum size for a lateral shall be 4 inches.

A 6-inch diameter minimum lateral is required for all commercial or general business applications or for multifamily connections.

The design is subject to all other design requirements as noted in this Chapter.

B. Material. Sewer main shall be PVC, ASTM D 3034, SDR 35 with joints and rubber gaskets conforming to ASTM D 3212 and ASTM F 477.

C. Depth. Gravity sewer will typically have a minimum depth of 5 feet to provide gravity service to adjoining parcels, adequate head room within manholes for maintenance personnel and vertical clearance between water and sewer lines. Actual depth will be determined by slope, flow, velocity and elevation of existing system.

D. All building side sewer connections to the main shall be made with a wye connection. All new mains connecting to existing mains shall require the installation of a new manhole if not made at an existing manhole.

5B.050 Connection to Existing System

A. At connection to existing system, all new sewer connections shall be physically plugged until all tests have been completed and the City approves the removal of the plug.

B. Connection of new pipelines to existing manholes shall be accomplished by using provided knockouts. Where knockouts are not available, the manhole shall be core drilled for connection. The transition of connecting channels shall be constructed so as not to interrupt existing flow patterns.

C. Connection of a pipeline to a system where a manhole is not available shall be accomplished by pouring a concrete base and setting manhole sections. The existing pipe shall not be cut into until approval is received from the City.

D. Connections where an existing stub out is not available or where a new building side sewer is the same size as the existing main shall be accomplished by the installation of a new manhole.

E. Taps shall not be allowed to protrude into the existing main. The Public Works Department shall be notified 48 hours prior to any tap of a City sewer. A City representative shall be present to witness the tap.

5B.060 Manholes

Precast manholes shall meet the requirements of ASTM C 478 with either a precast base or a cast-in-place base made from minimum 3000-psi structural concrete. Manholes shall be Type 1, 48-inch diameter minimum. The minimum clear opening in the manhole frame shall be 24 inches. Joints shall be rubber gasketed conforming to ASTM C 443 and shall be grouted from the inside. Lift holes shall be grouted from the outside and inside of the manhole. Eccentric manhole cone shall be offset so as not to be located in the tire track of a traveled lane.

Manhole frames and covers shall be cast iron casting marked "Sewer" conforming to the requirements of ASTM A-30, Class 25, and shall be free of porosity, shrink cavities, cold shuts or cracks, or any surface defects which would impair serviceability. Repairs of defects by welding or by the use of smooth-on or similar material will not be permitted. Manhole rings and covers shall be machine finished or ground-on seating surfaces so as to assure non-rocking fit in any position and interchangeability. Manholes located in areas subject to inflow shall be equipped with a sewer guard watertight manhole insert.

Where lock-type castings are called for, the casting device shall be such that the cover may be readily released from the ring and all movable parts shall be made of non-corrosive materials and otherwise arranged to avoid possible binding.

All castings will be coated with a bituminous coating prior to delivery to the job site.

Safety steps shall be fabricated of polypropylene conforming to an ASTM D-4101 specification, injection molded around a ½ inch ASTM A-615 grade 60 steel reinforcing bar with anti-slip tread. Steps shall project uniformly from the inside wall of the manhole. Steps shall be installed to form a continuous vertical ladder with rungs equally spaced on 12-inch centers.

Generally, gravity sewers shall be designed with straight alignment between manholes.

Manholes shall be provided at a maximum of 400 foot intervals for 8-inch to 15-inch sewers, 500 foot intervals for 18-inch to 30-inch sewers, at intersections, and at changes in direction, grade or pipe size. Greater spacing may be permitted in larger sewers.

Minimum slope through the manhole shall be 1/10th of a foot from invert in to invert out.

Manhole sizing shall be determined by the following criteria:

A. 48" Manhole

1. 2 connecting pipes, 8-inch to 12-inch diameter

2. 3 connecting pipes, 8-inch to 10-inch diameter, perpendicular

3. 4 connecting pipes, 8-inch diameter, perpendicular

B. 54" Manhole

1. 2 connecting pipes, 8-inch to 12-inch with more than 45º deflection
2. 3 connecting pipes, 10-inch to 12-inch diameter, perpendicular
3 4 connecting pipes, 10-inch to 12-inch diameter, perpendicular

C. 72" Manhole

1. 2 connecting pipes, 15-inch to 18-inch diameter with less than 45º deflection
2. 3 connecting pipes, 15-inch diameter, perpendicular
3. 4 connecting pipes, 15-inch diameter, perpendicular

In the above criteria "deflection" refers to the angle between any 2 pipe channels in the manhole.

For other pipe configurations, the City shall approve the size of the manhole.

The above configurations will provide adequate shelves and room for maintenance and performing TV inspections.

5B.070 Slope

All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second based on Mannings formula using an "n" value of 0.013. The City may permit use of other practical "n" values if deemed justifiable on the basis of research or field date submitted. The following minimum slopes should be provided however slopes greater than these are desirable. Sewers shall be laid with uniform slope between manholes

Sewer Size in Inches	Minimum % Slope % (Feet per 100')
6	1.00 (0.0100 Ft/Ft)
8	0.40 (0.0040 Ft/Ft)
10	0.28 (0.0028 Ft/Ft)
12	0.22 (0.0022 Ft/Ft)
14	0.17 (0.0017 Ft/Ft)
15	0.15 (0.0015 Ft/Ft)
16	0.14 (0.0014 Ft/Ft)
18	0.12 (0.0012 Ft/Ft)
21	0.10 (0.0010 Ft/Ft)
24	0.08 (0.0008 Ft/Ft)
27	0.07 (0.0007 Ft/Ft)
30	0.06 (0.0006 Ft/Ft)
36	0.05 (0.0005 Ft/Ft)

5B.080 Increasing Size

Manholes shall be provided where pipe size changes occur.

Where a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

5B.090 High Velocity Protection

Where velocities greater than 15 feet per second are expected, special provisions such as thrust blocking and piping materials shall be made to protect against displacement by erosion and shock.

5B.100 Drops

Straight grades between invert out of last manhole and connection to existing are preferred over drops whenever possible. Care must be taken when designing steep grades so as not to create a situation of excessive velocity or excavation.

An outside drop connection shall be provided for a sewer entering a manhole at an elevation of 24 inches or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert shall be filleted to prevent solids deposition.

The City will not allow an inside drop connection unless otherwise approved by the Public Works Director. If approved, a larger manhole will be required.

5B.110 Cleanouts

Cleanouts are not an acceptable substitute for manholes; however, they may be used in lieu of manholes at the end of 6 or 8 inch diameter lines of not more than 150 feet in length. This does not include a 6-inch building side sewer to serve one or two single-family dwellings. Location of cleanout for building side sewers is governed by the Uniform Plumbing Code (UPC) as adopted by SMC.

All cleanouts in City right-of-way shall be extended to grade and a 3-foot square by 4-inch concrete pad shall be installed around all cleanouts that are not in pavement area.

5B.120 Side Sewers

Prior to a building being connected to public sewer, a connection permit must be obtained from the City. Materials and design criteria for a building side sewer shall comply with the UPC as adopted by the City of Stanwood and this chapter. Inspections of the side sewer construction shall be performed by the City as required by the permit.

When a new main is being installed in front or alongside of existing properties, side sewers shall be stubbed to the property line for all existing properties pursuant to Stanwood Municipal Code.

5B.140 Grease Traps and Substance Interceptors

Grease traps and substance interceptors shall be installed in accordance with the most recent edition of the Uniform Plumbing Code and any other requirements by the city as set forth in this chapter when deemed necessary by the public works director. Plumbing permits are

processed by the Community Development Department. The Community Development Department will coordinate the required review with other City Departments through the permit process. Users who operate restaurants, cafes, lunch counters, cafeterias, bars or clubs, or hotel, hospital, factory or school kitchens, butcher shops, grocery stores or any other establishment where grease or other harmful ingredient may be introduced into the sewer system shall have a grease trap or substance interceptor to prevent the discharge of fat, oil, grease and/or other harmful waste. Such pretreatment facilities shall be either a grease trap or substance interceptor located outside the building and installed in the wastewater line leading from the sinks, drains or other fixtures where grease may be discharged. A plumbing permit is required.

Substance interceptors that include dishwasher effluent shall be sized to allow sufficient detention time to allow for cooling of the effluent. Sanitary facilities will not be allowed to connect upstream of any substance interceptor. Grease traps inside the building shall only be allowed upon approval by the City under special circumstances which may include but are not limited to insufficient space to install an outside interceptor, cost of retrofitting existing facilities, and single service businesses with limited menus.

5C LIFT STATIONS

5C.010 General

All lift stations will be designed to serve the appropriate basin as identified in the Stanwood Wastewater Facilities Plan.

5C.020 Design Standards

The design of any lift station shall conform to City standards, Department of Ecology's "Criteria of Sewage Works Design" and applicable standards as set forth herein. In addition, the plans shall include the following:

1. An overall site illustration of the lift station showing the location of all components including elevations.
2. Service size, voltage and enclosure type and location in relation to the pump station.
3. A list of specific materials used including quantity description and manufacturer name.
4. A schematic and line diagram of the service and motor control center and lift station.
5. The electrical shall be designed to meet state and local electrical code requirements.
6. The plans shall show all required telemetry installation with schematics.
7. An operation and maintenance manual from the lift station manufacturer shall be supplied.
8. A lift station emergency by-pass connection shall be provided per Standard Details.

A design report shall be submitted with each lift station demonstrating its conformance with the standards as outlined above and shall address the following items:

<u>Pump Data</u>

- size and type
- horsepower

- pump curves
- head capacity
- velocity

Motor

- size and type
- cycle length
- type of mount
- controls
- type

Telemetry

- alarm system (must be compatible with City system)

Housing

- size and type
- ventilation
- humidity control
- interior lighting
- access

Auxiliary Power

- An auxiliary generator will be required.

Well Sizing

- type
- storage capacity

Maintenance

- warranty
- tools and equipment required

Electrical Service

- size and type
- source

Corrosion Protection

- type of materials
- coatings
- linings
- maintenance

Site Layout

- location of lift station on property

Testing

- operational
- pressure

Pipes and Valves

- size and type
- bypass

Water Service

- 2-inch water service
- Double-check valve assembly
- Heat Enclosure (Hot Box or equivalent)

5D PRESSURE SEWER (FORCE MAIN)

5D.010 General

Low pressure systems may be considered for situations where high ground water table or topography make gravity sewer impractical.

5D.020 Design Standards

The design of any sewer extension/connection shall conform to City standards, Department of Ecology's "Criteria of Sewage Works Design", and any applicable standards as set forth herein.

The layout of extensions shall provide for the future continuation of the existing system as determined by the City. In addition, main extensions shall be extended to and through the side of the affected property fronting the main.

New sewer systems shall be designed by methods in conjunction with the basis of per capita flow rates. Methods shall include the use of peaking factors for the contributing area, allowances for future commercial and industrial areas, and modification of per capita flow rates based on specific data. Documentation of the alternative method used shall be provided along with plans.

5D.030 Force Main

A. Material. Force mains for sizes up to 12 inches shall be ductile iron AWWA C151, Class 50 PVC C900 with ductile iron fittings and gasketed joints, or AWWA C906 HDPE. For 14 to 24 inch mains, pipe shall be ductile iron AWWA C151 Class 50 or PVC C905 with ductile iron fittings and gasketed joints. A more rigid pipe may be required where unlimited trench widths occur.

B. Depth. Force mains shall have a minimum 36 inches of cover to top of pipe. See Water Chapter for sanitary sewer/water main crossing requirements.

C. Velocity. The minimum velocity allowed is 2 feet per second (fps) at average Dry Weather Flow. 2 fps is required to maintain solids in suspension although 3 fps is desired to scour settled solids. Maximum velocity allowed shall be 8 fps.

5D.040 Air/Vacuum Valves

Air release valves and air/vacuum valves shall be located at the high points of the line within a standard 48-inch manhole or a comparable sized approved vault. Air release valves shall be fitted with an activated carbon canister to absorb compounds with disagreeable odors prior to releasing the air to the surrounding area. Grades shall be designed to minimize the need for air/vacuum valves when practical. Vehicular access to valve is required for maintenance.

5D.050 Force Main Drain

Provisions to drain a force main to facilitate repairs or to temporarily remove force main from service shall be provided. This may be accomplished through the use of a valved tee connected to a drain line at the low point of the line. A manhole shall be set over the force main at the valved tee.

5D.060 Thrust Blocking

Location of thrust blocking shall be shown on plans. Thrust block concrete shall be Class 3000 poured against undisturbed earth. A plastic barrier shall be placed between all thrust blocks and fittings.

5D.070 Force Main Termination

Hydrogen sulfide odor (H2S) and the buildup of sulfuric acid (H2S04) occur in the operation of a force main. To mitigate these conditions some type of control method(s) shall be used. This may include chemical addition at the pump station and/or the reaeration of the wastewater at or near the terminus. Reaeration may include the following:

1. Construction of a vault housing and aspiration assembly.
2. The use of hydraulic fall (vertical siphon) within the terminal manhole.
3. High velocity discharge with smooth transition so as to not cause splashing of force main into the downstream gravity sewer.

These methods would all require an adequate source of fresh air at the vault or manhole. At a minimum, the manhole at the terminus and the first manhole downstream of the terminus shall be coated with Tnemec 120 vinyl ester, Quantum polymorphic resin or approved equal, which is resistant to sulfuric acid and hydrogen sulfide.

5D.080 Individual Pressure Sewer Services

Pump systems for individual pressure sewer systems shall be positive displacement pumps equal to Environment One. The pressure sewer systems shall be designed by a licensed engineer. Each pressure sewer service pump shall have its own discharge to a gravity sewer and shall not share a common force main. The specifics shall be reviewed by the City.

CITY OF STANWOOD

SEWER SYSTEM STANDARD DETAILS INDEX

STANDARD DETAILS

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S-2	FLAT TOP MANHOLE
S-3	MANHOLE COLLAR
S-4	CLEANOUT
S-5	FORCE MAIN AIR RELEASE ASSEMBLY
S-6	LIFT STATION EMERGENCY BYPASS CONNECTION
S-7	TYPICAL PRESSURE SEWER SERVICE DETAIL
S-8	TYPICAL E-1 GRINDER PUMP INSTALLATION
S-9	GRINDER PUMP INSTALLATION CONCRETE BALLAST
S-10	LOW PRESSURE FORCE MAIN CLEANOUT DETAIL
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WSDOT B-85.50-01	DROP CONNECTIONS
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WSDOT B-90.40-00	CONCRETE THRUST BLOCK
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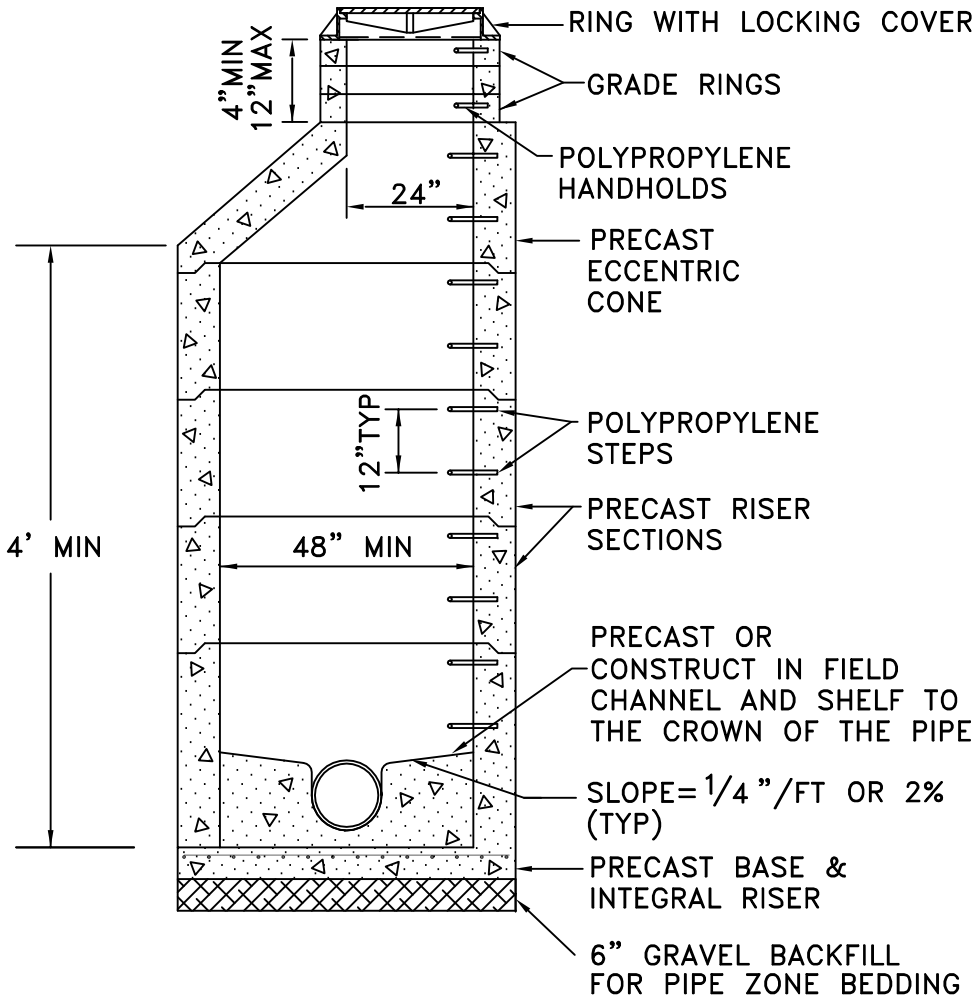
City of Stanwood			SEWER SYSTEM STANDARD DETAIL	
			SEWER DETAILS INDEX	
File:STADETSINDEX	Revised:Dec. 12, 2013	Printed: Jan. 10, 2014	DRAWING NO.	S-0



NOTES:

1. PRECAST MANHOLES SHALL MEET THE REQUIREMENTS OF ASTM C478. JOINTS SHALL BE RUBBER GASKETED CONFORMING TO ASTM C443 AND SHALL BE GROUTED FROM THE INSIDE. LIFT HOLES SHALL BE GROUTED FROM THE OUTSIDE AND INSIDE OF THE MANHOLE.

2. STEPS IN MANHOLE SHALL HAVE 6" MINIMUM CLEARANCE. HANDHOLES IN ADJUSTMENT SECTION SHALL HAVE 3" MINIMUM CLEARANCE THE FIRST STEP OR HANDHOLD SHALL BE A MAXIMUM OF 12" FROM THE TOP OF THE COVER.

3. CONNECTION TO MANHOLE SHALL BE MADE BY KOR-N-SEAL BOOT, SAND COLLAR OR A-LOCK GASKET.

4. SEE DETAIL S-3 FOR MANHOLE COLLAR INSTALLATION.

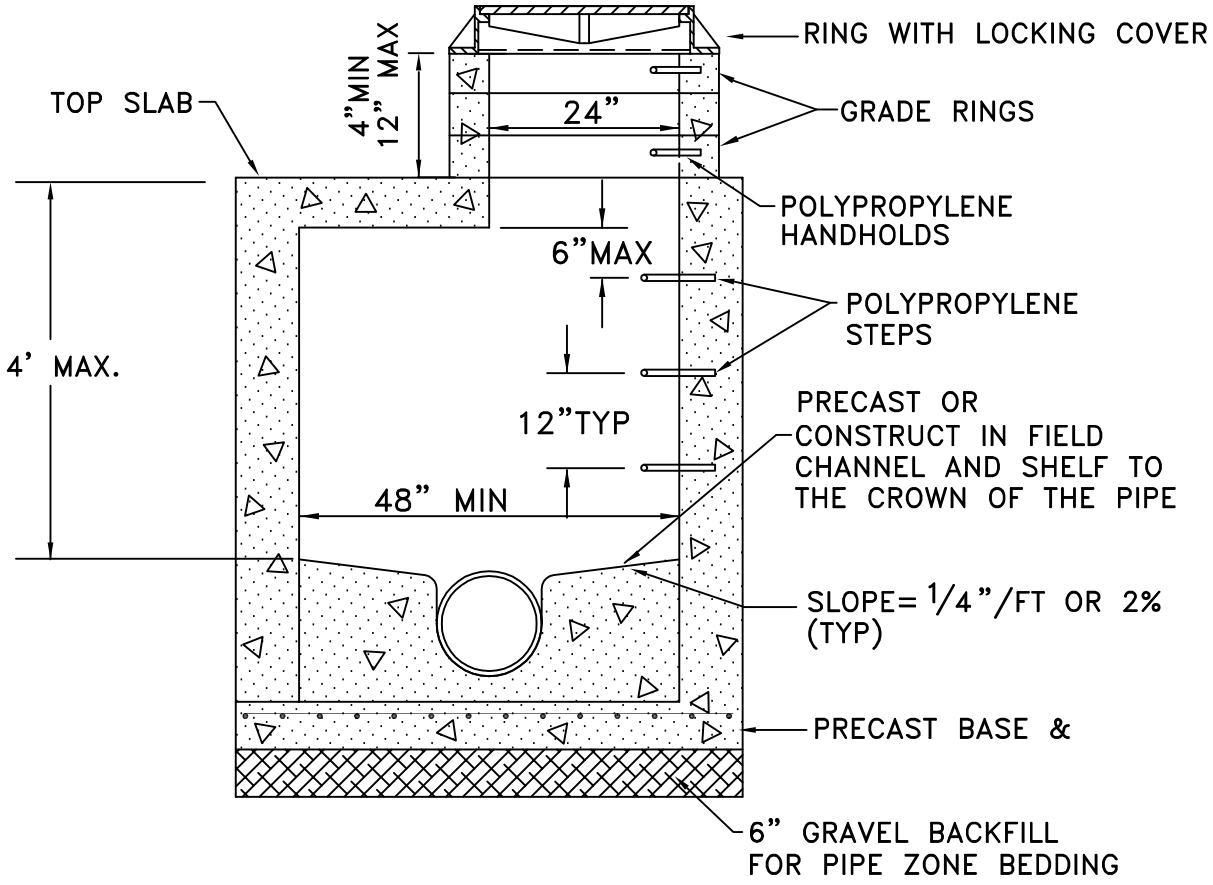
5. A SEWER GUARD SHALL BE INSTALLED IN ANY MANHOLE SUBJECT TO FLOODING.

City of Stanwood

SEWER SYSTEM STANDARD DETAIL

TYPE 1 MANHOLE

File: STADETS01	Revised: OCT 14, 2003	Printed: OCT 14, 2003	DRAWING NO. S-1



NOTES:

1. PRECAST MANHOLES SHALL MEET THE REQUIREMENTS OF ASTM C478. JOINTS SHALL BE RUBBER GASKETED CONFORMING TO ASTM C443 AND SHALL BE GROUTED FROM THE INSIDE. LIFT HOLES SHALL BE GROUTED FROM THE OUTSIDE AND INSIDE OF THE MANHOLE.

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3. CONNECTION TO MANHOLE SHALL BE MADE BY KOR-N-SEAL BOOT, SAND COLLAR OR A-LOCK GASKET.

4. SEE DETAIL S-3 FOR MANHOLE COLLAR INSTALLATION.

5. A SEWER GUARD SHALL BE INSTALLED IN ANY MANHOLE SUBJECT TO FLOODING.

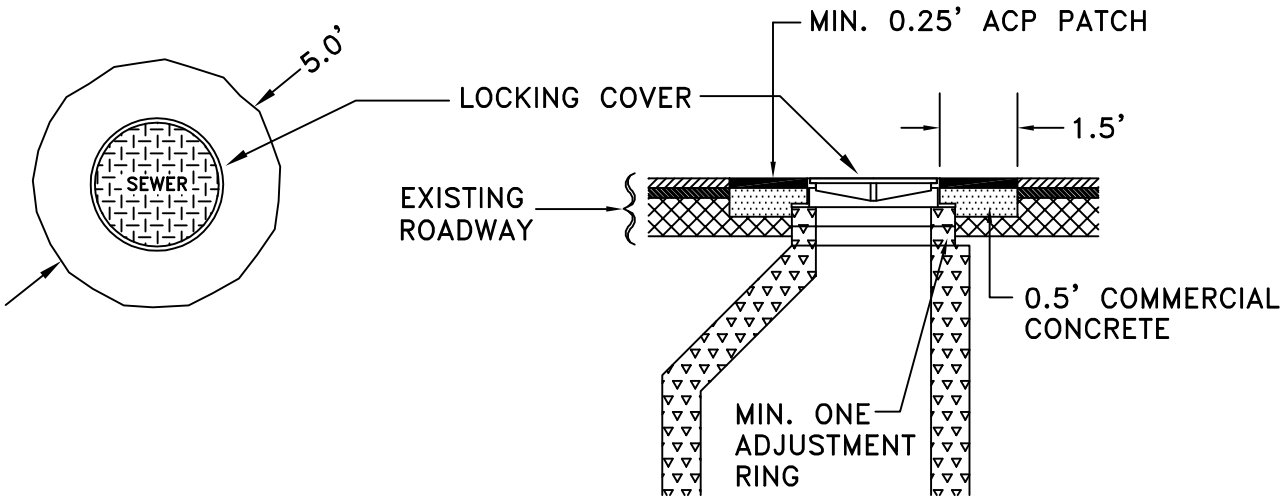
City of Stanwood

SEWER SYSTEM STANDARD DETAIL

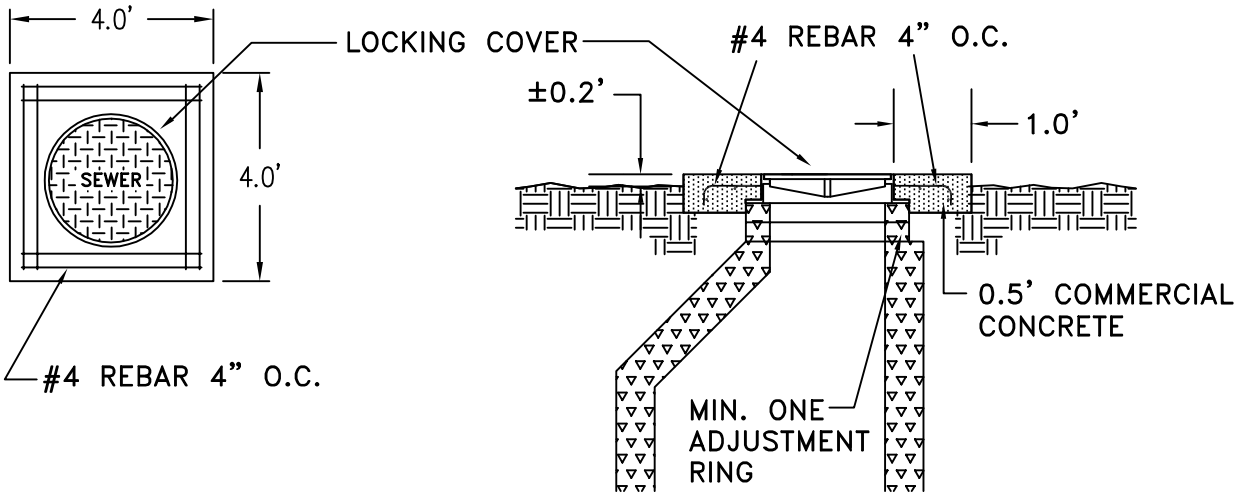
FLAT TOP MANHOLE

File: STADETS02	Revised: OCT 14, 2003	Printed: OCT 14, 2003	DRAWING NO. S-2

MANHOLE IN ASPHALT



MANHOLE OUTSIDE ASPHALT



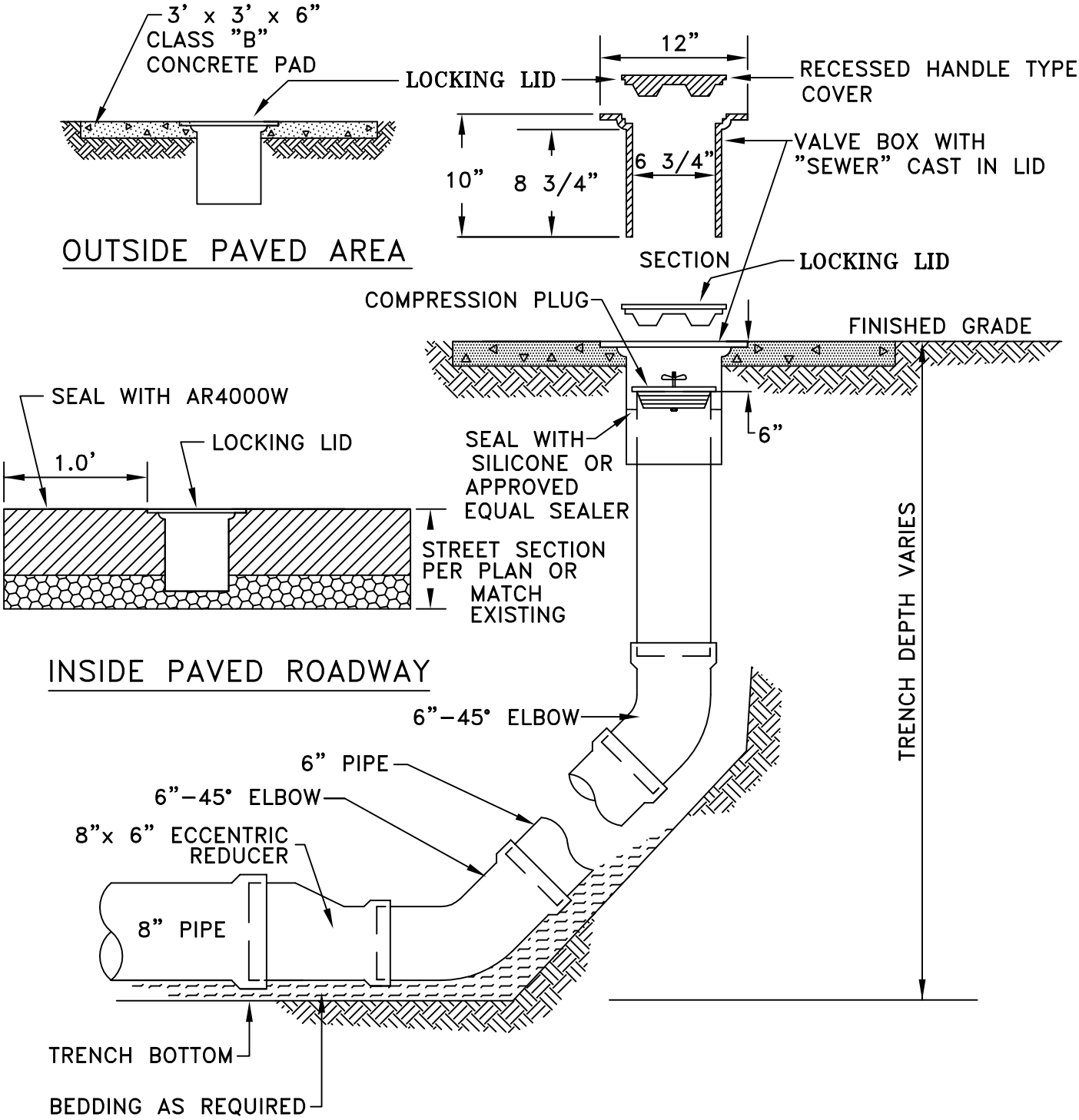
NOTE:
1. ON MANHOLE OUTSIDE ASPHALT ADD REINFORCING STEEL AS SHOWN ABOVE. DEFORMED BAR TO MEET ASTM A615 GRADE 60 FY=60,000 P.S.I.

City of Stanwood

SEWER SYSTEM STANDARD DETAIL

MANHOLE COLLAR

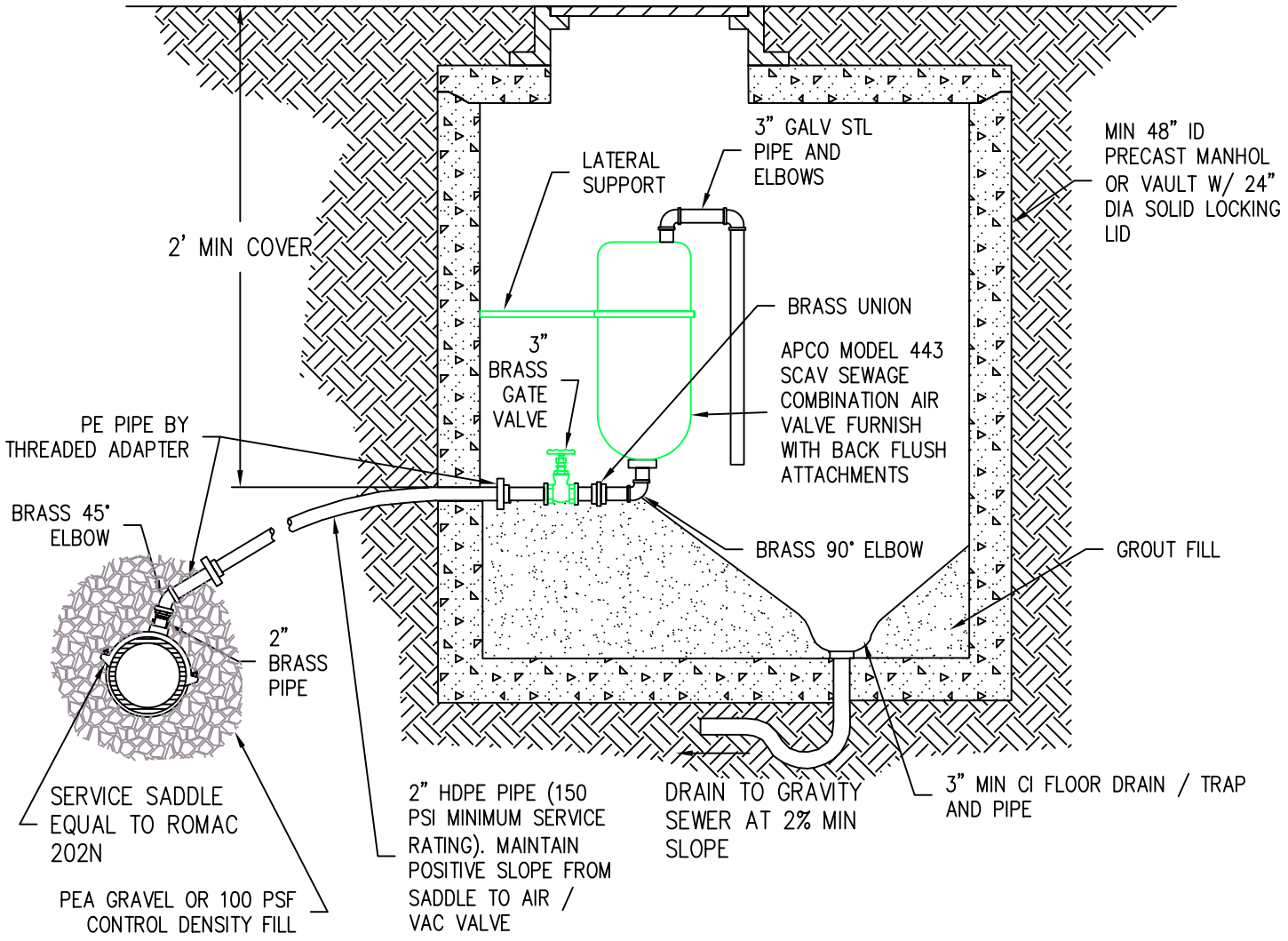
File: STADETS03	Revised: OCT 14, 2003	Printed: OCT 14, 2003	DRAWING NO. S-7



NOTE:

ALL SEWER PIPE SHALL BE ASTM 3034 SDR 35.

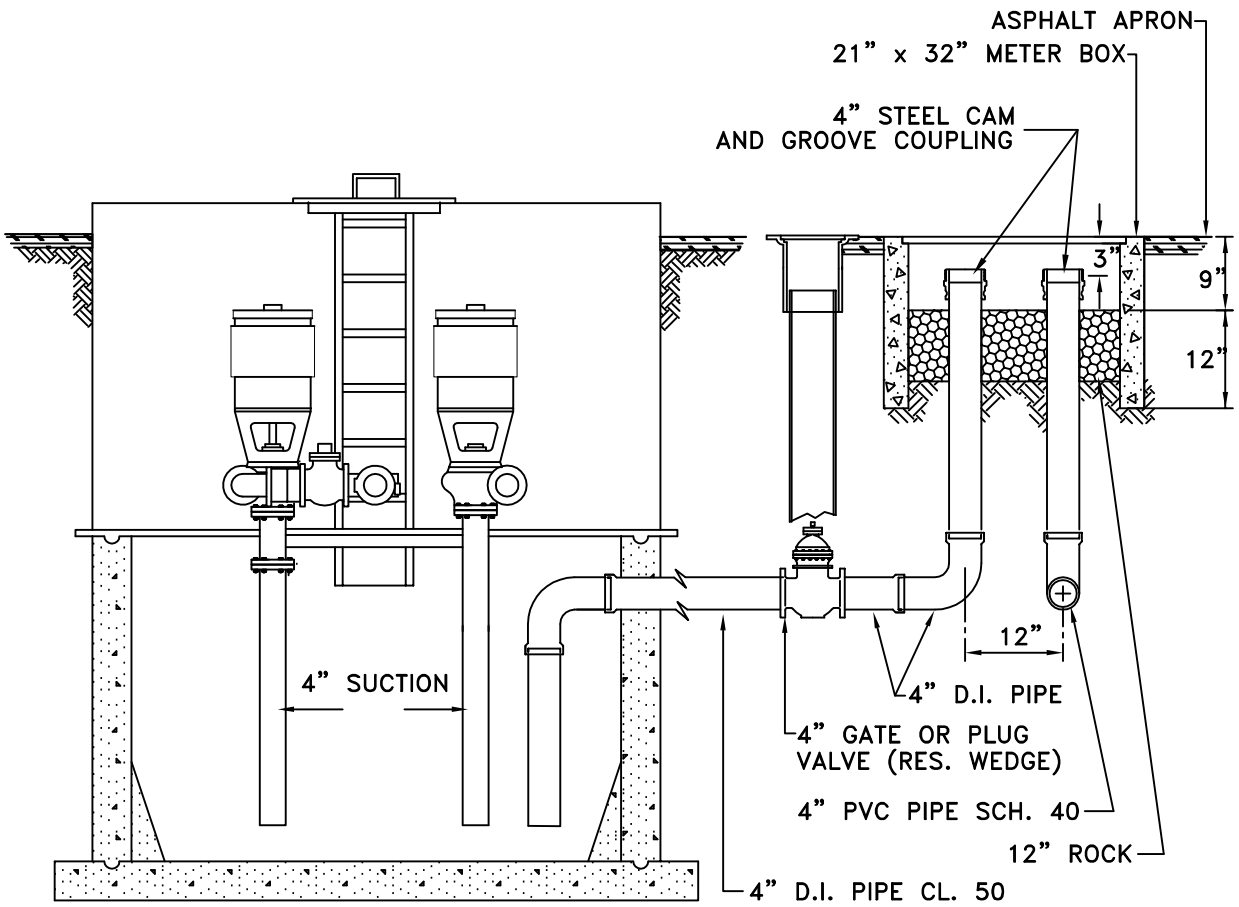
City of Stanwood		SEWER SYSTEM STANDARD DETAIL
		CLEANOUT
File: STADETS04 | Revised: OCT 14, 2003 | Printed: OCT 14, 2003		DRAWING NO. 526



NOTE:

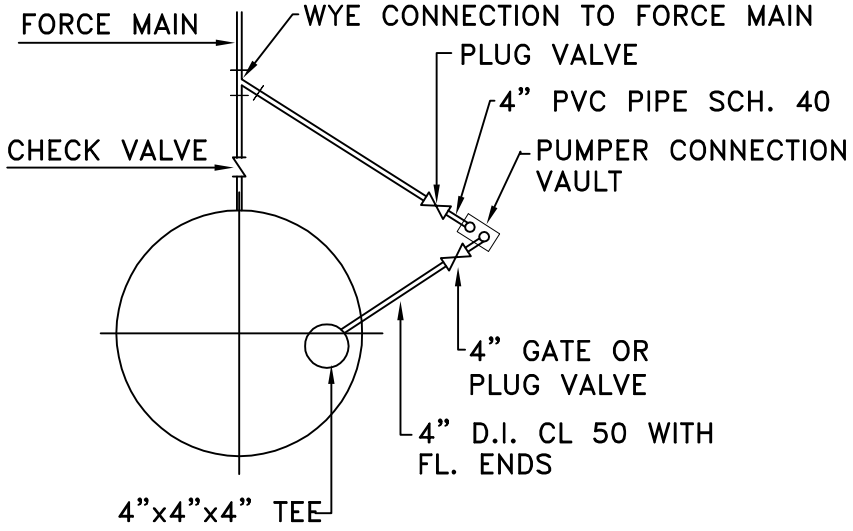
1. LOCATE AIR RELEASE ASSEMBLY IN SIDEWALK WHEN POSSIBLE.

City of Stanwood			SEWER SYSTEM STANDARD DETAIL	
			FORCE MAIN AIR RELEASE ASSEMBLY	
File: STADETS05	Revised: SEPT 9, 2005	Printed: MAY 1, 2006	DRAWING NO.	S-25



LIFT STATION

PUMPER CONNECTION VAULT



PLAN VIEW

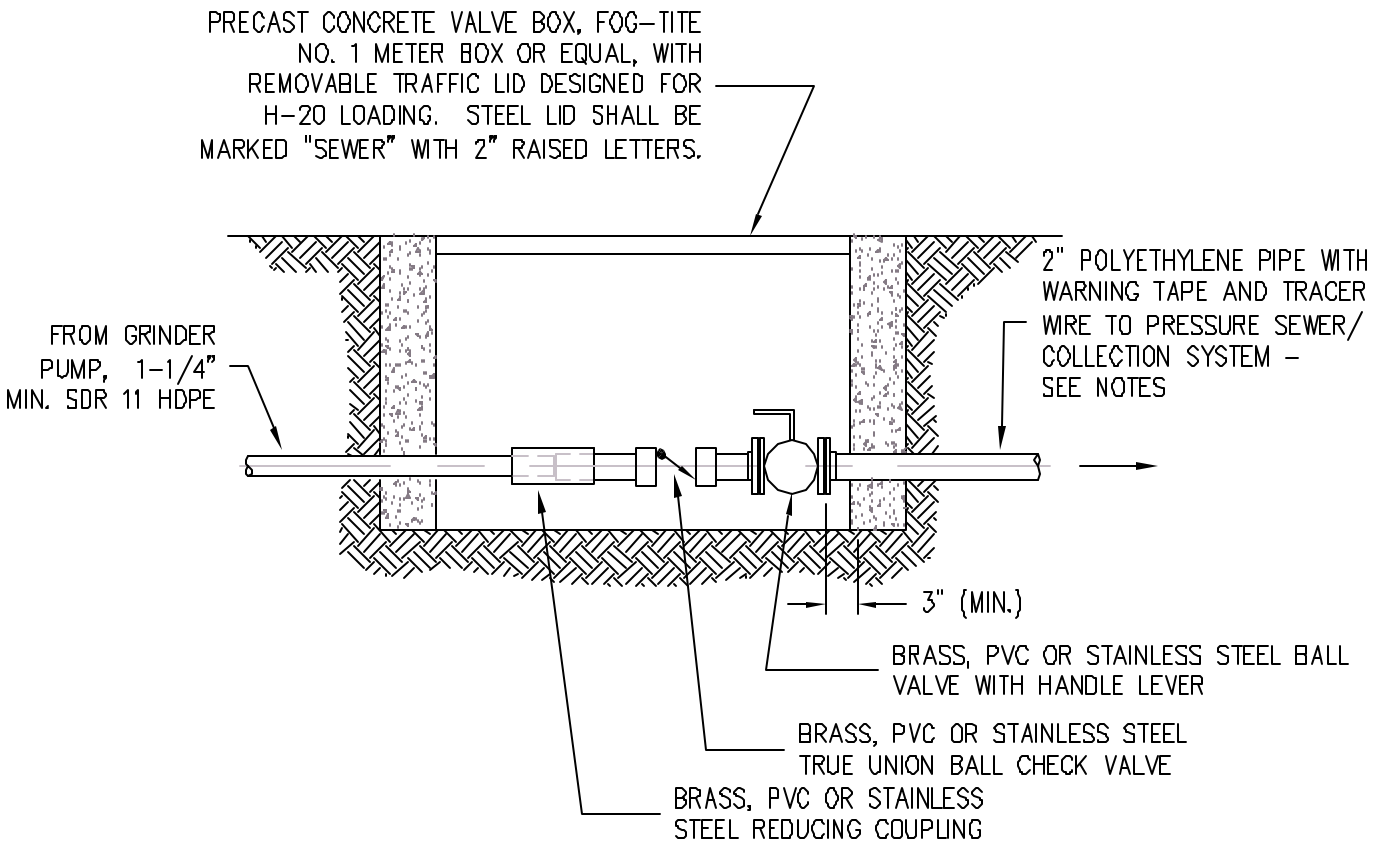
NOTE:
ENGINEER TO REVISE
PIPE SIZING AS REQUIRED
FOR SPECIFIC APPLICATIONS

City of Stanwood

SEWER SYSTEM STANDARD DETAIL

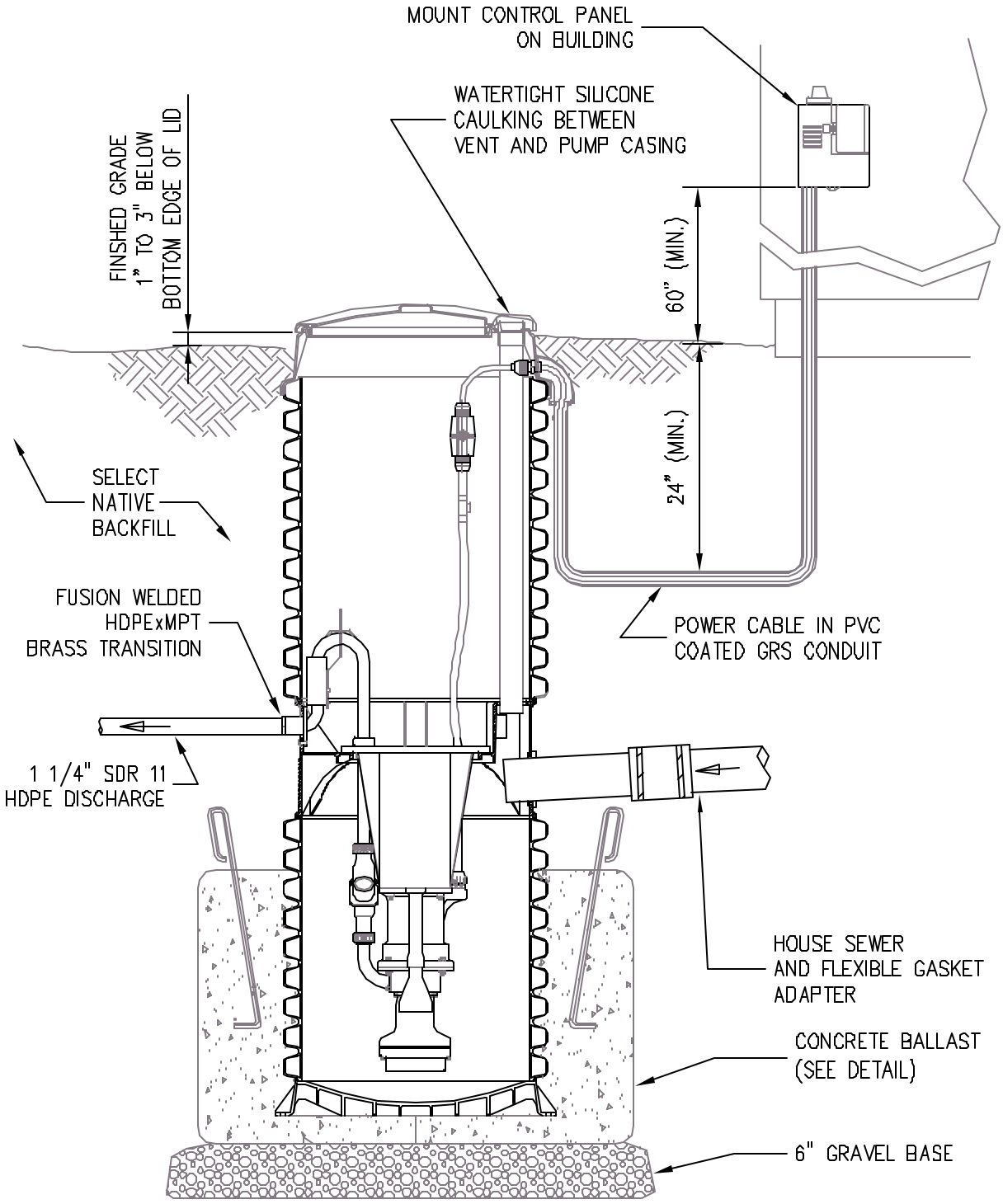
LIFT STATION EMERGENCY BYPASS CONNECTION

File: STADETS06	Revised: OCT 14, 2003	Printed: OCT 14, 2003	DRAWING NO. S-6

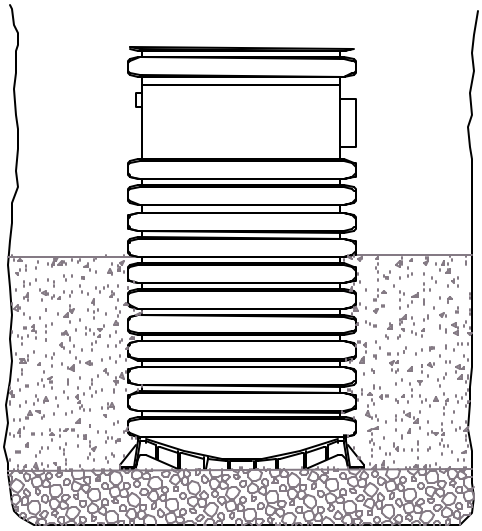


NOTES:
CONNECTION TO THE FORCE MAIN SHALL BE BY FUSION WELDED SADDLE OR ROMAC SERVICE SADDLE WITH STAINLESS STEEL STRAPS. CONNECTION TO A 2-INCH FORCE MAIN MAY ALSO BE MADE BY A BRASS, COPPER, STAINLESS STEEL OR PVC SCH 40 COMPRESSION TEE AND FITTING.

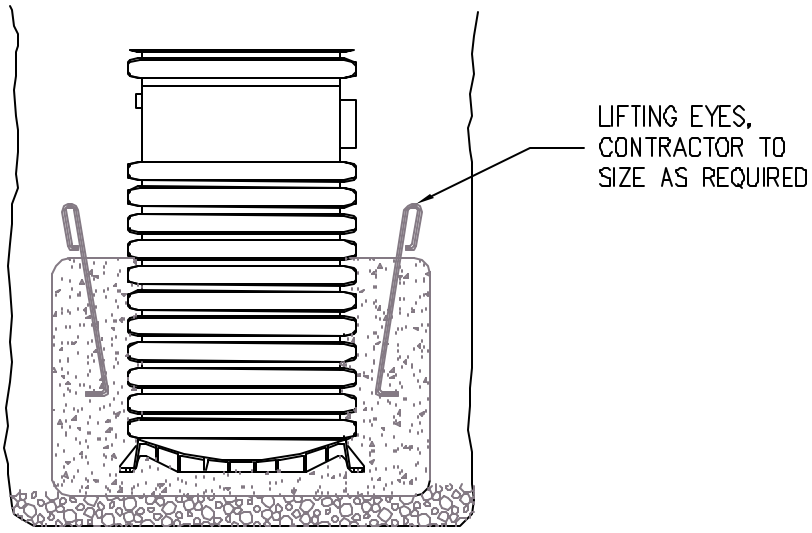
City of Stanwood		SEWER SYSTEM STANDARD DETAIL
		TYPICAL PRESSURE SEWER SERVICE DETAIL
File: stddets07 | Revised:MAR 10, 2004 | Printed: MAR 10, 2004		DRAWING NO. S-7



City of Stanwood		SEWER SYSTEM STANDARD DETAIL
		TYPICAL E-1 GRINDER PUMP INSTALLATION
File: stddets08 | Revised: MAR 10, 2004 | Printed: MAR 10, 2004		DRAWING NO. S-8



POURED IN PLACE

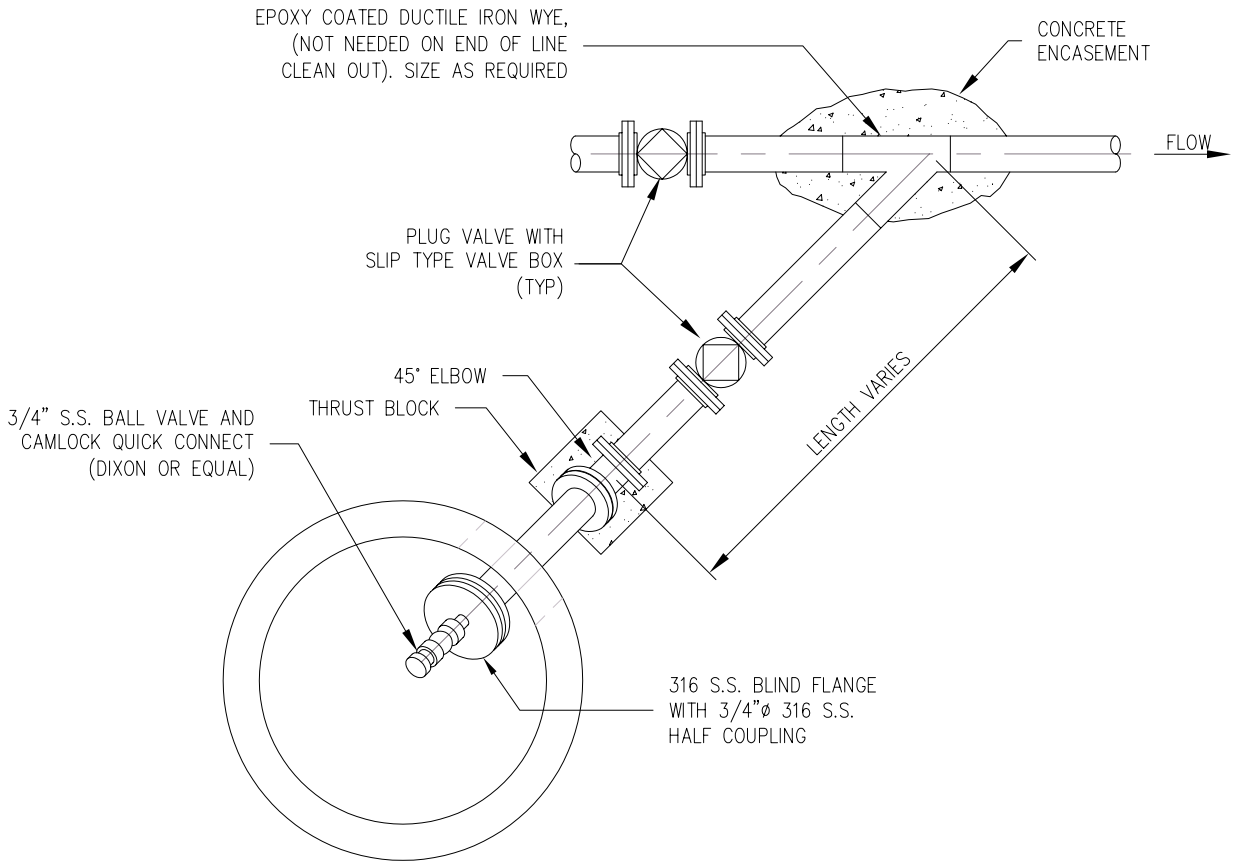


PRECAST

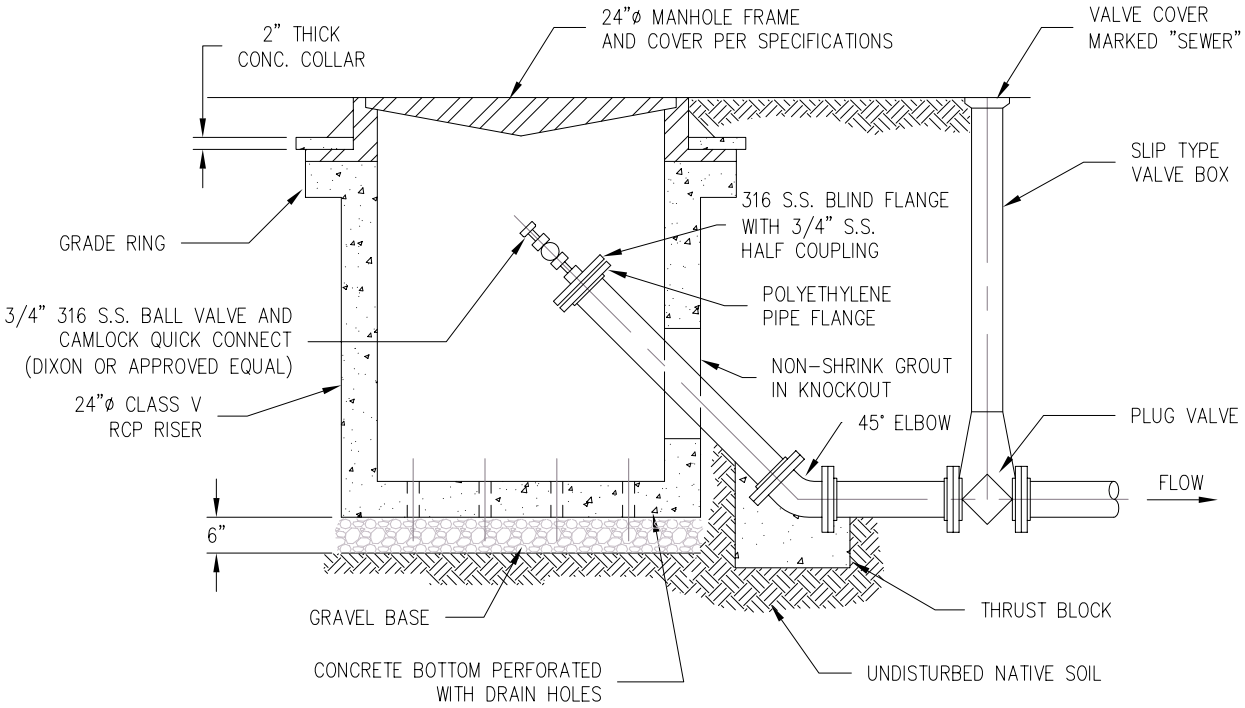
NOTES

1. THE FOLLOWING QUANTITIES OF CONCRETE ARE NECESSARY TO ANCHOR THE TANKS:
2. ENVIRONMENT ONE MODEL NO. 2010 REQUIRES 370 lbs. (2.5 CU.FT.) PER FOOT OF TOTAL STATION HEIGHT.
3. ENVIRONMENT ONE MODEL NO. 2012 REQUIRES 400 lbs. (2.7 CU.FT.) PLUS 370 lbs. FOR EACH FOOT OF TOTAL STATION HEIGHT.

City of Stanwood		SEWER SYSTEM STANDARD DETAIL
		GRINDER PUMP INSTALLATION CONCRETE BALLAST
File: STADETS09 | Revised: MAR 10, 2004 | Printed: MAR 10, 2004		DRAWING NO. S–9



PLAN



PROFILE

City of Stanwood		SEWER SYSTEM STANDARD DETAIL	
		LOW PRESSURE FORCE MAIN CLEANOUT DETAIL	
File: STADETS10	Revised: SEPT 9, 2005	Printed: MAY 1, 2006	DRAWING NO. S-12

1. ALL INTERCEPTORS SHALL BE SIZED ACCORDING TO THE UNIFORM PLUMBING CODE, APPENDIX IN EACH, OR OTHER ACCEPTABLE SIZING METHOD.
2. INTERCEPTOR SHALL BE A MINIMUM SIZE OF 500 GALLONS OF LIQUID CAPACITY. THE INLET COMPARTMENT SHALL HAVE 2/3 THE TOTAL CAPACITY OF THE INTERCEPTOR.
3. PLACE INTERCEPTOR IN LOCATION THAT ALLOWS FOR PUMP TRUCK MAINTENANCE ACCESS.
4. SANITARY SEWER SHALL BE CONVEYED BY A SEPARATE LINE DOWNSTREAM OF THE INTERCEPTOR. ONLY GRAY-WATER SHALL BE ROUTED THROUGH THE INTERCEPTOR.
5. INTERCEPTOR UNIT SHALL BE RATED FOR H20-44 AASHTO LOADING (CERTIFIED).
6. A CENTER MANHOLE IS REQUIRED IN SHALL HAVE STANDARD 24" BOLT DOWN LID.
7. SAMPLING TEE SHALL BE PLACED WITHIN 5' OF OUTLET OF THE VAULT.
8. POSITION ADJUSTMENT RINGS TO ALLOW FOR ACCESS AND ENTRY.
9. INTERCEPTOR SHALL BE INSTALLED PER MANUFACTURERS' RECOMMENDATIONS.
10. CENTER MANHOLE MUST BE CENTERED OVER THE CROSSOVER TEE.

SIZING CALCULATION

NUMBER OF MEALS PER PEAK HOUR X WASTE FLOW RATE X RETENTION TIME X STORAGE FACTOR = CAPACITY IN GALLONS

Waste Flow Rate

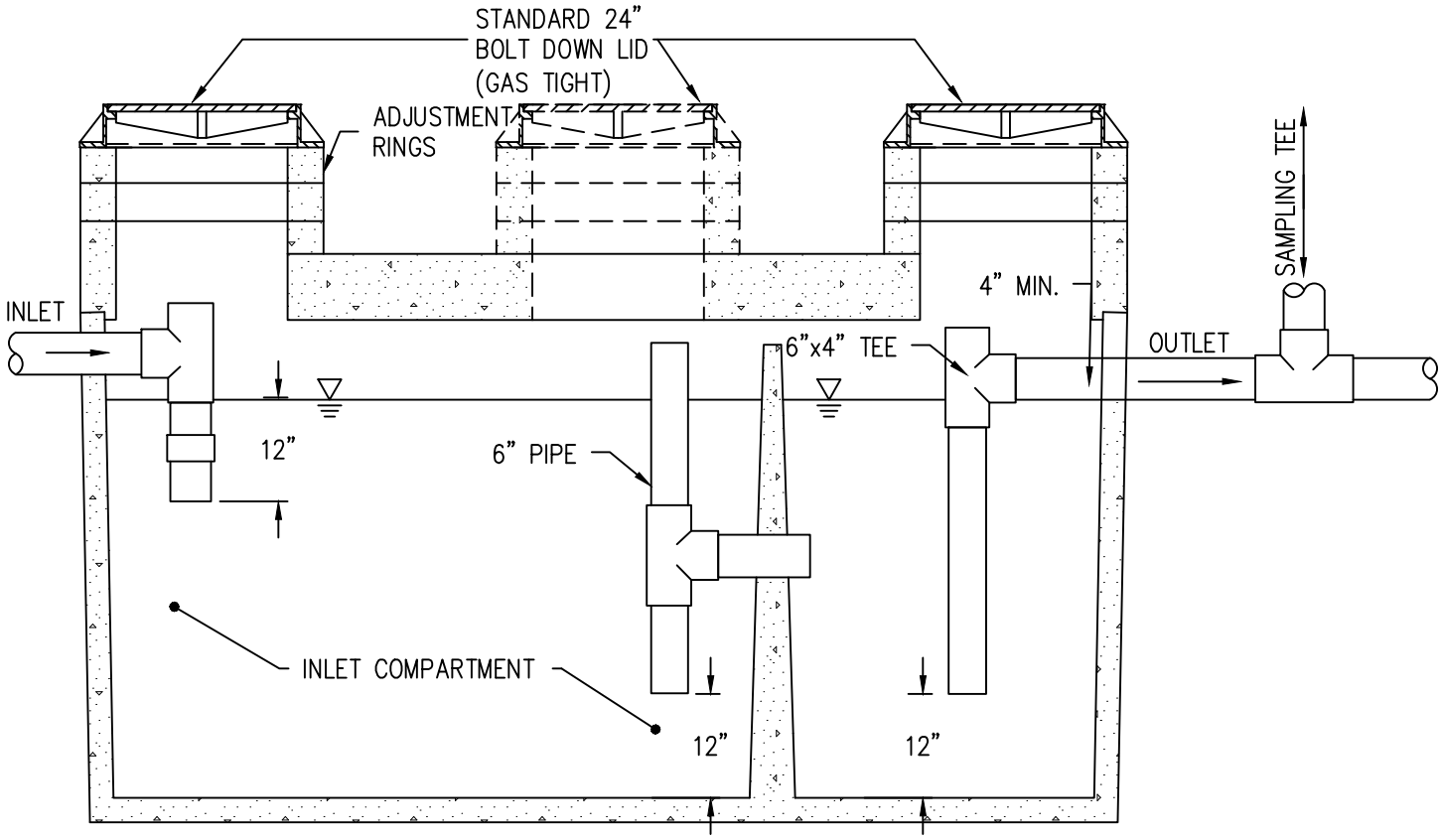
With dishwasher	6 gallon
Without dishwasher	5 gallon
Single service kitchen	2 gallon
Food waste disposer	1 gallon

Retention Times

Commercial kitchen waste dishwasher	2.5 hours
Single service kitchen single serving	1.5 hours

Storage factors

Fully equipped commercial kitchen, 8 hour operation	1
Fully equipped commercial kitchen, 16 hour operation	2
Fully equipped commercial kitchen, 24 hour operation	3
Single service kitchen	1.5



City of Stanwood

SEWER SYSTEM STANDARD DETAIL

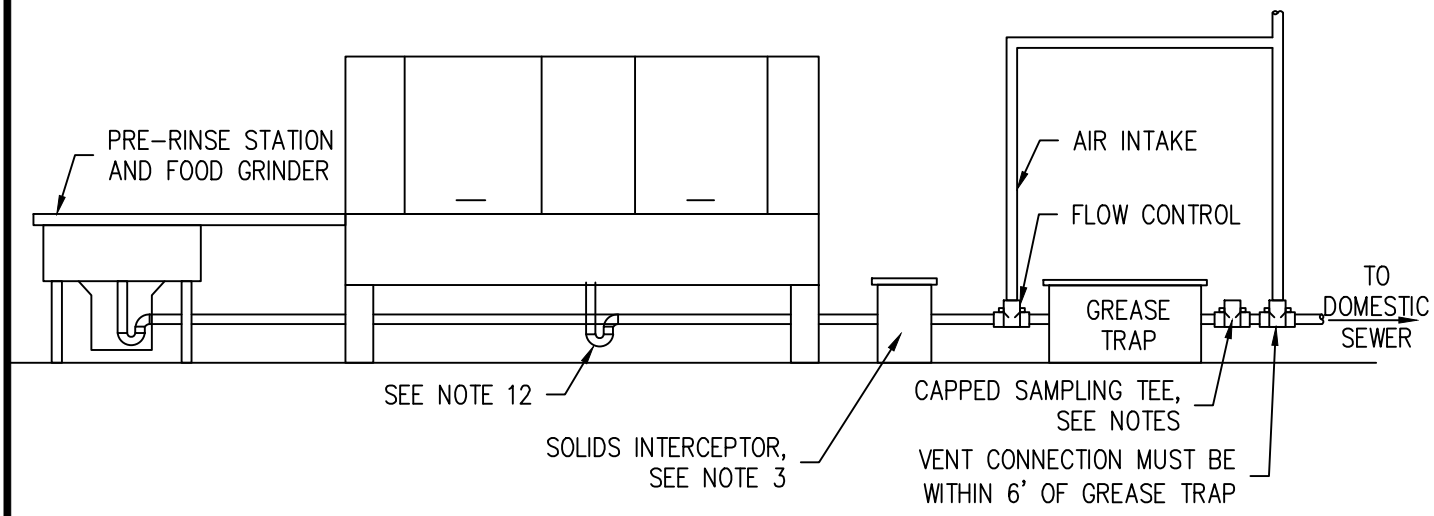
GREASE INTERCEPTOR

File:STADETS11	Revised:Dec. 12, 2013	Printed: Jan. 10, 2014	DRAWING NO.	S-11

NOTES:

1. GREASE TRAPS INSTALLED IN LIEU OF EXTERNAL INTERCEPTORS ARE ONLY ALLOWED WITH WRITTEN PERMISSION OF THE PUBLIC WORKS DIRECTOR.
2. ALL TRAPS WILL BE APPROPRIATELY SIZED TO THE UNIFORM PLUMBING CODE OR OTHER ACCEPTABLE METHOD.
3. TRAPS WILL HAVE A SOLIDS INTERCEPTOR INSTALLED PRIOR TO THE FLOW CONTROL DEVICE IF A GARBAGE DISPOSAL IS CONNECTED.
4. EACH PLUMBING FIXTURE CONNECTED TO A GREASE TRAP SHALL BE PROVIDED WITH AN APPROVED TYPE OF VENTED FLOW CONTROL LOCATED IN A READILY ACCESSIBLE AND VISIBLE PLACE.
5. FOOD WASTE DISPOSALS MUST BE CONNECTED TO THE GREASE TRAP.
6. ONLY 'GRAY WATER' SHALL BE CONVEYED TO THE TRAP. DOMESTIC (SANITARY) WATER SHALL BE CONVEYED BY A SEPARATE LINE DOWNSTREAM OF THE TRAP.
7. ALL WASTE SHALL ENTER THE TRAP THROUGH AN INLET PIPE ONLY.
8. DISHWASHER WASTE MUST NOT PASS THROUGH THE TRAP.
9. NOT MORE THAN FOUR (4) SEPARATE FIXTURES SHALL BE CONNECTED TO OR DISCHARGE INTO ANY ONE GREASE TRAP.
10. PLACE THE TRAP IN A LOCATION THAT ALLOWS FOR MAINTENANCE. TOP CLEARANCE SHALL PROVIDE TWO TIMES THE PHYSICAL DEPTH.
11. SAMPLING TEE MUST BE LOCATED IN AN ACCESSIBLE LOCATION DOWNSTREAM OF THE TRAP.
12. IF A SOLIDS INTERCEPTOR IS NOT REQUIRED, A WATER SEAL MUST BE PROVIDED BETWEEN GREASE TRAP AND FIXTURES.

Total of Fixtures Connected	Required Rate of Flow per Minute, gallons	Grease Retention Capacity, pounds
1	20	40
2	25	50
3	35	70
4	50	100



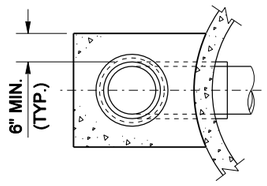
City of Stanwood

SEWER SYSTEM STANDARD DETAIL

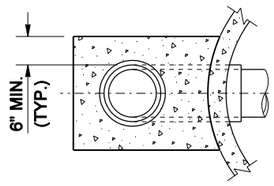
INDOOR GREASE TRAP

File:STADETS12	Revised:Dec. 12, 2013	Printed: Jan. 10, 2014	DRAWING NO.	S-12

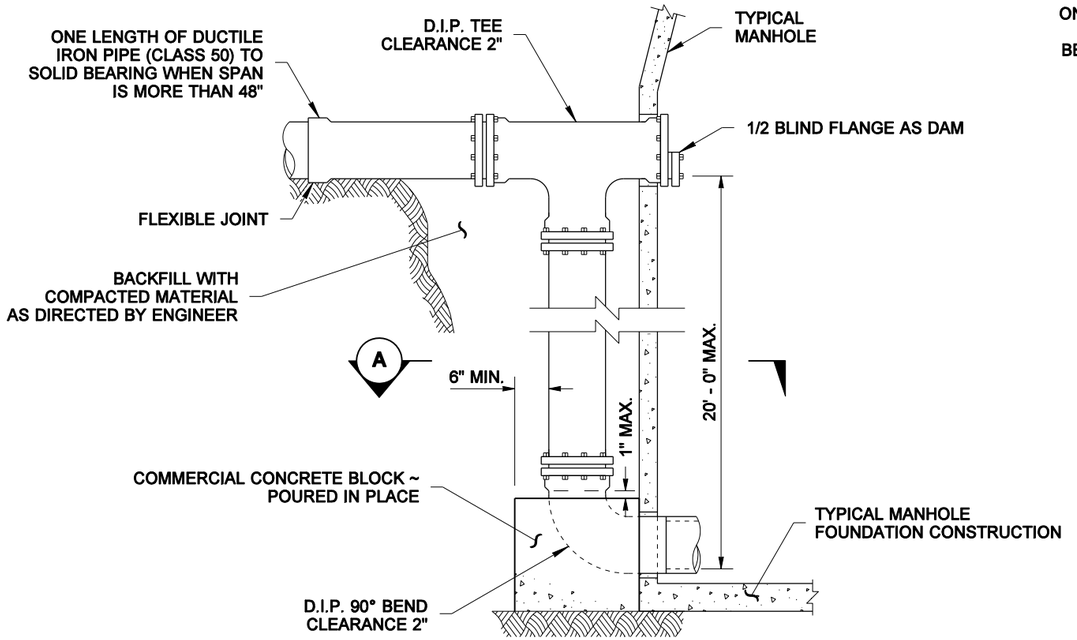
DRAWN BY: LISA CYFORD



SECTION A

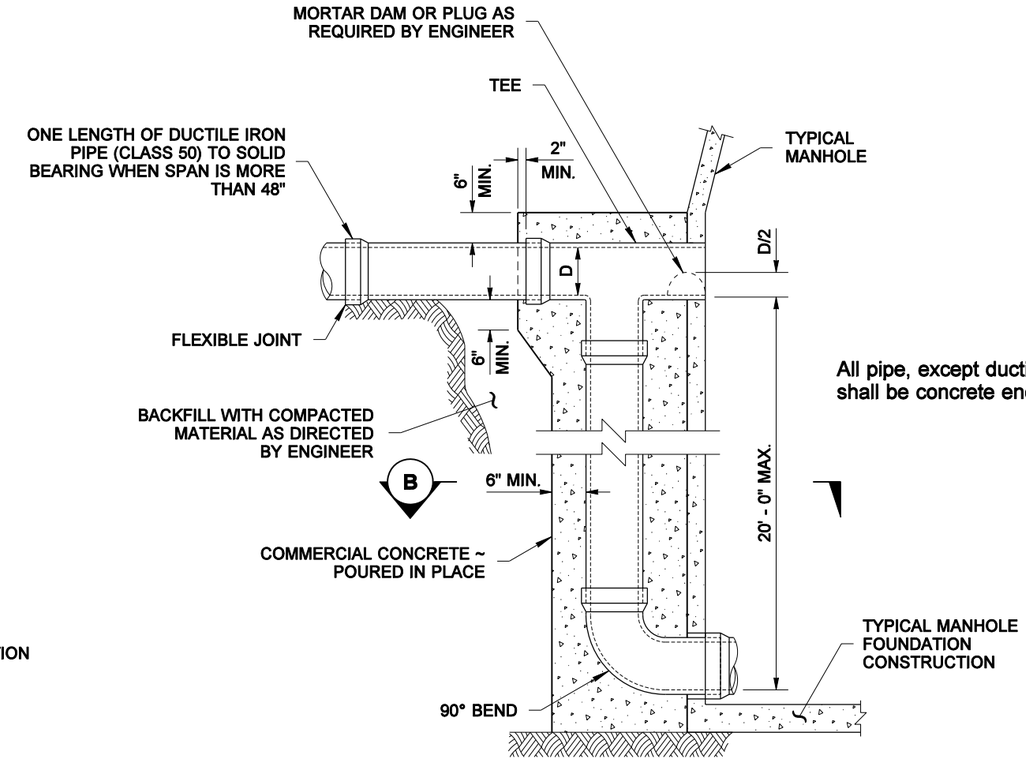


SECTION B



ELEVATION

DUCTILE IRON DROP CONNECTION



ELEVATION

CONCRETE ENCASED DROP CONNECTION

All pipe, except ductile iron pipe, shall be concrete encased.

FOR SANITARY SEWER USE

EXPIRES JULY 1, 2009

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DROP CONNECTIONS

STANDARD PLAN B-85.50-01

SHEET 1 OF 1 SHEET

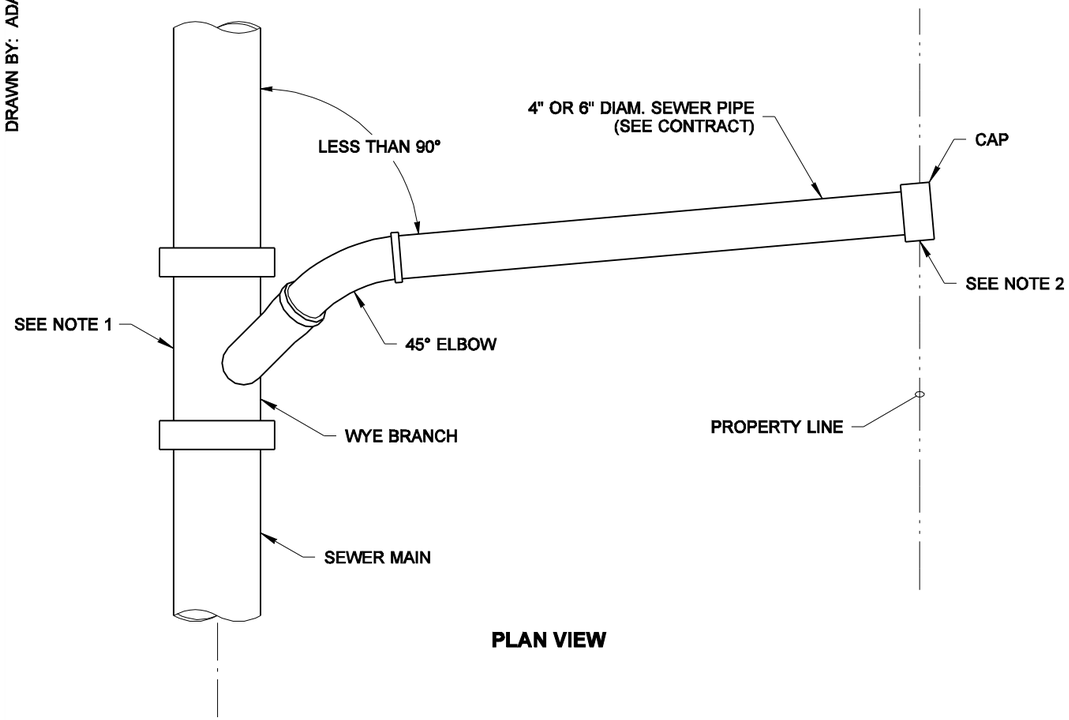
APPROVED FOR PUBLICATION

Pasco Bakotich III — STATE DESIGN ENGINEER

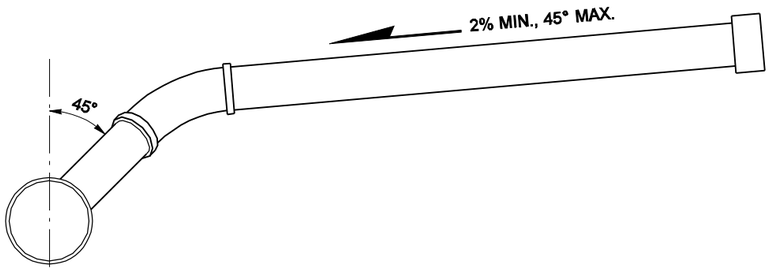
06-10-08 — DATE

Washington State Department of Transportation

DRAWN BY: ADAM COCHRAN

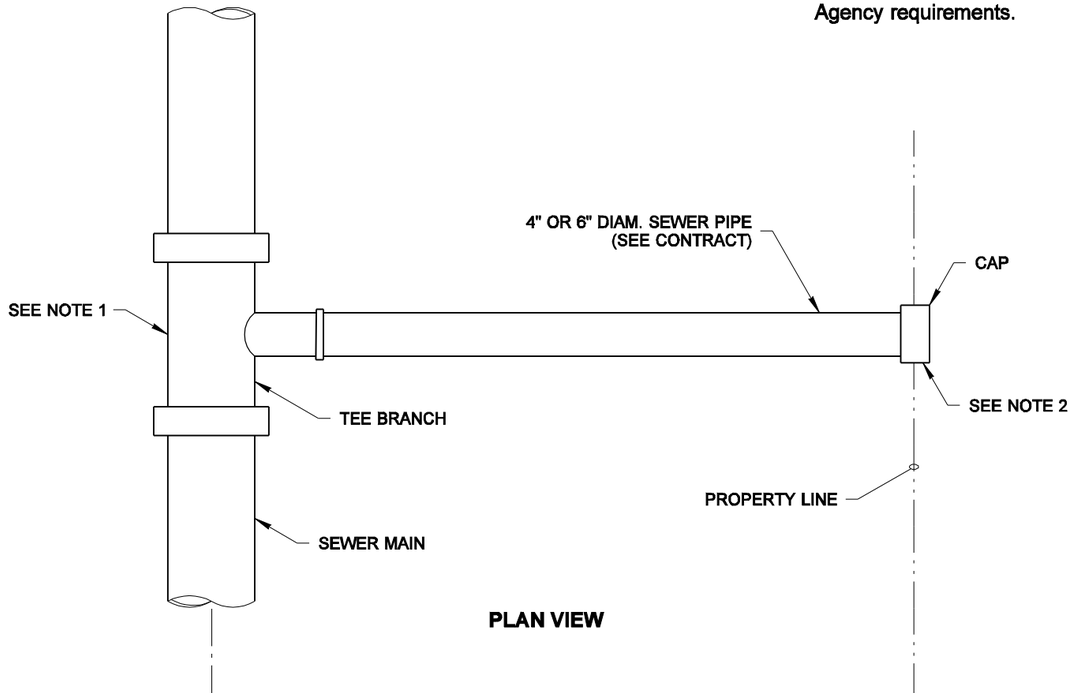


PLAN VIEW

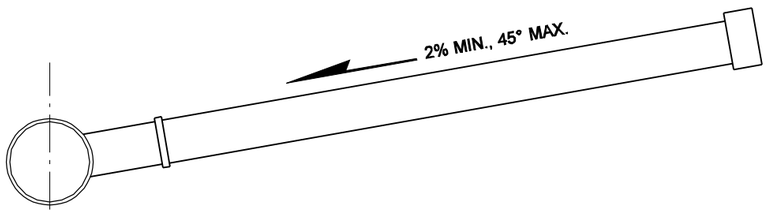


ELEVATION VIEW

WYE CONNECTION



PLAN VIEW



ELEVATION VIEW

TEE CONNECTION

NOTES

1. Install sewer saddle with gasket and stainless steel clamps for connection to existing sewers. Install wye or tee sewer fitting with gaskets for new sewer installations.
2. Mark location of sewer stub in accordance with Contracting Agency requirements.

FOR SANITARY SEWER USE

EXPIRES JULY 1, 2007

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SIDE SEWER CONNECTION

STANDARD PLAN B-85.20-00

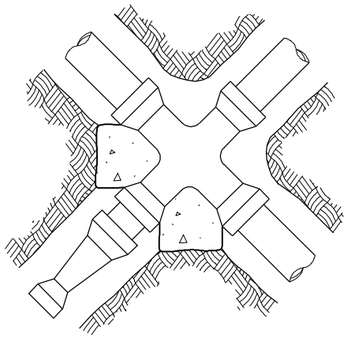
SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

Harold J. Peterfeso — STATE DESIGN ENGINEER

06-01-06 — DATE

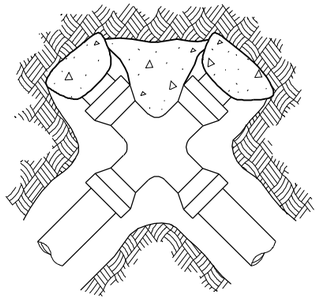
Washington State Department of Transportation



PLAN VIEW

UNBALANCED CROSS

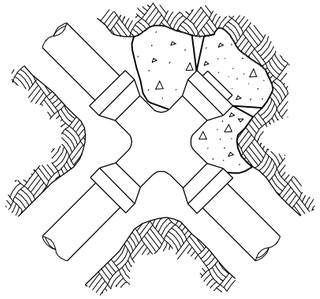
(USE COLUMN **A**)



PLAN VIEW

PLUGGED CROSS

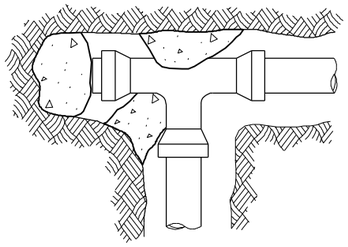
(USE COLUMN **B**)



PLAN VIEW

PLUGGED CROSS

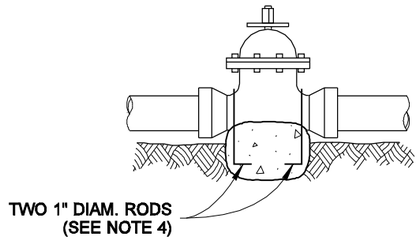
(USE COLUMN **A**)



PLAN VIEW

PLUGGED TEE

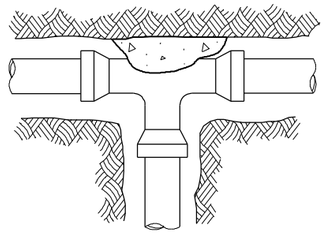
(USE COLUMN **B**)



PROFILE VIEW

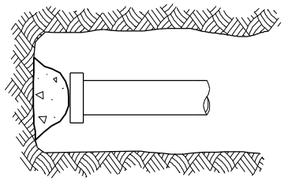
VALVE

(USE COLUMN **A**)



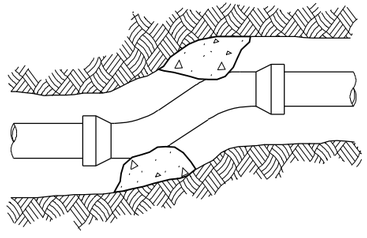
PLAN VIEW

TEE



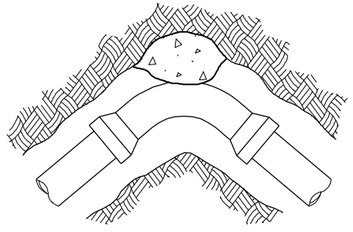
PLAN VIEW

DEAD END



OFFSET

(USE COLUMNS **B ~ E**)



BEND

NOTES

1. Contractor to provide blocking adequate to withstand full test pressure.
2. Divide thrust by safe bearing load to determine required area (in square feet) of concrete to distribute load.
3. Areas to be adjusted for other pressure conditions.
4. Provide two 1" minimum diameter rods on valves up through 10" diameter. Valves larger than 10" require special tie rod design.

SIZE	TEST PRESSURE (PSI)	THRUST AT FITTINGS IN POUNDS				
		A	B	C	D	E
		TEE AND DEAD ENDS	90° BEND	45° BEND	22.5° BEND	11.25° BEND
4"	250	3,140	4,440	2,405	1,225	615
6"	250	7,070	9,995	5,410	2,760	1,385
8"	250	12,565	17,770	9,620	4,905	2,465
10"	250	19,635	27,770	15,030	7,660	3,850
12"	250	28,275	39,985	21,640	11,030	5,545
14"	250	38,485	54,425	29,455	15,015	7,545
16"	250	50,265	71,085	38,470	19,615	9,855

SOIL TYPE	SAFE BEARING LOAD (PSF)
MUCK, PEAT, ETC.	0
SOFT CLAY	1,000
SAND	2,000
SAND AND GRAVEL	3,000
SAND AND GRAVEL CEMENTED WITH CLAY	4,000
HARD SHALE	10,000

MATTHEW J. WITECKI
STATE OF WASHINGTON
15588
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES JULY 1, 2007

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CONCRETE THRUST BLOCK

STANDARD PLAN B-90.40-00

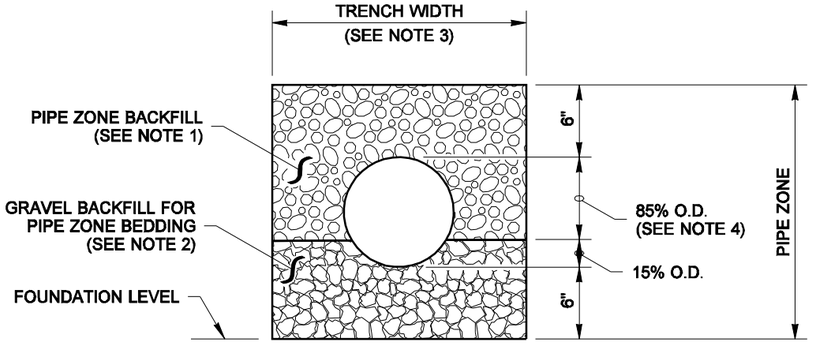
SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

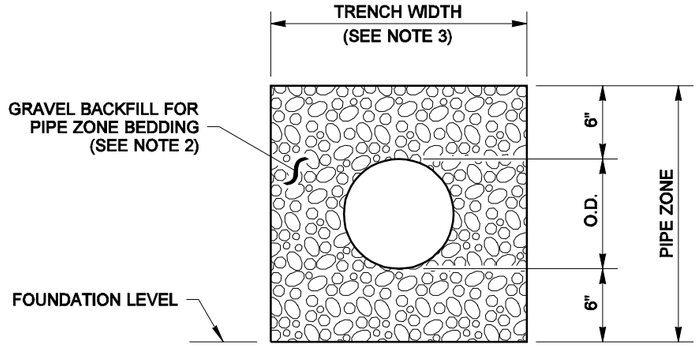
Harold J. Peterfeso — STATE DESIGN ENGINEER

06-08-06 — DATE

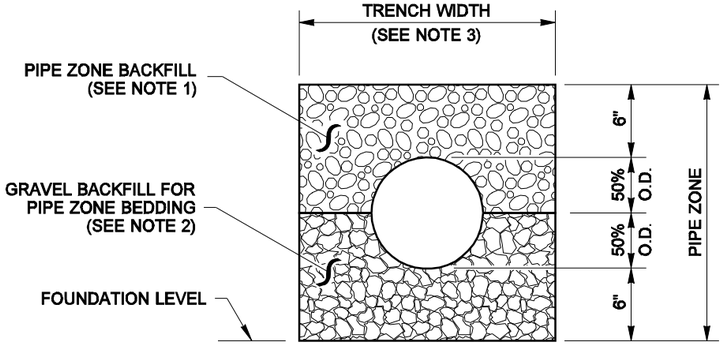
Washington State Department of Transportation



CONCRETE AND DUCTILE IRON PIPE



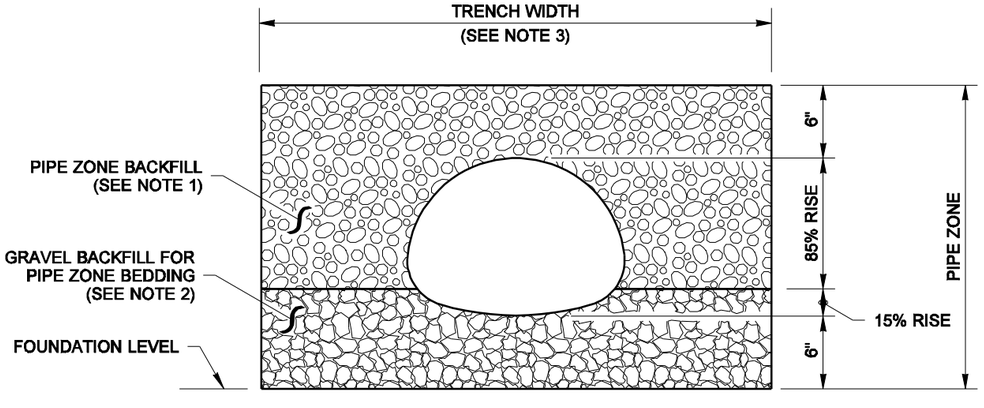
THERMOPLASTIC PIPE



METAL PIPE

NOTES

1. See Standard Specifications Section 7-08.3(3) for Pipe Zone Backfill.
2. See Standard Specifications Section 9-03.12(3) for Gravel Backfill for Pipe Zone Bedding.
3. See Standard Specifications Section 2-09.4 for Measurement of Trench Width.
4. For sanitary sewer installation, concrete pipe shall be bedded to spring line.



PIPE ARCHES

CLEARANCE BETWEEN PIPES FOR MULTIPLE INSTALLATIONS		
PIPE	**SIZE**	**MINIMUM DISTANCE BETWEEN BARRELS**
CIRCULAR PIPE (DIAMETER)	12" to 24"	12"
	30" to 96"	DIAM. /2
	102" to 180"	48"
PIPE ARCH (SPAN) METAL ONLY	18" to 36"	12"
	43" to 142"	SPAN /3
	148" to 200"	48"

MATTHEW J. WITECKI
STATE OF WASHINGTON
15588
REGISTERED
PROFESSIONAL ENGINEER

EXPIRES JULY 1, 2007

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PIPE ZONE BEDDING AND BACKFILL

STANDARD PLAN B-55.20-00

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

Harold J. Peterfeso — STATE DESIGN ENGINEER — *06-01-06* — DATE

Washington State Department of Transportation

Appendix D

Influent Flow, BOD and TSS Data

Flow (MGD)									
Annual Average, Maximum Month, and Maximum Week									
Month	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Average**
January		0.65	0.58	0.76	0.59	0.77	0.74	0.80	0.70
February		0.70	0.62	0.93	0.64	0.85	0.95	0.57	0.75
March		0.61	0.78	0.62	0.59	0.62	0.58	0.73	0.65
April	0.67	0.51	0.61	0.81	0.52	0.52	0.61	0.63	0.61
May	0.57	0.46	0.55	0.50	0.48	0.54	0.47	0.64	0.53
June	0.44	0.47	0.47	0.47	0.46	0.53	0.47	0.57	0.49
July	0.46	0.43	0.42	0.44	0.44	0.46	0.45	0.45	0.45
August	0.41	0.41	0.41	0.44	0.43	0.44	0.45	0.45	0.43
September	0.48	0.44	0.42	0.44	0.49	0.45	0.47	0.45	0.46
October	0.46	0.53	0.47	0.46	0.53	0.52	0.56	0.47	0.50
November	0.76	0.76	0.67	0.55	0.51	0.55	0.84	0.63	0.66
December	0.95	0.67	0.66	0.59	0.62	0.70	0.66	0.70	0.69
Annual Avg.	**0.58**	**0.55**	**0.56**	**0.58**	**0.52**	**0.58**	**0.60**	**0.59**	
Max. Month	**0.95**	**0.76**	**0.78**	**0.93**	**0.64**	**0.85**	**0.95**	**0.80**	
Max. 30-day	**0.95**	**0.81**	**0.79**	**0.93**	**0.69**	**0.89**	**0.94**	**0.82**	
Max. 7-day	**1.40**	**1.05**	**0.86**	**1.29**	**0.76**	**1.34**	**1.18**	**1.11**	

Maximum Day								
Month	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
January		1.11	0.85	1.15	0.85	1.09	1.41	1.39
February		1.38	0.83	1.90	0.91	2.18	1.67	1.07
March		0.88	1.02	0.78	1.03	0.92	0.66	1.00
April	1.19	0.72	0.78	1.36	0.60	0.67	0.98	0.82
May	0.95	0.48	0.71	0.67	0.58	0.78	0.56	0.84
June	0.48	0.62	0.55	0.51	0.50	0.67	0.61	0.85
July	0.83	0.50	0.45	0.54	0.47	0.54	0.49	0.49
August	0.48	0.45	0.43	0.48	0.52	0.49	0.52	0.50
September	0.91	0.50	0.48	0.49	0.71	0.54	0.67	0.48
October	0.69	0.88	0.61	0.54	1.00	0.90	1.00	0.68
November	2.21	1.26	1.02	0.72	0.80	0.68	1.47	1.45
December	1.82	0.97	1.15	1.11	1.01	1.72	0.95	1.54
Max. Day	**2.21**	**1.38**	**1.15**	**1.90**	**1.03**	**2.18**	**1.67**	**1.54**

Note: Data for January - March 2015 not available from Ecology.

Note: Data for January - March 2015 Acquired From City After Ecology Comments Received In November 2025. DMRs Located At End Of Appendix.

BOD_5 (mg/L)

Annual Average, Maximum Month, and Maximum Week

Month	2015	2016	2017	2018	2019	2020	2021	2022	Average
January		311	274	266	342	290	298	282	295
February		275	200	257	330	264	270	386	283
March		284	173	316	342	313	304	378	301
April	421	332	252	330	326	274	361	382	335
May	436	389	292	331	360	251	457	393	364
June	380	307	365	336	406	352	429	490	383
July	449	316	322	459	381	428	308	520	398
August	497	271	336	420	400	368	462	598	419
September	367	289	340	461	353	395	342	515	383
October	435	282	319	371	432	308	346	489	373
November	304	253	282	371	434	345	332	457	347
December	237	205	253	369	301	315	375	390	306
Annual Avg.	**389**	**292**	**284**	**357**	**368**	**326**	**358**	**442**	
Max. Month	**497**	**389**	**365**	**461**	**434**	**428**	**462**	**598**	

Maximum Day

Month	2015	2016	2017	2018	2019	2020	2021	2022
January		382	405	425	463	487	391	413
February		382	358	349	436	341	455	457
March		407	203	422	461	448	451	578
April	567	360	325	479	482	325	590	435
May	595	575	367	433	535	320	665	523
June	459	402	411	443	474	445	738	648
July	560	401	376	642	456	719	594	859
August	831	372	531	583	467	422	854	1,179
September	509	388	395	543	445	514	551	557
October	508	366	386	399	511	358	702	612
November	552	344	385	677	684	424	538	638
December	368	254	424	522	407	433	533	590
Max. Day	**831**	**575**	**531**	**677**	**684**	**719**	**854**	**1,179**

BOD_5 (ppd)

Annual Average, Maximum Month, and Maximum Week

Month	2015	2016	2017	2018	2019	2020	2021	2022	Average
January		1,569	1,317	1,635	1,762	1,871	1,862	1,880	1,699
February		1,496	1,018	1,796	1,824	1,723	2,306	1,525	1,670
March		1,432	1,126	1,676	1,698	1,677	1,457	2,133	1,600
April	2,419	1,390	1,260	2,209	1,397	1,187	1,837	2,053	1,719
May	2,128	1,486	1,294	1,441	1,414	1,128	1,801	2,081	1,597
June	1,412	1,222	1,423	1,311	1,570	1,559	1,701	2,233	1,554
July	1,594	1,177	1,146	1,728	1,393	1,682	1,184	2,003	1,488
August	1,719	957	1,164	1,553	1,467	1,362	1,766	2,301	1,536
September	1,520	1,077	1,251	1,692	1,413	1,481	1,309	1,957	1,463
October	1,643	1,239	1,277	1,431	2,022	1,333	1,450	1,899	1,537
November	1,848	1,556	1,549	1,613	1,905	1,653	1,991	2,272	1,798
December	1,789	1,103	1,486	1,705	1,393	1,914	1,834	2,099	1,665
Annual Avg.	**1,773**	**1,310**	**1,276**	**1,641**	**1,608**	**1,559**	**1,704**	**2,050**	
Max. Month	**2,419**	**1,569**	**1,549**	**2,209**	**2,022**	**1,914**	**2,306**	**2,301**	
Max. 30-day	**2,977**	**1,622**	**1,698**	**2,410**	**2,270**	**2,185**	**2,333**	**2,563**	
Max. 7-day	**3,992**	**1,929**	**2,418**	**2,810**	**3,180**	**3,537**	**3,442**	**3,730**	
MW/AA	2.25	1.47	1.90	1.71	1.98	2.27	2.02	1.82	

Maximum Day

Month	2015	2016	2017	2018	2019	2020	2021	2022
January		1,931	1,885	2,697	2,318	2,787	2,366	2,227
February		1,834	1,572	2,981	2,813	2,668	3,552	2,125
March		2,027	1,474	2,733	1,941	2,734	2,083	2,847
April	5,013	1,580	1,495	3,081	2,129	1,674	2,458	2,194
May	3,575	2,213	1,591	1,723	2,059	1,429	2,689	2,728
June	1,684	1,551	1,559	1,656	1,858	1,859	2,884	2,763
July	1,868	1,597	1,312	2,354	1,668	2,649	2,272	3,217
August	2,829	1,394	1,835	2,107	1,749	1,618	3,400	4,532
September	2,345	1,469	1,575	1,931	1,986	1,925	1,968	2,109
October	1,862	1,459	1,938	1,543	3,565	1,620	2,817	2,568
November	3,064	2,284	2,116	2,695	2,664	2,056	3,168	2,851
December	3,217	1,423	3,447	2,087	2,003	4,586	2,862	2,839
Max. Day	**5,013**	**2,284**	**3,447**	**3,081**	**3,565**	**4,586**	**3,552**	**4,532**

TSS (mg/L)

Annual Average, Maximum Month, and Maximum Week

Month	2015	2016	2017	2018	2019	2020	2021	2022	Average
January		257	290	239	346	347	256	188	274
February		261	250	248	330	382	233	296	286
March		270	220	248	321	363	218	260	271
April	344	331	272	281	295	377	317	236	307
May	347	301	307	287	313	309	437	274	322
June	341	311	361	305	332	339	362	316	333
July	380	326	340	388	356	299	193	382	333
August	393	324	323	351	330	285	260	498	345
September	324	298	334	369	283	285	199	323	302
October	428	309	312	335	399	297	182	312	322
November	278	238	295	361	386	288	290	282	302
December	250	242	202	357	273	235	332	280	271
Annual Avg.	**340**	**289**	**292**	**314**	**332**	**316**	**274**	**306**	
Max. Month	**428**	**331**	**361**	**388**	**399**	**382**	**437**	**498**	

Maximum Day

Month	2015	2016	2017	2018	2019	2020	2021	2022
January		399	419	345	655	481	324	245
February		358	293	362	487	480	315	370
March		354	267	370	571	440	332	373
April	391	412	314	354	405	484	531	307
May	436	485	460	355	402	373	1,014	348
June	471	420	431	360	604	392	1,017	365
July	473	464	460	804	451	411	303	763
August	741	418	663	712	450	359	442	1,063
September	493	527	400	440	427	417	366	415
October	653	454	477	436	523	349	330	363
November	518	432	362	596	499	347	438	350
December	396	292	405	524	337	357	551	617
Max. Day	**741**	**527**	**663**	**804**	**655**	**484**	**1,017**	**1,063**

TSS (ppd)

Annual Average, Maximum Month, and Maximum Week

Month	2015	2016	2017	2018	2019	2020	2021	2022	Average
January		1,322	1,404	1,490	1,752	2,233	1,687	1,263	1,593
February		1,405	1,290	1,703	1,873	2,725	2,099	1,130	1,746
March		1,371	1,427	1,307	1,606	1,956	1,033	1,473	1,453
April	1,976	1,389	1,377	1,893	1,265	1,654	1,580	1,263	1,549
May	1,718	1,150	1,360	1,271	1,234	1,396	1,718	1,450	1,412
June	1,265	1,242	1,409	1,194	1,279	1,500	1,440	1,441	1,346
July	1,345	1,200	1,209	1,460	1,306	1,185	741	1,468	1,239
August	1,346	1,143	1,120	1,295	1,210	1,055	987	1,914	1,259
September	1,306	1,110	1,232	1,356	1,134	1,072	762	1,223	1,149
October	1,608	1,373	1,241	1,293	1,842	1,282	763	1,210	1,327
November	1,904	1,431	1,677	1,577	1,710	1,383	1,749	1,408	1,605
December	1,909	1,301	1,290	1,674	1,261	1,310	1,599	1,481	1,478
Annual Avg.	**1,586**	**1,286**	**1,337**	**1,452**	**1,462**	**1,562**	**1,339**	**1,407**	
Max. Month	**1,976**	**1,431**	**1,677**	**1,893**	**1,873**	**2,725**	**2,099**	**1,914**	
Max. 30-day	**2,511**	**1,556**	**1,819**	**1,966**	**2,093**	**3,120**	**2,214**	**2,044**	
Max. 7-day	**3,932**	**1,997**	**2,784**	**2,894**	**2,791**	**4,970**	**3,154**	**4,066**	
MW/AA	2.48	1.55	2.08	1.99	1.91	3.18	2.35	2.89	

Maximum Day

Month	2015	2016	2017	2018	2019	2020	2021	2022
January		2,280	2,139	2,190	2,957	2,964	2,909	1,487
February		1,851	1,525	2,340	3,142	6,750	3,705	1,635
March		1,740	1,903	1,996	2,404	3,360	1,462	1,840
April	3,351	1,855	1,758	3,168	1,758	2,186	2,256	1,556
May	3,107	1,866	1,948	1,762	1,607	1,675	4,101	1,656
June	1,689	1,634	1,630	1,346	2,302	1,658	4,024	1,613
July	1,578	1,619	1,706	2,948	1,645	1,514	1,159	2,857
August	2,488	1,454	2,291	2,569	1,698	1,376	1,625	4,134
September	1,798	1,995	1,515	1,580	1,649	1,544	1,307	1,522
October	2,377	1,820	1,972	1,864	2,864	1,438	1,324	1,523
November	3,963	2,188	2,698	2,372	2,372	1,683	3,154	1,794
December	3,846	1,636	3,801	2,374	1,618	1,876	2,545	2,969
Max. Day	**3,963**	**2,280**	**3,801**	**3,168**	**3,142**	**6,750**	**4,101**	**4,134**

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA-0020290	Discharge No.	001	Month	January Year 2015
Facility Name	Stanwood WWTP			Location	26279 - 98th Ave NW, Stanwood, WA
Receiving Water	Old Stillaguamish River				
Plant Type	Oxidation Ditch			Check box if NO DISCHARGE for month	☐

	INFLUENT					EFFLUENT										
Frequency	Daily	2/week	2/week	2/week	2/week	Daily	2/week	2/week	1/month	2/week	2/week	1/month	7/week	2/Week		
Type	Cont.	24-HC	Calc.	24-HC	Calc.	Cont.	24-HC	Calc.	Calc.	24-HC	Calc.	Calc.	Grab	Grab		
Units	MGD	MG/L	LBS/DAY	MG/L	LBS/DAY	MGD	MG/L	LBS/DAY	% REMOVAL	MG/L	LBS/DAY	% REMOVAL	STANDARD UNITS	#/100 ML		
Day of the Month	FLOW	BOD 5-DAY	BOD 5-DAY	TSS	TSS	FLOW	BOD 5-DAY	BOD 5-DAY	BOD 5-DAY	TSS	TSS	TSS	pH	FECAL COLIFORM		
1	0.51					0.48							7.77			
2	0.55					0.53							7.85			
3	0.55					0.52							7.79			
4	0.65					0.62							7.85			
5	1.97					2.06							7.80			
6	1.04	196	1700	197	1709	1.07	4	36	98	8	71	96	7.71	4		
7	0.82	190	1299	149	1019	0.90	4	30	98	9	68	94	7.74	6		
8	0.74					0.78							7.79			
9	0.66					0.69							7.39			
10	0.62					0.67							7.49			
11	0.62					0.64							7.52			
12	0.60					0.59							7.51	8		
13	0.57					0.60							7.55			
14	0.56	190	887	251	1172	0.59	2	10	99	10	49	96	7.60	12		
15	0.53	118	522	268	1185	0.58	3	15	97	5	24	98	7.46			
16	1.09					1.10							7.59			
17	0.66					0.70							7.55			
18	0.79					0.82							7.58			
19	0.71					0.74							7.61			
20	0.66	265	1459	201	1106	0.63	7	37	97	8	42	96	7.54	9		
21	0.61	538	2737	221	1124	0.64	6	32	99	7	37	97	7.48	2		
22	0.59					0.63							7.55			
23	0.64					0.68							7.66			
24	0.80					0.84							7.57			
25	0.71					0.71							7.55			
26	0.65					0.75							7.64	5		
27	1.21	484	4884	439	4430	1.03	6	52	99	12	103	97	7.62			
28	0.57	307	1459	251	1193	0.57	11	52	96	10	48	96	7.60	18		
29	1.10					1.28							7.65			
30	0.54					0.70							7.65			
31	0.54					0.77							7.69			
Total																
	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	MIN	GEM		
Monthly	0.74	286	1868	247	1617	0.77	5	33	98	9	55	96	7.39	7		
Limit	**1.50**		**4100**		**4100**	**Report**	**30**	**376**	**>85%**	**30**	**376**	**>85%**	**6.0**	**200**		
	MAX	MAX	MAX	MAX	MAX	MAX	AVW	AVW		AVW	AVW		MAX	GM7		
Weekly	1.97	538	4884	439	4430	2.06	9	52		11	76		7.85	9		
Limit							**45**	**563**		**45**	**563**		**9.0**	**400**		

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum MXD=Max Daily GM7=highest 7-day Geometric Mean

COMMENT AND EXPLANATION OF ANY VIOLATIONS MUST BE ATTACHED ON A SEPARATE SHEET.

Mail to: Department of Ecology, Northwest Regional Office, Water Quality, 3190 160th Ave SE Bellevue, WA 98008

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Kevin Hushagen Public Works Director
Name and Title (Typed or Printed)

Kevin Hushagen 2/12/15
Signature/Date

(360) 629-9782
Phone Number

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA-0020290	Discharge No.	001	Month	February Year 2015
Facility Name	Stanwood WWTP			Location	26279 - 98th Ave NW, Stanwood, WA
Receiving Water	Old Stillaguamish River				
Plant Type	Oxidation Ditch			Check box if NO DISCHARGE for month	

	INFLUENT					EFFLUENT										
Frequency	Daily	2/week	2/week	2/week	2/week	Daily	2/week	2/week	1/month	2/week	2/week	1/month	7/week	2/Week		
Type	Cont.	24-HC	Calc.	24-HC	Calc.	Cont.	24-HC	Calc.	Calc.	24-HC	Calc.	Calc.	Grab	Grab		
Units	MGD	MG/L	LBS/DAY	MG/L	LBS/DAY	MGD	MG/L	LBS/DAY	% REMOVAL	MG/L	LBS/DAY	% REMOVAL	STANDARD UNITS	#/100 ML		
Day of the Month	FLOW	BOD 5-DAY	BOD 5-DAY	TSS	TSS	FLOW	BOD 5-DAY	BOD 5-DAY	BOD 5-DAY	TSS	TSS	TSS	pH	FECAL COLIFORM		
1	0.51					0.73							7.66			
2	0.54					0.75							7.59	27		
3	0.58	367	1775	374	1809	0.59	5	25	99	8	39	98	7.57			
4	1.22	201	2045	213	2167	1.26	5	53	98	8	84	96	7.65	19		
5	0.78					0.80							7.69			
6	0.74					0.76							7.67			
7	1.61					1.68							7.63			
8	0.75					0.77							7.65			
9	0.75					0.77							7.65	6		
10	0.82					0.85							7.66			
11	0.73	368	2240	273	1662	0.75	3	19	99	6	38	98	7.57	12		
12	0.65	491	2662	368	1995	0.68	4	23	99	5	28	99	7.59			
13	0.60					0.62							7.62			
14	0.61					0.64							7.65			
15	1.14					1.18							7.67			
16	0.57					0.59							7.67	20		
17	0.54	331	1491	382	1720	0.56	4	19	99	3	14	99	7.63			
18	0.53	399	1764	333	1472	0.54	6	27	98	3	14	99	7.65	5		
19	0.59					0.59							7.69			
20	0.65					0.59							7.72			
21	1.18					0.99							7.65			
22	0.56					0.55							7.67			
23	0.54					0.52							7.55	11		
24	1.05	442	3871	564	4939	0.98	8	65	98	11	90	98	7.49			
25	0.53	383	1693	414	1830	0.52	5	22	99	5	22	99	7.55	4		
26	0.55					0.58							7.57			
27	1.50					1.33							7.52			
28	1.41					1.44							7.55			
29																
30																
31																
Total																
	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	MIN	GEM		
Monthly	0.79	373	2193	365	2199	0.81	5	32	99	6	41	98	7.49	11		
Limit	**1.50**		**4100**		**4100**	**Report**	**30**	**376**	**>85%**	**30**	**376**	**>85%**	**6.0**	**200**		
	MAX	MAX	MAX	MAX	MAX	MAX	AVW	AVW		AVW	AVW		MAX	GM7		
Weekly	1.61	491	3871	564	4939	1.68	7	44		8	62		7.72	23		
Limit							**45**	**563**		**45**	**563**		**9.0**	**400**		

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum MXD=Max Daily GM7=highest 7-day Geometric Mean

COMMENT AND EXPLANATION OF ANY VIOLATIONS MUST BE ATTACHED ON A SEPARATE SHEET.

Mail to: Department of Ecology, Northwest Regional Office, Water Quality, 3190 160th Ave SE Bellevue, WA 98008

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Kevin Hushagen Public Works Director
Name and Title (Typed or Printed)

Kevin Hushagen 3/11/15
Signature/Date

(360) 629-9782
Phone Number

WASTEWATER TREATMENT PLANT MONITORING REPORT

Permit No.	WA-0020290	Discharge No.	001	Month	March	Year	2015
Facility Name	Stanwood WWTP			Location	26279 - 98th Ave NW, Stanwood, WA		
Receiving Water	Old Stillaguamish River						
Plant Type	Oxidation Ditch			Check box if NO DISCHARGE for month			

	INFLUENT					EFFLUENT										
Frequency	Daily	2/week	2/week	2/week	2/week	Daily	2/week	2/week	1/month	2/week	2/week	1/month	7/week	2/Week		
Type	Cont.	24-HC	Calc.	24-HC	Calc.	Cont.	24-HC	Calc.	Calc.	24-HC	Calc.	Calc.	Grab	Grab		
Units	MGD	MG/L	LBS/DAY	MG/L	LBS/DAY	MGD	MG/L	LBS/DAY	% REMOVAL	MG/L	LBS/DAY	% REMOVAL	STANDARD UNITS	#/100 ML		
Day of the Month	FLOW	BOD 5-DAY	BOD 5-DAY	TSS	TSS	FLOW	BOD 5-DAY	BOD 5-DAY	BOD 5-DAY	TSS	TSS	TSS	pH	FECAL COLIFORM		
1	0.64					0.62							7.57			
2	0.54					0.53							7.59	9		
3	0.55	367	1683	335	1537	0.36	4	12	99	5	15	99	7.69			
4	1.07	371	3311	354	3159	1.05	6	53	98	5	44	99	7.64	4		
5	0.52					0.52							7.66			
6	0.51					0.48							7.64			
7	0.51					0.51							7.59			
8	0.49					0.49							7.57			
9	1.00					1.00							7.67	10		
10	0.49	451	1843	374	1528	0.48	5	20	99	5	20	99	7.78			
11	0.96	372	2978	336	2690	0.94	2	16	99	5	39	99	7.67	12		
12	0.96					0.94							7.65			
13	0.47					0.46							7.65			
14	0.49					0.48							7.63			
15	0.86					0.87							7.61			
16	0.80					0.85							7.54	15		
17	0.67	343	1917	321	1794	0.68	6	34	98	6	34	98	7.54			
18	1.28	312	3331	286	3053	1.30	3	33	99	5	54	98	7.63	5		
19	1.20					1.18							7.61			
20	1.26					1.26							7.65			
21	1.34					1.35							7.61			
22	0.65					0.66							7.58			
23	0.61					0.61							7.57	9		
24	1.22	295	3002	246	2503	1.19	4	40	99	4	40	98	7.51			
25	0.63	371	1949	294	1545	0.61	4	20	99	3	15	99	7.53	23		
26	1.16					1.13							7.55			
27	0.57					0.55							7.57			
28	1.90					1.93							7.51			
29	0.69					0.69							7.50			
30	0.62					0.62							7.52	6		
31	0.70	234	1366	216	1261	0.63	1	5	99	1	5	99	7.55			
Total																
	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	AVG	MIN	GEM		
Monthly	0.82	346	2376	307	2119	0.81	4	26	99	4	30	99	7.50	9		
Limit	**1.50**		**4100**		**4100**	**Report**	**30**	**376**	**>85%**	**30**	**376**	**>85%**	**6.0**	**200**		
	MAX	MAX	MAX	MAX	MAX	MAX	AVW	AVW		AVW	AVW		MAX	GM7		
Weekly	1.90	451	3331	374	3159	1.93	5	34		6	44		7.78	14		
Limit							**45**	**563**		**45**	**563**		**9.0**	**400**		

AVG=Average AVW =Highest Weekly Average GEM=Geometric Mean MAX=Maximum MIN=Minimum MXD=Max Daily GM7=highest 7-day Geometric Mean

COMMENT AND EXPLANATION OF ANY VIOLATIONS MUST BE ATTACHED ON A SEPARATE SHEET.

Mail to: Department of Ecology, Northwest Regional Office, Water Quality, 3190 160th Ave SE Bellevue, WA 98008

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Kevin Hushagen Public Works Director
Name and Title (Typed or Printed)

Signature/Date 4/13/15

(360) 629-9782
Phone Number

Appendix E
Related Planning Documents

Stephanie Wright
Megan Dunn
Sam Low
Nate Nehring
Jared Mead

September 15, 2021

Dave Andersen, AICP
Managing Director, Growth Management Services
Washington State Department of Commerce
1011 Plum Street SE
P.O. Box 42525
Olympia, WA 98504-2525

RE: 2021 Buildable Lands Report for Snohomish County

We are pleased to transmit electronically to your office the 2021 Buildable Lands Report for jurisdictions within Snohomish County, consistent with GMA requirements. This report is being transmitted to you to satisfy the GMA requirement at RCW 36.70A.215(2)(b) for a fourth buildable lands review and evaluation report from Snohomish County. Please let us know if you would like to receive hard copies of the report from us as well.

This report was developed in consultation with the cities of Snohomish County using the Snohomish County Tomorrow (SCT) process. It is the result of a coordinated county and city data collection and analysis process established by the Countywide Planning Policies and carried out by jurisdictions through the cooperative planning process of Snohomish County Tomorrow.

The methodological assumptions employed for the preparation of the 2021 Buildable Lands Report respond to the new buildable lands methods and procedures requirements established by E2SSB 5254, passed by the Legislature in 2017, and further described in the updated Buildable Lands Guidelines published by Commerce in December 2018. The methodology updates approved by Snohomish County Tomorrow for the 2021 Buildable Lands Report were informed by stakeholder and public input, building on previous public involvement processes carried out for previous reports prepared in 2002, 2007 and 2012.

On July 28, 2021, county and city elected officials on the Snohomish County Tomorrow Steering Committee approved the 2021 Buildable Lands Report on behalf of their jurisdictions. On September 8, 2021, the Snohomish County Council held a public hearing and adopted Amended Motion 21-272, which adopted this 2021 Buildable Lands Report, consistent with requirements in county code.

We wish to express thanks for state funding to assist in our fulfillment of this GMA requirement, and for your staff efforts to work with all the buildable lands jurisdictions. We note that continued funding for the required monitoring and improvement of the data is critical to our mutual goals of effectively implementing the GMA.

If you have any questions, please contact Mike McCrary (425-388-3311), Michael Kattermann (425-806-6401) or Russ Wright (425-622-9424), the SCT Planning Advisory Committee Co-Chairs.

Signed,

Stephanie Wright, Council Chair

Megan Dunn, Council Vice-Chair

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SNOHOMISH COUNTY COUNCIL
Snohomish County, Washington

AMENDED MOTION 21-272

ADOPTING THE 2021 BUILDABLE LANDS REPORT FOR SNOHOMISH COUNTY AND AUTHORIZING THE COUNTY COUNCIL CHAIR AND VICE-CHAIR TO SIGN TRANSMITTAL LETTER TO THE WASHINGTON STATE DEPARTMENT OF COMMERCE

WHEREAS, the Growth Management Act (GMA) (chapter 36.70A RCW) at RCW 36.70A.215 requires certain local governments to carry out review and evaluation programs that analyze various factors relating to growth, density and capacity of urban growth areas (UGAs) and that annually collect data on urban and rural land uses; and

WHEREAS, the Growth Monitoring Report is a Snohomish County Tomorrow (SCT) report series, first published in 1997, containing comprehensive Snohomish County demographic information including population, employment, residential development and housing cost trends; and

WHEREAS, the review and evaluation program under RCW 36.70A.215 requires that Snohomish County produce a report, commonly referred to as a buildable lands report, every eight years; and

WHEREAS, the Snohomish County Countywide Planning Policy (CPP) GF-7 establishes a process for the development of the buildable lands reports involving Snohomish County cities and the county through the cooperative planning process of SCT; and

WHEREAS, CPP GF-7 requires that the development of the Buildable Lands Report for Snohomish County follow a framework for coordinated county and city data collection and analysis established in the Procedures Report titled “Recommended Methodology and Work Program for a Buildable Lands Analysis for Snohomish County and its Cities,” which was originally approved by the SCT Steering Committee in July 2000, and used as the framework for the 2002, 2007 and 2012 Buildable Lands Reports for Snohomish County; and

WHEREAS, E2SSB 5254, passed by the Legislature in 2017, enacted a number of changes to state requirements for buildable lands methods and procedures, which were subsequently clarified in updated Buildable Lands Guidelines published by the State Department of Commerce in December 2018, and which resulted in an updated Procedures Report that was approved by the SCT Steering Committee on June 24, 2020, and adopted by the Snohomish County Council on September 8, 2021; and

WHEREAS, the 2021 Buildable Lands Report for Snohomish County uses the revised methods and procedures outlined in the updated Procedures Report (2020); and

WHEREAS, the methodological assumptions employed for the preparation of Snohomish County’s buildable lands reports were informed by extensive stakeholder and public input through an early and continuous public involvement process over the two past decades; and

WHEREAS, the SCT Planning Advisory Committee (PAC), following a nearly 2½ year review process, recommended a Draft 2021 Buildable Lands Report to the SCT Steering Committee on June 10, 2021; and

WHEREAS, the SCT Steering Committee, at its meeting on June 23, 2021, delayed action on the PAC's Draft 2021 Buildable Lands Report, to allow more time for additional data comments or concerns from cities to be considered for inclusion in the report; and

WHEREAS, the SCT Planning Advisory Committee, on July 8, 2021, reviewed and approved proposed revisions from the City of Lake Stevens for transmittal in an updated Draft 2021 Buildable Lands Report to the SCT Steering Committee; and

WHEREAS, the SCT Steering Committee on July 28, 2021, recommended the PAC's updated Draft 2021 Buildable Lands Report to the Snohomish County Council; and

WHEREAS, adoption of the 2021 Buildable Lands Report does not constitute an agency action as defined by WAC 197-11-704. Therefore, SEPA environmental review is not required. Although the adoption of the report is not an agency action, to the extent it may be considered an agency action, it is categorically exempt under WAC 197-11-800(17) as information collection and research; and

WHEREAS, SCC 2.01.035 recognizes the authority of the Snohomish County Council to adopt buildable lands reports on behalf of Snohomish County; and

WHEREAS, on September 1, and continued to September 8, 2021, the Snohomish County Council held a public hearing on the Draft 2021 Buildable Lands Report recommended by the SCT Steering Committee;

NOW, THEREFORE ON MOTION, the Snohomish County Council adopts the 2021 Buildable Lands Report, attached to this motion as Exhibit A, as the buildable lands report for Snohomish County and authorizes the Council Chair and Vice-Chair to affix their signatures to a letter under cover of which the report will be transmitted to the Washington State Department of Commerce.

PASSED this 8th day of September, 2021.

SNOHOMISH COUNTY COUNCIL
Snohomish County, Washington

Megan Dunn
Council Acting Chair

ATTEST:

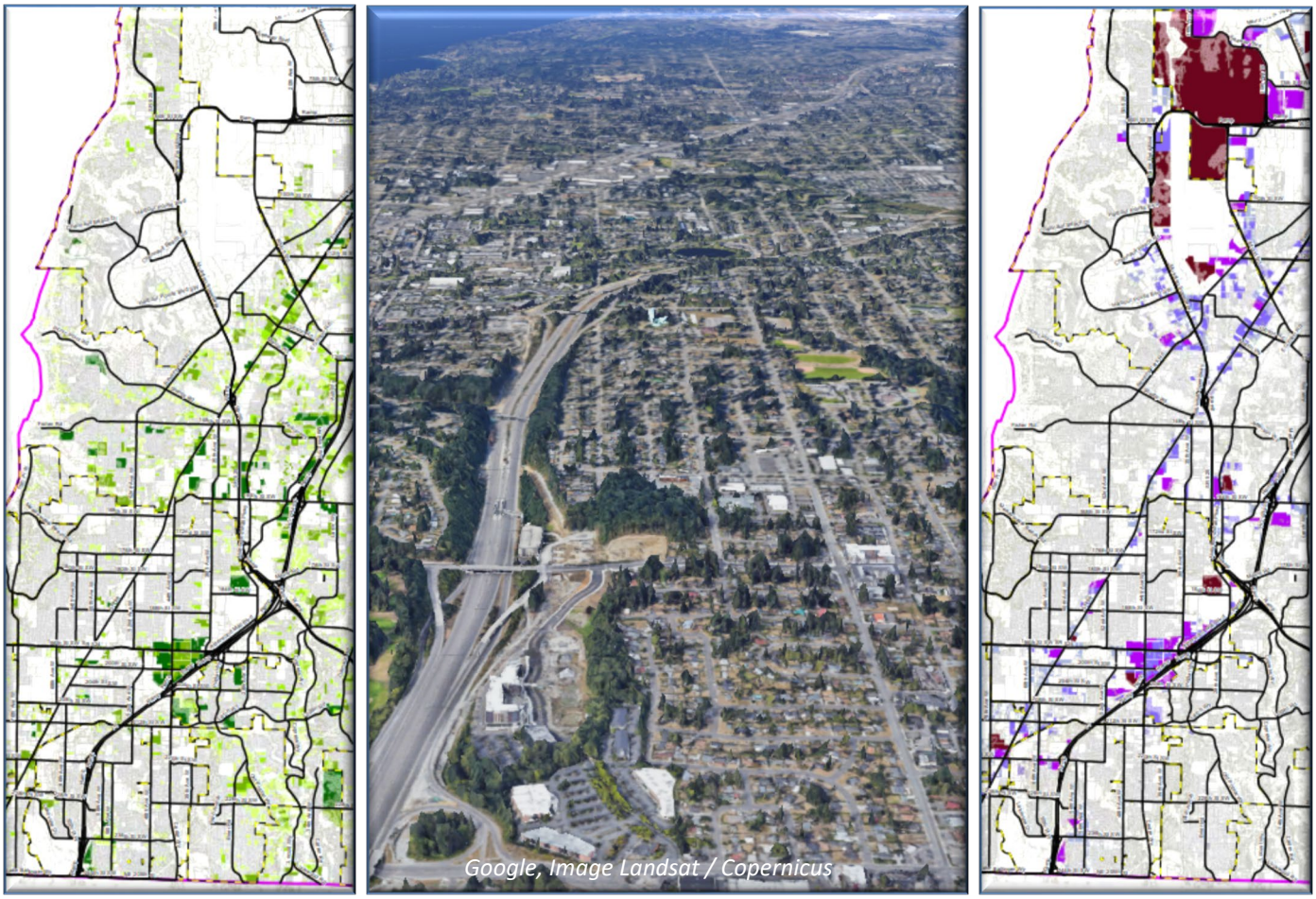
Clerk of the Council

Snohomish County

Snohomish County Tomorrow
A GROWTH MANAGEMENT ADVISORY COUNCIL

Snohomish County

2021 Buildable Lands Report



Adopted by the Snohomish County Council on September 8, 2021

Approved by the Snohomish County Tomorrow Steering Committee on July 28, 2021

Funded in part through grant funding provided by the Washington State Department of Commerce
Contract numbers 19-63312-005 and 20-63312-005

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2021 Buildable Lands Report for Snohomish County

Adopted by the Snohomish County Council on September 8, 2021

Recommended by the
Snohomish County Tomorrow (SCT)
Planning Advisory Committee on July 8, 2021 and
SCT Steering Committee on July 28, 2021

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2021 Buildable Lands Report for Snohomish County

Adopted by the Snohomish County Council on September 8, 2021

Executive Summary

The Buildable Lands Report (BLR) is a requirement of the state Growth Management Act (RCW 36.70A.215). The BLR is intended to periodically review and evaluate whether urban densities are being achieved within the UGA (in both city and county portions). Based on observed densities, the report must determine whether there is sufficient suitable land to accommodate the adopted 2035 growth targets in urban growth areas (UGAs). The BLR must also identify any inconsistencies between actual and planned development patterns and targets where such inconsistencies may hinder local governments from accommodating projected growth. If the results of the buildable lands review and evaluation reveal that urban densities and growth are not being achieved consistent with original plan objectives, or that deficiencies in buildable land exist within UGAs, cities and counties are required to adopt and implement reasonable measures, other than adjusting UGA boundaries, that are likely to reduce these differences.

Note that the Buildable Lands Report evaluates how current comprehensive plans and zoning are functioning relative to the original growth goals and objectives contained in the plans. The BLR as such provides a report card on the performance of city and county plans with regard to growth accommodation. This purpose is distinct from the Land Capacity Analysis (LCA) requirements, also required of jurisdictions planning under the Growth Management Act at the time of the major periodic updates. The LCA is intended to ensure sufficient growth capacity of land suitable for urban development when comprehensive plans and development regulations are updated to accommodate the urban growth projected to occur in the county for the succeeding twenty-year period. In short, the BLR looks back while the LCA looks forward[1].

This is Snohomish County's fourth BLR, with reports previously prepared in 2002, 2007 and 2012. Pursuant to the Countywide Planning Policies, it is developed jointly by cities and the county using the Snohomish County Tomorrow process.

[1] For more information on the distinctions between the Buildable Lands Report and Land Capacity Analyses, please refer to the "Review & Evaluation Program & Land Capacity Analysis" section (pages 13-14) of the Buildable Lands Guidelines, Department of Commerce (2018).

In 2017, the state legislature passed E2SSB 5254, which enacted a number of changes to state requirements for buildable lands methods and procedures. Subsequently, the Washington State Department of Commerce published updated Buildable Lands Program Guidelines in December 2018. In response, Snohomish County staff, using the SCT process, worked with city planning staff, consultant staff, and stakeholder representatives during 2019-2020 to review and recommend updates to the buildable lands methods and procedures to be used for the 2021 Buildable Lands Report (BLR). The SCT Steering Committee approved the recommended methodology updates in June 2020. The 2021 BLR incorporates the revised methods and procedures that resulted from the methodology review and update required by E2SSB 5254.

METHODOLOGY:

Using geographic information systems (GIS) technology, the present analysis began with a April 2019 extract of all Assessor parcel records within incorporated and unincorporated portions of the Snohomish County urban growth area (UGA). Parcels with additional development potential were classified into one of four categories:

Vacant – parcels without structures.
Partially-used – parcels where existing structures use a portion of the site and where additional development is possible without demolition.
Redevelopable – parcels with existing structures that are expected to be demolished and replaced with new and more intensive uses.
Pending – parcels with pending applications for new construction.

Structures existing as of April 1, 2019 were considered developed and counted as part of the population or employment base, while everything proposed, built or occupied after that date was counted as future capacity for the 2021 report.

Future land use information was then transferred to individual parcels using zoning classifications for most cities and plan designations for most parcels within unincorporated urban areas. There were some exceptions to this general rule, especially in areas where cities control utility extensions in unincorporated UGAs through a requirement to annex, in which case city pre-zoning (or plan designations) for unincorporated areas was used.

Unbuildable land area in developable parcels was then removed from the buildable lands inventory for parcels affected by: critical areas and buffers (steep slopes, wetlands, streams and lakes, frequently flooded areas); major utility easements; future arterial rights-of-way and land needed for other capital facilities (schools, parks, etc.).

Future development densities (represented as housing units and/or jobs per buildable acre), which were based on an analysis of actual residential, commercial and industrial development activity within both city and county plan and/or zone designations, were then applied to the parcel-level estimates of buildable acres. This resulted in an estimate of additional housing units and employment capacity by parcel.

The resulting additional capacity estimates were then reduced to account for development uncertainties. These reductions pertained to uncertainties regarding: ability to obtain necessary capital facilities and services to support urban development over the next 20 years; removal of land for miscellaneous public/institutional uses (churches, schools, municipal purposes, etc.); and market availability (property that is held out for development over the next 20 years).

Once these adjustments for uncertainties were made, the additional residential and employment capacities were aggregated from parcels to the city, UGA and Municipal UGA (MUGA) level in order to compare with the adopted 2035 population and employment targets, contained in Appendix B of the Countywide Planning Policies for Snohomish County.

KEY RESULTS:

- Overall, at the countywide UGA level:
  - Urban densities are being achieved consistent with GMA comprehensive plans, and
  - There is adequate land capacity to accommodate the adopted 2035 total UGA population, housing and employment growth targets. This is also the case for cities overall and the unincorporated UGA overall.

- At the individual city level, there is adequate capacity to accommodate the adopted 2035 population growth targets, with the following exceptions:
  - There is a significant 2035 population capacity shortfall within the City of Everett, and
  - Minor capacity shortfalls appear to exist for Gold Bar and Index.

- At the individual city level, there is adequate capacity to accommodate the adopted 2035 employment growth targets, with the following exceptions:
  - Relatively minor 2035 employment capacity shortfalls appear to exist for the cities of Granite Falls and Lake Stevens.

- Progress has been made towards achievement of the 2035 population growth targets by individual jurisdictions.

2021 Buildable Lands Report for Snohomish County

Adopted by the Snohomish County Council on September 8, 2021

Introduction

This report responds to and satisfies the review and evaluation requirements of the Washington State Growth Management Act (GMA) in RCW 36.70A.215, commonly referred to as the "buildable lands" statute. The report was prepared by staff from the county and the cities using the Snohomish County Tomorrow (SCT) process, the county's adopted multi-jurisdictional process for accomplishing GMA work requiring interjurisdictional coordination.

This report includes much of the updated growth monitoring information typically produced for the *SCT Growth Monitoring Report* series. It includes the county's growth and development information through the year 2020, and updates the *SCT 2020 Growth Monitoring Report* with updated population, housing and employment capacity information. This report is thus intended to convey the monitoring information required of SCT by Countywide Planning Policy GF-5(c) for the year 2021.

Background

In 1997, the Growth Management Act (GMA) was amended to include new requirements for Snohomish County and five (now six) other western Washington counties and the cities within those counties to establish review and evaluation programs that monitor residential, commercial and industrial development, and the densities at which this development has occurred under each jurisdiction's GMA comprehensive plan and development regulations. Based on the observed development densities, a periodic evaluation of the sufficiency of remaining suitable residential, commercial and industrial land within Urban Growth Areas (UGAs) to accommodate projected growth is required. As such, the Buildable Lands Report (BLR) "looks back" and compares planned vs. actual urban densities in order to determine whether the original plan assumptions pertaining to assumed densities and the adequacy of buildable land for accommodating projected growth (currently to the year 2035) were accurate.

If the results of the buildable lands review and evaluation reveal that urban densities and growth are not being achieved consistent with original plan objectives, or that deficiencies in buildable land exist within UGAs, cities and counties are required to adopt and implement measures, other than adjusting urban growth areas, that are reasonably likely to reduce these differences. The reasonable measures process shall be used by jurisdictions as part of the next comprehensive plan update to reconcile inconsistencies. In Appendix D of the *Countywide Planning Policies*, Snohomish County and its cities have identified a process for identifying and evaluating potential reasonable measures that may be implemented by the cities or the county to address

potential inconsistencies revealed by the review and evaluation program.

In 2017, the state legislature passed E2SSB 5254, which enacted a number of changes to state requirements for buildable lands methods and procedures. Subsequently, the Washington State Department of Commerce published updated Buildable Lands Program Guidelines in December 2018. Specific areas of focus for the review of the buildable lands methodology included:

- Expanded reasonable measures definition to reduce differences between growth targets and actual growth
- Evaluation of regulations and infrastructure gaps that could limit achievement of targets/densities
- Review and refinement of the market availability factor
- Overall emphasis on increasing the accuracy of buildable lands reports.

In response, Snohomish County was required to review and update its buildable lands methods and procedures to be used for the 2021 Buildable Lands Report (BLR). County staff worked with city planning staff, consultant staff, and stakeholder representatives during 2019-2020 to conduct the methodology review. This work resulted in approval by the SCT Steering Committee in June 2020 of two technical supplements to two key guidance documents, originally developed by SCT in the early 2000's, for the development of previous buildable lands reports and the implementation of reasonable measures programs by jurisdictions:

- *Snohomish County Tomorrow Recommended Methodology and Work Program for a Buildable Lands Analysis for Snohomish County and its Cities* (Procedures Report, July 2000)
- *Snohomish County Tomorrow Recommended Method for Evaluating Local Reasonable Measures Programs* (June 2003).

Specific enhancements called for in the *Methods and Procedures Technical Supplement: Response to E2SSB-5254* are briefly described below in the "Countywide Planning Policies and Procedures Report" section.

This is the fourth buildable lands review and evaluation report completed by Snohomish County and its cities. The current report evaluates whether there is sufficient suitable land within UGAs to accommodate the forecasted residential, commercial and industrial growth anticipated through the end of the 20-year GMA planning period, currently 2035. The report is based on the methods and approaches first developed and used by the county and cities for the three previous buildable lands reports prepared by Snohomish County Tomorrow in 2002, 2007 and 2012. In addition, it incorporates the revised methods and procedures that resulted from the methodology review and update required by E2SSB 5254.

It is important to note that the 2035 targets that are evaluated in the 2021 BLR are scheduled later in 2021 to be replaced in the Countywide Planning Policies by 2044 initial population and employment targets developed and recommended by SCT. The new 20-year growth targets will help guide the city and county GMA plan updates in 2024. Even though the 2021 BLR is focused on evaluating the currently adopted targets to the year 2035, as required by GMA, it will

provide key baseline information for the subsequent development of the 2044 initial growth targets by SCT.

Process

Using the SCT process, Snohomish County and the cities within the county have conducted a review and evaluation of achieved urban densities, remaining anticipated growth, and the adequacy of the urban area land supply to accommodate the remaining projected residential and employment growth through 2035. This report is the result of that analysis and characterizes the capacity in UGAs as of April 1, 2019 based on densities achieved under GMA. The following sections describe additional inputs to the development of the 2021 Buildable Lands Report.

Countywide Planning Policies and Procedures Report (2000)

In February 2000, the buildable lands review and evaluation program was established in Snohomish County with the adoption of amendments to Countywide Planning Policy UG-14 (now called GF-7) by the County Council. These amendments were recommended by Snohomish County Tomorrow and were intended to provide interjurisdictional guidelines for the development of the buildable lands report.

One key requirement of the Countywide Planning Policies (CPPs) was the development of a Procedures Report to establish general buildable lands definitions and methods, interjurisdictional data collection and data coordination issues, and city and county work program responsibilities. The Procedures Report was developed with consultant assistance from ECONorthwest. The resulting report, entitled *Recommended Methodology and Work Program for a Buildable Lands Analysis for Snohomish County and its Cities,* was developed under the direction of a Technical Advisory Committee, and was approved by the SCT Steering Committee in October 2000 as the guiding document for subsequent interjurisdictional technical work on the buildable lands program by city and county staff.

Additional technical guidance for Snohomish County's Procedures Report came from Washington State's (CTED) report entitled "*Issues in Designating Urban Growth Areas (Part I): Providing Adequate Urban Area Land Supply*," released March 1992; and Washington State's (CTED) report entitled *Buildable Lands Program Guidelines*, released June 2000.

The Procedures Report has been used to guide Snohomish County jurisdictions during preparation of the 2002, 2007 and 2012 buildable lands reports. It provides a general set of basic steps to follow when conducting the buildable lands analysis, along with descriptions of various optional approaches. The Procedures Report outlined a flexible approach to the buildable lands analysis, which can adapt to improved geographic information systems (GIS) tools and data availability over time, and as familiarity with relevant data sources increases.

E2SSB 5254/Updated Commerce Buildable Lands Guidelines and SCT Procedures Report

In 2017, E2SSB 5254 was passed by the Washington State Legislature. This legislation constituted the first major revision to the buildable lands program since its inception in 1997. In

December 2018, the Washington State Department of Commerce published updated Buildable Lands Guidelines in response to the requirements passed in E2SSB-5254. The Guidelines were also the first update since the original Guidelines were published in 2000.

To assist in the review of the new GMA buildable lands requirements that the 2021 BLR would need to address, Snohomish County in 2019 procured the consultant services of Environmental Science Associates and ECONorthwest. The consultant team worked with county staff, a subcommittee of the SCT Planning Advisory Committee (PAC), and other key stakeholders, to review the previous methods and data used by Snohomish County in relation to the new requirements of E2SSB 5254 and the new Commerce Buildable Lands Guidelines. Potential revisions that were analyzed included: (1) land classification definitions, (2) market factor, (3) infrastructure gaps, and (4) reasonable measures. The above groups worked with the consultant team to evaluate alternative approaches to addressing each key issue.

Following this process, the SCT Planning Advisory Committee concluded that:

- The current methodology generally works well at predicting land that is potentially developable within the UGA, however, some minor adjustments to thresholds used to determine developable land status are recommended.
- The current methodology is generally accurate in predicting the housing unit capacity at locations that eventually develop, as revealed by the recently published Snohomish County 2012 Buildable Lands Report Validation Study. To the extent it was inaccurate, it was in the direction of underestimating capacity.
- The actual single family market availability reduction factor was less than used in the current methodology and should be adjusted downward.
- An updated list of reasonable measures with additional measures and metrics should be considered.
- An updated methodology to reflect procedural steps to address infrastructure gaps should be considered.

The PAC's recommendations were transmitted to the SCT Steering Committee via two technical supplements: one supplementing content in the July 2000 SCT Procedures Report, and the other supplementing the June 2003 SCT Reasonable Measure Program document. The SCT Steering Committee approved the PAC's recommendation at their June 24, 2020 meeting. These recommended updates to the buildable lands methodology were used by county and city staff to conduct the data analysis for the 2021 BLR.

Stakeholder Outreach for 2021 Report

Part of the effort that Snohomish County Planning and Development Services (PDS) staff made in preparing the 2021 report included contacting representatives from the development, environmental, and infrastructure-provider communities for their input. This stakeholder outreach process began with the review and update of the buildable lands methodology. A Stakeholder Workshop was held in November 2019 to discuss the overall process for updating the BLR methodology, provide preliminary findings of the research, and to gather input and ideas for the PAC subcommittee to consider. Due to the cancellation of in-person meetings as a

result of the COVID-19 emergency declaration beginning in March 2020, the BLR stakeholder outreach approach subsequently shifted to updates of stakeholder representatives via email and 2021 BLR webpage updates. This included both the methodology review and update phase of the project, as well as the data development and draft results review phases.

Other opportunities exist for stakeholder input to the 2021 BLR through the SCT review process, at both Planning Advisory Committee meetings and Steering Committee meetings. Following an SCT Steering Committee recommendation on a final 2021 report, the County Council will hold a public hearing on the report prior to adopting a final version for Snohomish County.

Uncertainties and Monitoring

This report builds upon and attempts to improve the land capacity work done by the county and cities for the initial GMA comprehensive plan adoption in the mid-1990s, the 2002, 2007 and 2012 Buildable Lands Reports, and for the 10-year GMA plan updates in 2004-05 and 2015. The authors and contributors to this report have endeavored to improve accuracy and ensure that the information and analysis has been subject to quality control and quality assurance processes. However, there are uncertainties inherent in any analysis that is based on forecasts of future activity, and the data methods used have limitations. Such uncertainties are not likely to significantly affect the major factual conclusions of the report.

This report is not an attempt to fully analyze or depict the current market feasibility or availability of a particular parcel for immediate development, the affordability of land and availability of financing, the availability or capacity of infrastructure, or the pace at which individual parcels of land will develop in the future. Rather, this report is intended to provide useful information and analysis for use in subsequent policy discussions and actions that evaluate and implement the GMA during the 20-year plan horizon in Snohomish County.

This report has been developed using available information and reasonable methodological assumptions. However, as with any empirical analysis, there is an on-going need to monitor and assess the methodological assumptions and data used in this report, in order to ensure the accuracy of future land capacity analyses for each UGA.

Census 2020 Results

The U.S. Census Bureau's data release schedule following a decennial census would normally have provided county and subcounty level population and housing counts in time for use in this Buildable Lands Report. However, due the impact of COVID-19 on the Census Bureau's operations during 2020, the release of the detailed population and housing count data is now planned for end of September 2021, rather than April 2021 as would normally have been the case. City and county staff will evaluate the Census 2020 data once it is released this fall for consistency with the base year data used for this report.

Summary of Key Results

The purpose of the GMA Review & Evaluation Program, commonly referred to as the Buildable Lands Program (RCW 36.70A.215), is to answer two questions:

Is urban development occurring according to plan? Determine whether a county and its cities are achieving urban densities within urban growth areas by comparing growth and development assumptions, targets, and objectives contained in the countywide planning policies and the county and city comprehensive plans with actual growth and development that has occurred in the county and its cities.

If not, what adjustments might need to be made? Identify reasonable measures, other than adjusting urban growth areas, that will be taken to comply with the requirements of this chapter. Reasonable measures are those actions necessary to reduce the differences between growth and development assumptions and targets contained in the countywide planning policies and the county and city comprehensive plans with actual development patterns. The reasonable measures process shall be used as part of the next comprehensive plan update to reconcile inconsistencies.

In order to address these questions, the buildable lands analysis must determine whether there is sufficient suitable land to accommodate the adopted population and employment allocations in urban growth areas, and identify any inconsistencies between actual and planned development patterns and densities where such inconsistencies may prevent local governments from accommodating projected growth. As called for in Appendix D of the Countywide Planning Policies (CPPs):

> In UGAs where a consistency problem has been found (e.g. not achieving urban densities or a lack of sufficient capacity), GMA (RCW 36.70A.215) and Countywide Planning Policy GF-7 direct cities and the county to consider "reasonable measures," other than expanding Urban Growth Areas (UGAs) to resolve the inconsistency.[1]

Urban Densities Not Being Achieved or Insufficient Capacity

Below are the key observations from the 2021 SCT Buildable Lands Report, recommended by the PAC on June10, 2021. These observations describe the estimated capacity shortfalls (termed "inconsistencies" under the GMA buildable lands statute) and capacity surpluses shown in the 2021 BLR.

Overall, at the countywide UGA level:

- Urban densities are being achieved consistent with GMA comprehensive plans, and

[1] CPPs, App. D (Reasonable Measures); Guidelines for Review; Applicable Policies.

- There is adequate land capacity to accommodate the adopted 2035 total UGA population, housing and employment growth targets[2]. This is also the case for cities overall and the unincorporated UGA overall.

Population

	2019 Estimated Population	CPP 2035 Population Target	2019-2035 Numeric Change	2035 Total Population Capacity	Additional 2019-2035 Pop Capacity	Pop Capacity Surplus vs. Shortfall (in parentheses)
UGA Total	687,356	815,132	127,776	914,036	226,680	98,904
City Total	453,110	578,994	125,884	606,632	153,522	27,638
Uninc UGA Total	234,246	236,138	1,892	307,404	73,158	71,266

Housing

	2019 Estimated Housing Units	CPP 2035 Housing Unit Target	2019-2035 Numeric Change	2035 Total Housing Unit Capacity	Additional 2019-2035 Housing Unit Capacity	HU Capacity Surplus vs. Shortfall (in parentheses)
UGA Total	265,222	330,518	65,296	373,108	107,886	42,590
City Total	181,266	236,563	55,297	256,825	75,559	20,262
Uninc UGA Total	83,956	93,955	9,999	116,283	32,327	22,328

Employment

	2019 Estimated Employment	CPP 2035 Employment Target	2019-2035 Numeric Change	2035 Total Employment Capacity	Additional 2019-2035 Emp Capacity	Emp Capacity Surplus vs. Shortfall (in parentheses)
UGA Total	277,930	373,052	95,122	405,570	127,640	32,518
City Total	238,425	325,205	86,780	346,697	108,272	21,492
Uninc UGA Total	39,505	47,847	8,342	58,873	19,368	11,026

For all city-specific observations below, please note that:

1) They are based on December 13, 2012 city boundaries (the date at which city boundaries were used to develop the 2035 targets), and
2) Capacity deficits of generally 100 or less are not considered to be inconsistencies. Given the uncertainties and limitations of the available data and methods, capacity shortfalls this small are not significant. For example, small differences in employment targets and capacity may result because the buildable lands evaluation of land supply does not consider potential growth in home-based occupations.

Population Capacity:

At the individual city level, there is adequate capacity to accommodate the adopted 2035 population growth targets, with the following exceptions:

[2] For the countywide UGA, additional 2019-2035 population capacity exceeds 2019-2035 projected UGA population growth by 98,904 (77.4%).

- There is a significant 2035 population capacity shortfall within the City of Everett, and
- Minor capacity shortfalls appear to exist for Gold Bar and Index.

City Population

	2019 Estimated Population	CPP 2035 Population Target	2019-2035 Numeric Change	2035 Total Population Capacity	Additional 2019-2035 Pop Capacity	Pop Capacity Surplus vs. Shortfall (in parentheses)
Arlington City	19,734	24,937	5,203	33,991	14,257	9,054
Bothell City (part)	18,180	23,510	5,330	28,357	10,177	4,847
Brier City	6,611	6,972	361	7,074	463	102
Darrington Town	1,410	1,764	354	1,770	360	6
Edmonds City	42,170	45,550	3,380	51,663	9,493	6,113
Everett City	111,794	164,812	53,018	151,063	39,269	(13,749)
Gold Bar City	2,150	2,406	256	2,349	199	(57)
Granite Falls City	3,900	7,624	3,724	7,845	3,945	221
Index Town	175	220	45	208	33	(12)
Lake Stevens City	33,057	39,340	6,283	40,591	7,534	1,251
Lynnwood City	39,596	54,404	14,808	58,145	18,549	3,741
Marysville City	67,820	87,589	19,769	89,550	21,730	1,961
Mill Creek City	20,590	20,196	(394)	21,716	1,126	1,520
Monroe City	19,250	22,102	2,852	23,673	4,423	1,571
Mtlk Terrace City	21,590	24,767	3,177	31,678	10,088	6,911
Mukilteo City	21,350	21,812	462	22,364	1,014	552
Snohomish City	10,200	12,139	1,939	13,000	2,800	861
Stanwood City	7,013	10,116	3,103	10,632	3,619	516
Sultan City	5,170	7,345	2,175	9,544	4,374	2,199
Woodway Town	1,350	1,389	39	1,419	69	30

Housing Unit Capacity:[3]

At the individual city level, there is a 2035 housing unit capacity shortfall within the City of Everett. Minor capacity shortfalls appear to exist for Brier, Lake Stevens and Mukilteo:

[3] Note that the relationship between additional population and housing unit capacity is not always direct due to the complexities inherent in translating population targets into housing targets. There are several conversion factors that are used in the process, including assumptions about average household size and vacancy rates by housing type, as well as the share of population growth assumed to be within group quarters. As a result, remaining housing target growth at the jurisdictional level may not match the demographic characteristics represented by the zoned capacity-based yields by housing type generated by the buildable lands analysis. City and county staff will continue to investigate these relationships, including the use of new data from Census 2020.

City Housing Units

	2019 Estimated Housing Units	CPP 2035 Housing Unit Target	2019-2035 Numeric Change	2035 Total Housing Unit Capacity	Additional 2019-2035 HU Capacity	HU Capacity Surplus vs. Shortfall (in parentheses)
Arlington City	7,521	9,654	2,133	14,800	7,279	5,146
Bothell City (part)	7,198	9,782	2,584	11,984	4,786	2,202
Brier City	2,365	2,536	171	2,526	161	(10)
Darrington Town	650	764	114	775	125	11
Edmonds City	18,925	21,168	2,243	24,073	5,148	2,905
Everett City	46,882	70,067	23,185	68,553	21,671	(1,514)
Gold Bar City	863	917	54	932	69	15
Granite Falls City	1,516	3,090	1,574	3,215	1,699	125
Index Town	117	127	10	128	11	1
Lake Stevens City	11,809	14,883	3,074	14,822	3,013	(61)
Lynnwood City	16,349	22,840	6,491	26,704	10,355	3,864
Marysville City	25,057	32,876	7,819	34,043	8,986	1,167
Mill Creek City	8,840	8,756	(84)	9,411	571	655
Monroe City	5,840	6,526	686	7,673	1,833	1,147
Mtlk Terrace City	9,144	10,928	1,784	14,365	5,221	3,437
Mukilteo City	8,696	9,211	515	9,102	406	(109)
Snohomish City	4,271	5,204	933	5,414	1,143	210
Stanwood City	2,855	4,179	1,324	4,385	1,530	206
Sultan City	1,894	2,581	687	3,422	1,528	841
Woodway Town	474	472	(2)	498	24	26

Employment Capacity:

At the individual city level, there is adequate capacity to accommodate the adopted 2035 employment growth targets, with the following exceptions:

- Relatively minor 2035 employment capacity shortfalls appear to exist for the cities of Granite Falls and Lake Stevens.

City Employment

	2019 Estimated Employment	CPP 2035 Employment Target	2019-2035 Numeric Change	2035 Total Employment Capacity	Additional 2019-2035 Emp Capacity	Emp Capacity Surplus vs. Shortfall (in parentheses)
Arlington City	10,265	20,829	10,564	23,441	13,176	2,612
Bothell City (part)	16,093	18,576	2,483	22,515	6,422	3,939
Brier City	494	405	(89)	524	30	119
Darrington Town	522	800	278	1,894	1,372	1,094
Edmonds City	14,174	13,948	(226)	16,722	2,548	2,774
Everett City	99,796	140,000	40,204	141,075	41,279	1,075
Gold Bar City	250	661	411	812	562	151

Granite Falls City	971	2,275	1,304	2,014	1,043	(261)
Index Town	27	25	(2)	27	-	2
Lake Stevens City	5,500	7,412	1,912	7,307	1,807	(105)
Lynnwood City	28,617	42,229	13,612	42,526	13,909	297
Marysville City	15,310	27,419	12,109	31,434	16,124	4,015
Mill Creek City	6,787	6,310	(477)	7,168	381	858
Monroe City	10,096	11,456	1,360	11,705	1,609	249
Mtlk Terrace City	8,431	9,486	1,055	10,740	2,309	1,254
Mukilteo City	10,313	10,250	(63)	12,380	2,067	2,130
Snohomish City	5,842	6,291	449	7,272	1,430	981
Stanwood City	3,864	4,688	824	4,821	957	133
Sultan City	1,005	2,077	1,072	2,252	1,247	175
Woodway Town	68	68	-	68	-	-

NOTE: The county and cities are already in the process of updating growth targets and comprehensive plans by 2024, so some of the minor inconsistencies identified above may be resolved through that update process. This occurred in a number of instances following the 2012 BLR when the 2035 growth targets were developed and adopted into the CPPs.

Growth Targets Not Being Met

Beyond the question of determining whether there is sufficient suitable land to accommodate the adopted population and employment allocations in urban growth areas, the buildable lands statue at RCW 36.70A.215(3)(c) requires an "analysis of county and/or city development assumptions, targets, and objectives contained in the countywide planning policies and the county and city comprehensive plans when growth targets and assumptions are not being achieved." For this purpose, the 2021 BLR relies on the *Snohomish County Tomorrow 2020 Growth Monitoring Report* and the April 1, 2021 OFM population estimates for cities and unincorporated areas (adjusted to reflect city boundaries as of December 13, 2012) for the following information.

As can be seen in the graph below, progress has been made towards achievement of the 2035 population growth targets by individual jurisdictions. During the first ten years (2011-2021) of the 2011-2035 GMA planning period, roughly half of the jurisdictions within the Snohomish County UGA have accommodated 42% or more of the growth assigned to them during the entire planning period[4].

When reviewing the limited extent to which other jurisdictions fall below the 42% red line, it is reasonable to assume that future heightened growth rates may reduce the percentage gap over time, especially when considering that 14 years remain in the current GMA planning period. In areas where planned high-capacity transit investments are to be built and operational late in the planning period, higher growth rates may be expected to occur during the latter half of the planning period. Note that even with Everett (Metropolitan City) showing a relatively low

[4] This 42% figure represents the percentage of the 2011-2035 projected population growth that would be expected to have been attained by 2021 if the population projection line to 2035 is assumed to be linear (10 out of 24 years = 41.7%).

percentage of 2011-2035 growth reached by 2021, Everett grew in absolute terms by more than any other city in Snohomish County between 2011 and 2021.[5]

Figure 1.

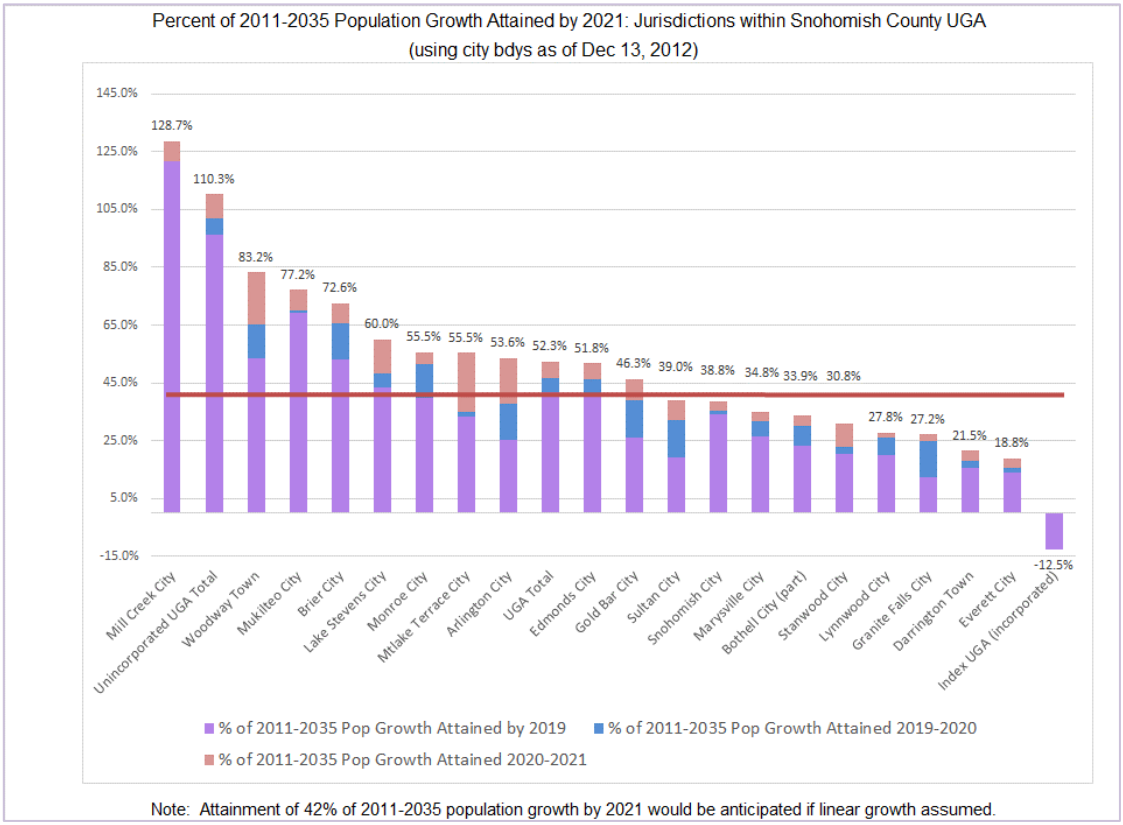
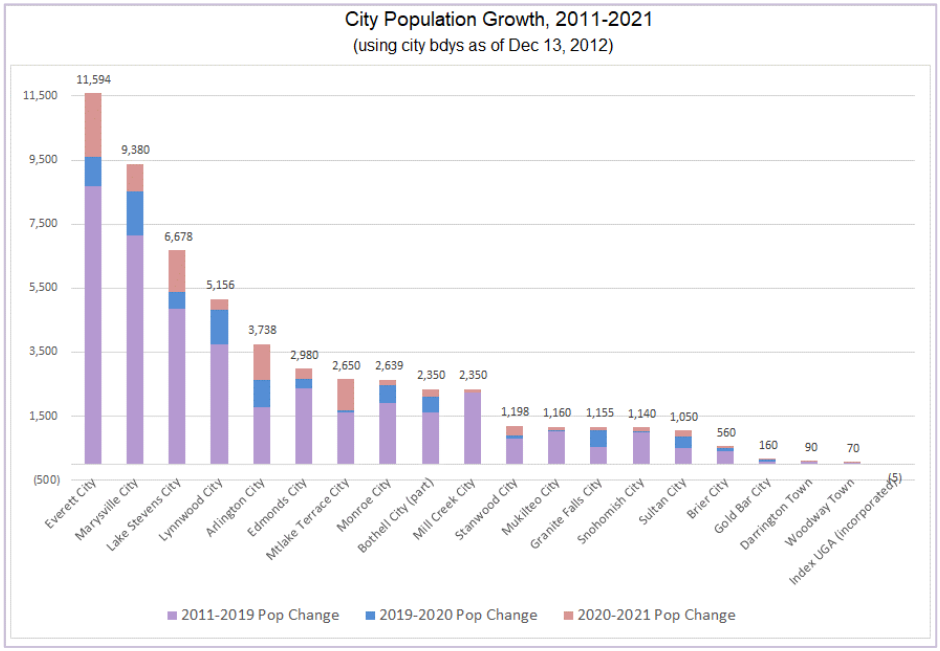


Figure 2.



[5] Note that Figures 1 and 2, using the annual OFM population estimates, show post-April 1, 2019 population by jurisdiction to help illustrate the extent to which the additional population capacity estimates represented by pending projects as of April 1, 2019 would likely have been built and occupied since that date.

Similar conclusions can be drawn when evaluating 2011-2019 employment growth as a share of total 2011-2035 growth anticipated by jurisdiction within the UGA:

Figure 3.

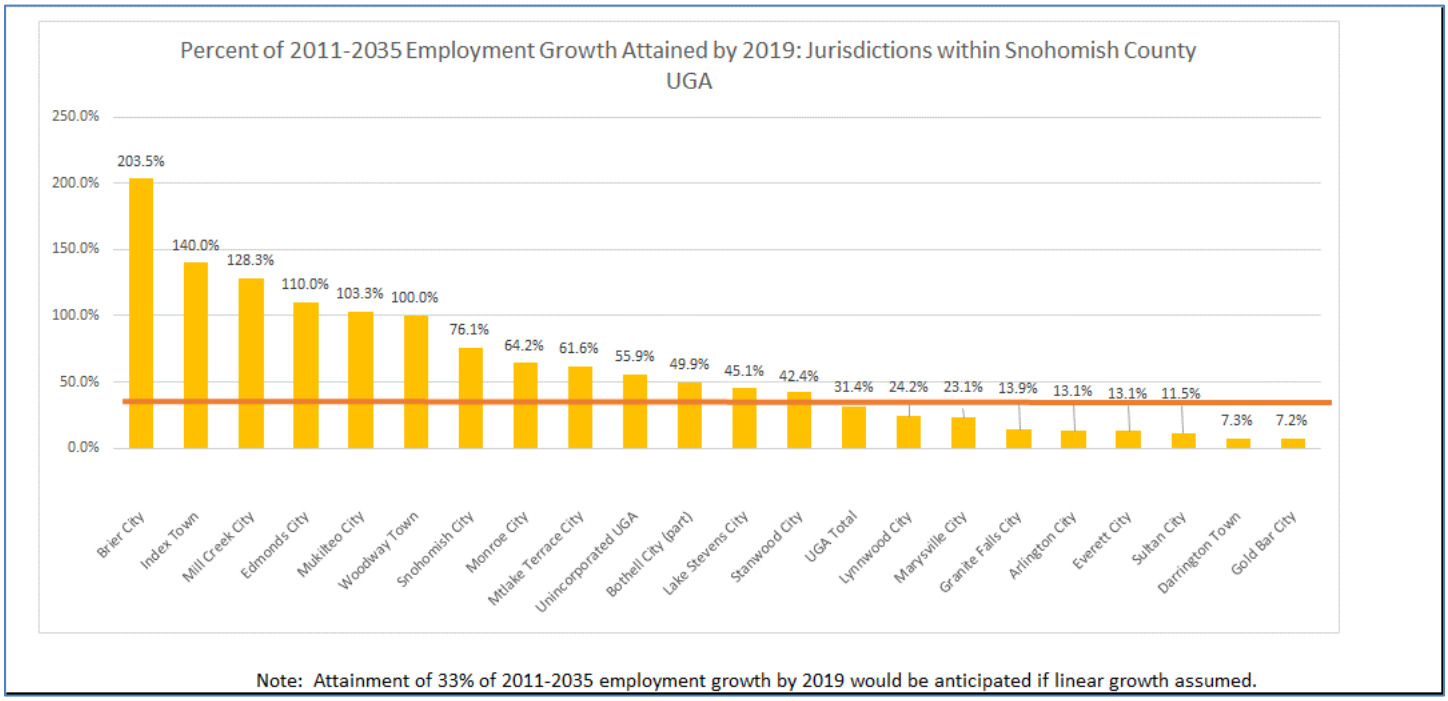
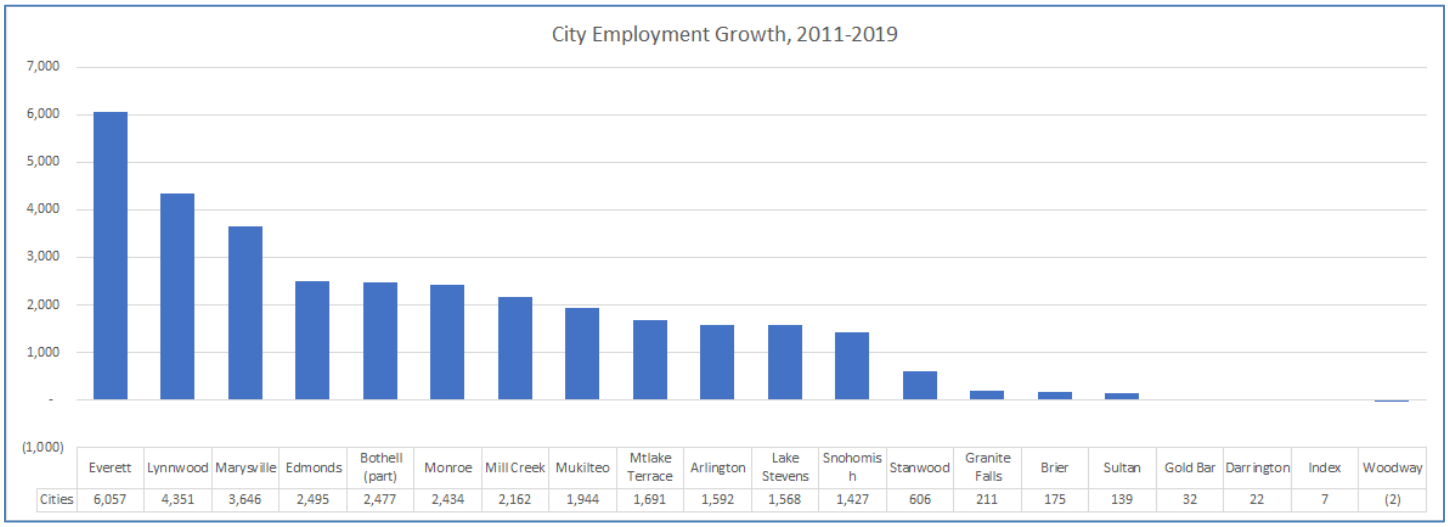


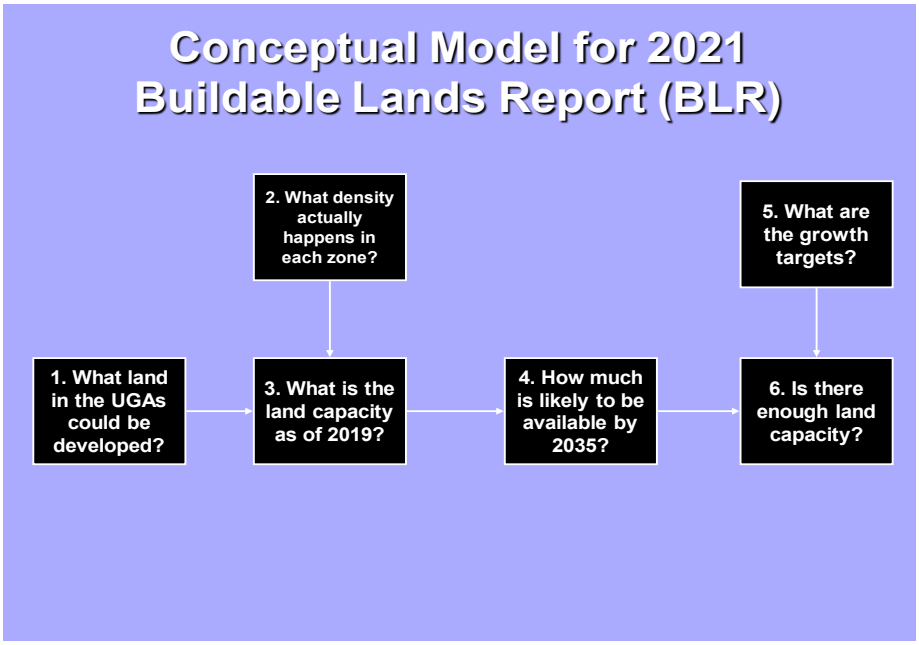
Figure 4.



	Everett	Lynnwood	Marysville	Edmonds	Bothell (part)	Monroe	Mill Creek	Mukilteo	Mtlake Terrace	Arlington	Lake Stevens	Snohomish	Stanwood	Granite Falls	Brier	Sultan	Gold Bar	Darrington	Index	Woodway
Cities	6,057	4,351	3,646	2,495	2,477	2,434	2,162	1,944	1,691	1,592	1,568	1,427	606	211	175	139	32	22	7	(2)

Methodology

The UGA buildable lands analysis follows six major steps and a several sub-steps.



Step 1: Buildable Lands Inventory (*What land in the UGAs could be developed?*)

The 2021 buildable lands inventory uses parcel-level data for both incorporated and unincorporated areas. Parcel boundaries and associated parcel attribute data were established for the inventory by downloading an April 2019 extract of Assessor parcel data in county geographic information system (GIS) parcel map in ArcGIS shapefile format. For the purposes of the buildable lands analysis, only parcels within the UGA (including cities) are included in the analysis.

Assessor attribute data was supplemented with data supplied from external sources in two instances:

- For parcels with residential structures containing 5 or more housing units, an actual unit count is not provided with the Assessor records. Instead, for these records PDS staff relied on residential meter location data from the Snohomish County Public Utility District (PUD).
- For information on size and placement of existing structures on individual parcels, PDS used Snohomish County's recently developed building roofprint GIS data derived from aerial imagery.

Baseline Date

The spring 2019 date for the parcel GIS extract was chosen to coincide with the date at which both the base year population and employment estimates would be available for the 2021 report.

For existing population, the baseline date is April 1, 2019 as established by the Washington State Office of Financial Management (OFM) population estimates for counties and cities. For existing employment, an extract of Washington State Employment Security (ESD) covered employment counts, prepared and supplemented by the Puget Sound Regional Council to include estimates of non-covered employment, was obtained for March 2019.

The concept of using April 2019 as the base point in time for the buildable lands inventory is an important one. The review and editing of the accuracy of the buildable lands inventory has to center on one particular date in order to be consistent across all jurisdictions. Since the most recent state population and employment estimates for Snohomish County during the development of the current buildable lands inventory is close to this date, April 2019 was chosen as the base date for representing what was built and occupied as of that date. Therefore, it also represents the date at which additional holding capacity for population and jobs were calculated. **Structures existing as of April 1, 2019 were considered developed and counted as part of the population or employment base, while everything proposed, built or occupied after that date was counted as future capacity for the 2021 report.**

Use of summer 2019 aerial photography for Snohomish County, in combination with the Assessor parcel data extract as of April 2019, helped to verify the existence of structures at that time.

Future land use and zoning information

Likely future development is usually best predicted by city zoning or unincorporated county plan designation. For most cities, the zoning and the plan designation are the same. For most unincorporated areas, however, the county's plan designations allow a range of implementing zones.

In cities, zoning designations were used to predict future densities since it has been determined to be the most reliable predictor of future residential densities and commercial/industrial intensities. In unincorporated areas however, the county's future land use (FLU) designations were used due to the frequent and likely continued rezoning of property from lower to higher implementing zone categories within a plan designation prior to or concurrent with development of a property. The use of observed densities for County FLU designations would thus incorporate the likely continued practice of rezoning to higher densities within the same FLU designation in the same way that has been observed during the recent past.

The major exception to this is in unincorporated UGAs where cities control the extension of utilities (Arlington, Granite Falls, Monroe, Snohomish, Stanwood and Sultan). Some of these cities require annexation before granting utility extensions and thus development approval. Others require that developments in their unincorporated UGA conform to their development standards in order to receive city utilities. In all these situations, the densities associated with the city's prezoning (or plan designations) were used, or in locations without prezoning, the densities associated with the city zone that matched the county FLU designation most closely were used.

Minor exceptions to the use of adopted zoning and plan designations occur where the two are

inconsistent or where there is an existing non-conforming use. In some isolated instances, densities and FARs associated with the County's current zoning was determined to be more predictive than the more generalized future land use category. These situations were isolated to parcels in unincorporated UGAs near SR-99 with higher allowed multiple residential (MR) densities or to parcels with business park (BP) zoning within an Urban Center designation.

Economic units

The 2021 report continues the approach, started with the 2007 BLR, of reorganizing parcels into "economic units." In most cases, parcels and economic units are synonymous. However, other situations warranted the combination of parcels or the division of a parcel based on location, ownership and/or land use.

To anticipate land assembly prior to development, economic units were created by merging parcels when common ownership was verified, but only if land use and zoning are consistent across all parcels. There are many other instances where a residence or commercial building spans across parcel lines. In these cases, an economic unit was also created. Other examples of parcel aggregation include businesses and parking lots on separate parcels, multiple parcel parks, buildings covering abandoned right-of-ways, adjacent buildings with common ownership and zoning, and pending development projects that spanned more than one parcel.

Examples of economic units formed by dividing parcels would include those with split zoning, land removed for a functioning roadway, or parcels split by roadways or boundary lines. Economic units were also created by splitting existing parcels where it was evident that land use varied within the parcel. An example would be an unrecorded, phased development where a future development tract could be considered its own vacant parcel or a parcel that spans a lake.

In cases where multiple parcels share identical boundaries and are considered "stacked" on one another (such as condominiums, mobile homes parks, and senior citizen exemptions), parcels were combined and quantitative values such as improvement and land assessments were summed.

Note: Unless specifically stated otherwise, the use of the word "parcel" which follows means economic unit in this methodology.

Pending development

Since the April 2019 parcel base extract, development has taken place on many of the parcels with additional capacity in the buildable lands inventory. Other parcels currently have pending applications for new construction. Some parcels had older development proposals that were unbuilt or unoccupied new construction as of April 2019. In these situations (pending applications received since April 2019, post-April 2019 development, and older development proposals that were unbuilt or unoccupied as of April 2019), this report uses the actual development or pending application information as the capacity on a given parcel as of April 2019. This capacity information is then compared later in the buildable lands analysis to remaining projected growth starting at the same point in time – April 2019 through April 2035.

Pending residential and commercial/industrial projects in the UGA were added to the parcel database through spring 2021. This pending capacity information overrides the theoretical capacity estimates calculated by the capacity analysis. Theoretical capacity estimates (based on historic observed densities for developable parcels in the same plan/zone designation) are used for parcels without recent or pending development. The use of actual or proposed development yields for pending projects is a more accurate way of estimating additional capacity than using the average densities achieved on comparable sites.

For parcels with pending development, the property owner intent to develop is evident. Consequently, the market availability reduction factor (discussed later) is not applied for these parcels during the capacity calculations.

Land Status Classifications

The buildable lands analysis of additional urban area land capacity is not based solely on an inventory of vacant parcels. Instead, parcels with existing development that could be further developed over time under existing zoning (i.e., parcels containing enough surplus land to support additional development, or which can redevelop to more intensive uses) are also included in the estimates of buildable land supply.

The buildable lands capacity analysis focuses solely on parcels within the current UGA boundary. Parcels in which potential capacity for additional development by the year 2035 is calculated were classified into three land status categories: vacant, partially-used, and redevelopable land[6]. Parcels with pending development are not included in this classification process.

> **Vacant.** Vacant parcels are generally those where the Assessor's building improvement value is less than $5,000[7]. Some exceptions include parks and cemeteries where there are no building improvements (this report considers them as unchanging, or constant uses). Conversely, paved parking lots in the downtown areas of Everett and Lynnwood often have assessed improvements over $5,000 but are still considered vacant.
>
> **Redevelopable**. Redevelopable parcels are those non-vacant parcels which the buildable lands analysis considers are candidate locations for demolition of the existing building and replacement by something new at some time during the 20-year GMA plan horizon. Identification of buildings as redevelopable begins with the ratio of improvement-to-land value, the UGA in which the parcel is located, the zoning or plan designation, and the current use.

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[6] Parcels where no development is anticipated (i.e., no additional capacity assigned) were classified as "constant." These parcels had existing uses that were anticipated to remain unchanged during the remaining portion of the current GMA planning period.

[7] The revised improvement value threshold for vacant parcels was reached following a review of photos of the types of structures that exist on parcels with current improvement values less than $5,000.

For *single family* zoned or designated land, existing houses valued at less than $162,000[8] and 75% of the land value are considered potentially redevelopable. If the parcel is too small to subdivide, then it is considered a replacement building, and no additional capacity is assigned to it. If the parcel is large enough to subdivide, and the improvement value of the house is over $162,000, then it is considered partially-used and is analyzed under the conditions described below.

For *multi-family, commercial, industrial, or mixed-use* zoned or designated land, existing buildings valued at less than 100% of the land value are usually considered potentially redevelopable. Exceptions include condominiums and certain existing commercial uses. Gas stations are the most common commercial exception because they require a high visibility location, which means the land is expensive, while the condition of the building itself is of little importance to running the business. Similarly, many warehouse buildings are perfectly viable in a decrepit condition, and if the location is not attractive to other uses, it is unlikely to redevelop.

Partially-used. Partially-used parcels are those where the model assumes that the existing building(s) use only a portion of the site and that additional development on the parcel is possible without demolition. Different criteria apply depending on the land classification:

For *single-family residential zones*, parcels normally must be at least twice the zoned lot size. For example, a house with RS-8,000 zoning must be on at least a 16,000 square foot lot.

For *multi-family zoned parcels*, the building footprint must be less than 20% of the buildable parcel area. Further, the existing density must be less than the historic norm for the zone. (The development history shows that additions to existing multi-family buildings or complexes are relatively rare, and the predictions in the model support this.)

For *commercial, industrial, and mixed-use zones*, the building footprint is usually less than 25% and the building improvement to land value ratio is greater than 100%. For uses such as restaurants, auto dealerships and gas stations that require substantial amounts of parking, the building footprint is less than 10%[9]. Some existing buildings are in good condition but have enough extra land to lower the

[8] The revised improvement value threshold for partially-used single family zoned parcels was reached by taking the median 2011 improvement value for single family properties that were categorized as partially-used in the 2012 BLR and which actually experienced infill development between 2011-2018 ($135,750 – see Exhibit 4 on page 6 of https://www.snohomishcountywa.gov/DocumentCenter/View/75246/20200728-SnohCo-BLR-Methods-and-Procedures-Update_SCT-SC-Approved_Jun-24-2020), and adjusting for inflation using the CPI-U for the Seattle-Tacoma-Bellevue metropolitan area.

[9] There are case-by-case exceptions, especially in places such as downtown Everett where parking requirements are minimal.

building improvement to land value ratio below 100% and are modeled as partially used.

Land Status Map Review: The results of the above rule-based initial land status classification process were then reviewed extensively by city and county staff, as well as various stakeholder groups, to "ground-truth" this information based on the 2019 aerial imagery or other administrative records. In many cases, the initial land status classification was overridden to establish a final land status classification to be used for capacity calculations, based on the application of more detailed information to better reflect each parcel's development potential as of April 1, 2019. An example of the type of changes that were made during this review was the removal of many "sliver" parcels as developable from the buildable lands inventory maps – parcels that are unlikely to develop due to their small size or irregular shape, and in which setback requirements are unlikely to be met.

Use of Critical Areas to Establish the Buildable Lands Inventory

GIS information on critical area features within UGAs was gathered for the 2021 buildable lands analysis. Critical area data was collected from various federal, state, county and city sources indicated in the table below. Buffer data was added by Snohomish County PDS staff for purposes of the Buildable Lands Report. In cases where critical area features included direction on specific buffer widths, this information was used to create feature-specific buffers. Otherwise, buffer widths were averaged per wetland and stream classifications according to SCC 30.62A.320.

Critical area and buffer overlays were produced for each city, UGA and MUGA for cities to examine and provide comments. These city revisions were researched further by county staff and included in additional round(s) of editing. Some cities, to improve accuracy, provided PDS with their own data which was incorporated into the layer. These city sources are also listed in the table below:

Critical Areas Data Collection

Data	Source
Watercourse	Snohomish County Surface Water Management (SWM)
Watercourse Buffers	Snohomish County Planning and Development Services (PDS)
Wetlands	Snohomish County (SWM), National Wetland Inventory (NWI), and Remote Sensed Wetland Model (SWM)
Critical Area Slopes	Snohomish County Department of Information Technology (IT)
Landslide Hazard Areas	Snohomish County Planning and Development Services (PDS)
Waterbodies	Snohomish County SWM, Buffers produced by PDS
Floodplain	Federal Emergency Management Agency

	(FEMA)
Floodway	FEMA
Hydric Soils (Darrington)	Snohomish County IT
Darrington Wetlands	City of Darrington Planning Consultant
Bothell Steep Slopes	City of Bothell GIS Department
Bothell Floodplain	City of Bothell GIS Department
Edmonds Stream Buffers	City of Edmonds Planning Division
Edmonds Wetlands and Buffers	City of Edmonds Planning Division
Edmonds Critical Area Slopes	City of Edmonds Planning Division
Edmonds Floodplain	City of Edmonds Planning Division
Everett Wetlands	City of Everett Planning Department
Everett Streams	City of Everett Planning Department
Lake Stevens Streams	City of Lake Stevens Planning Department
Lake Stevens Wetlands	City of Lake Stevens Planning Department
Lynnwood Streams	Lynnwood Community Development Department
Lynnwood Wetlands	Lynnwood Community Development Department
Lynnwood Erosion Hazard Areas	Lynnwood Community Development Department
Lynnwood Landslide Hazard Areas	Lynnwood Community Development Department
Lynnwood Steep Slopes LiDAR Analysis	Lynnwood Community Development Department
Lynnwood Steep Slopes Inventory	Lynnwood Community Development Department
Lynnwood Floodplain	Lynnwood Community Development Department
Lynnwood Native Growth Protection Areas	Lynnwood Community Development Department
Marysville Streams	City of Marysville Planning Department
Marysville Stream Buffers	City of Marysville Planning Department
Marysville Wetlands and Buffers	City of Marysville Planning Department
Marysville Waterbodies	City of Marysville Planning Department
Marysville Shoreline Zone	City of Marysville Planning Department
Mountlake Terrace Streams and Buffers	City of Mountlake Terrace Community and Economic Department
Mountlake Terrace Wetlands and Buffers	City of Mountlake Terrace Community and Economic Department
Mountlake Terrace Unstable Soils with Buffer	City of Mountlake Terrace Community and Economic Department
Mountlake Terrace Floodplain	City of Mountlake Terrace Community and Economic Department
Mukilteo Streams and buffers	Mukilteo Planning and Community

	Development
Mukilteo Wetlands and buffers	Mukilteo Planning and Community Development
Mukilteo Floodplains	Mukilteo Planning and Community Development

After acquiring stream data, **streams** were buffered according to their fish habitat type per WAC 222.16.031 and SCC 30.62A.230. The following cities supplied city-specific information for this analysis:

- Edmonds provided stream buffers widths to be used with the county watercourses layer according to Edmonds City Code. The City of Edmonds also provided wetland buffers according to Edmonds City Code.
- Everett provided stream and wetland layers.
- Lake Stevens provided stream and wetland data with associated buffer width data.
- Lynnwood provided stream data.
- Marysville provided stream, wetlands and buffer data.
- Mountlake Terrace provided stream, wetland, and buffer data.
- Mukilteo also provided stream, wetland, and buffer widths.

The following buffers were applied to stream data not provided by city staff. These buffer widths were also applied in cases where city staff provided stream data but not jurisdiction-specific buffer widths:

Stream Type	Buffer Width
Type "S"	150 feet
Type "F" with anadromous fish species	150 feet
Type "F" without anadromous fish species	100 feet
Type "Np"	50 feet
Type "Ns"	50 feet
Type "U"	50 feet

Waterbodies within the county were buffered according to their fish habitat type applying the same standards as listed above.

Wetland data was acquired from the National Wetland Inventory (2007), the Snohomish County Wetland Inventory collected from the PDS County Stream and Wetlands Survey (1986) and the DPW/SWM Drainage Needs Report (2002), as well as the Remote Sensed Wetland Model produced by SWM (2012). In order to obtain a maximum estimate of wetlands within Snohomish County, the NWI, County datasets, and remote sensed model layer were combined.[10] Buffers were set at 110 feet, an average used in the 2007 and 2012 Buildable Lands Reports which was originally derived from Washington State Department of Ecology statistics. A hydric

[10] After review by the City of Sultan staff, only the PDS wetland inventory was used for the Sultan UGA. This layer most accurately depicted critical areas based on site plan verification.

soil layer was also applied in the Town of Darrington to account for forested wetlands not included in the above surveys, however buffers were not applied.

Critical area **slopes** were obtained from Snohomish County IT. This data was originally generated from United States Geological Survey 10-meter Digital Elevation Model (DEM) which is based on various data sources including radar, satellite imagery and LiDAR flights. A buffer width of 25 feet was applied to the tops and toes of slopes greater than 33%. These data were used for critical slope determinations in cities, except in cases where city staff provided jurisdiction-specific steep slope data to use.

For the unincorporated UGAs, a LiDAR based **landslide hazard area** feature layer was used in place of the critical area slope data, since Snohomish County updated its Critical Area Regulations in September 2015 to include development regulations specific to landslide hazard areas. County GIS maps based on the new landslide hazard definition were used for the 2012 buildable lands analysis in unincorporated UGAs.

Flood hazard data was also provided by IT and is based on 2019 Flood Insurance Rate Maps (FIRMs) published by FEMA. The FIRM maps are official maps on which FEMA has delineated flood hazard areas and risk zones. These maps were adopted by the County Council in 2020. Depending on city development standards or on their instructions, either the 100-year floodplain or floodway was displayed and used.

All of the critical area features and buffers described above were merged into a composite GIS layer that was then overlaid on parcels. This GIS overlay process was then used to deduct critical areas and buffer areas from the total gross area of the parcel, to arrive at an estimate of buildable acres within vacant, partially-used and redevelopable parcels. Note that an exception to this calculation was applied in cases where vacant parcels were constrained by critical areas to the extent that the owner would potentially be deprived of all economically viable uses of the property. In these situations, an additional housing unit capacity of one was calculated in order to recognize the potential for the granting of a single-family building permit through a **reasonable use exemption process.**

Please note that the depiction of these features on GIS parcel maps for the 2021 BLR is for general analysis purposes only – specifically the development of the UGA-level buildable lands capacity estimates. They are not intended, nor are they at a sufficient level of detail and positional accuracy, to be used for a parcel-level determination of a parcel's actual development potential that would be obtained following submittal of a site-specific development application. In addition, the criteria used represent best approximations of what may be unbuildable in a typical situation. However, there are specific instances where these criteria would not automatically result in unbuildable area (e.g., 33% or greater slopes can still be developed with certain engineering and development standards). These criteria should therefore be viewed as representing "average" situations.

Removal of Major Utility Easements from the Buildable Lands Inventory

Another GIS data source for unbuildable land within UGAs was the Assessor's records on

easements. Major utility easements (power transmission lines, oil and gas pipeline easements, etc.) were overlaid on parcels, and the land area within parcels associated with the utility easement was deducted from the total acres to arrive at buildable acres. In order to avoid double-counting areas that were both critical areas and utility easements, the critical areas plus buffers were merged with utility easements first before overlaying on parcels.

Removal of Land Needed for New Transportation Arterials and other Capital Facilities Needs

Using GIS, land acquired for the future rights-of-way was removed from the buildable lands inventory. In addition, during review of the buildable lands parcel maps with cities, parcels acquired or to be acquired for major public purposes (where known) were identified and removed from the buildable lands inventory. This included future school sites, parks and other municipal purposes uses.

Step 2: Development History – Residential, Commercial and Industrial (*What density actually happens in each zone?*)

The history of residential, commercial, industrial and mixed-use development in cities and the county was collected and evaluated for the 2021 buildable lands analysis. The period of time covered by the detailed development history database was extended from the period covered in the 2002, 2007 and 2012 reports (from January 1995 to December 2010) to include an additional 8 years of development activity (through the end of 2018). Residential densities (housing units per acre) and commercial/industrial intensities (floor area ratios, or FARs) were summarized for comprehensive plan or zoning designation within each jurisdiction.

Buildable acres, residential densities and commercial/industrial employment densities were calculated after deducting critical areas, buffers and major utility easements from the total site area of the subdivision or development. Ultimately, buildable densities are used in Step 3 of the buildable lands analysis to assign future development densities to developable parcels in the buildable lands inventory to determine land capacity. Please refer to the graphic on page 33 for a visual depiction of how buildable density is determined compared with gross and net density in a sample subdivision. The text below also provides a more detailed description of how these different densities are determined for different land use types.

For single family residential development:

1 *Gross residential density* is the number of housing units divided by total area in acres.

2 *Buildable area* is the area of any use that alters the landscape, e.g. building lots, roads, detention ponds, and tot lots. It does not include wetlands, critical area buffers, utility easements, or any area that is to remain unchanged. Buildable density is the number of housing units/buildable acreage.

3 *Net residential area* is the area used for residential building lots only. Typical land uses that are excluded from residential area include roads, wetlands, Native Growth Protection Areas, recreational areas and detention ponds. Net density is the number of housing

units/net residential acreage.

The definition of single-family development includes traditional detached homes, as well as duplexes and segregated-lot detached condominiums.

For the 2021 BLR, townhouse development densities have been tallied separately for the first time, rather than including townhouses as part of single family development (when a separate lot for each dwelling unit is created through a unit lot subdivision process) or multi-family development (when developed as condominiums or apartment rentals) as was the case in previous BLRs.

For multi-family, non-residential development, mixed-use projects:

1 *Gross site area* for each project is the total site area in acres.

2 *Buildable site area* is the gross site area minus protected critical areas and other unbuildable areas, such as power line easements.

3 *Net site area* is the buildable site area minus road dedications.

Multi-family residential densities and commercial/industrial employment densities were calculated as follows[11].

The number of multi-family units was divided by the gross, buildable and net residential acreage to obtain gross, buildable and net residential densities on a project-by-project basis.
For employment uses, the following steps were followed in order to translate permitted square footage of commercial and industrial employment space into estimates of employees per buildable acre. Square footage of commercial and industrial permitted structures was first categorized into building type categories. For each building type category, an assumed percent distribution of square footage amounts into one of eight employment categories, based on the North American Industrial Classification System (NAICS), was applied in order to estimate actual square footage of construction by employment category. The resulting square footage amounts were then divided by an assumed amount of square footage space needs per employee by employment category to obtain an estimate of jobs (and jobs per buildable acre) by employment category in permitted commercial and industrial structures:

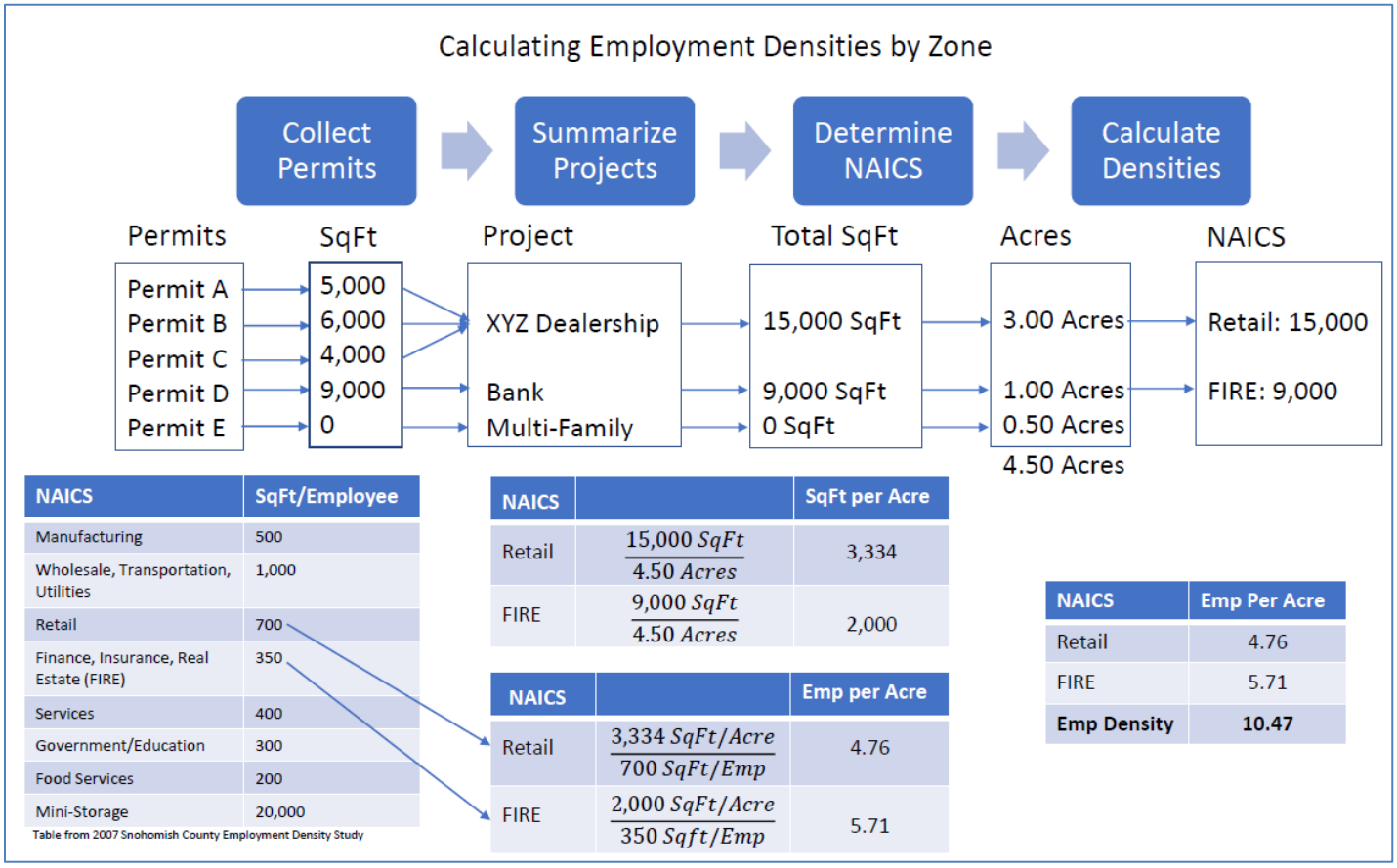
- Food Services: 200 square feet per employee
- Other Services: 400 square feet per employee
- Finance, Insurance and Real Estate (FIRE) – mini-storage warehouses only: 20,000 square feet per employee
- Finance, Insurance and Real Estate (FIRE) – other: 350 square feet per employee
- Retail = 700 square feet per employee
- Manufacturing: 500 square feet per employee
- Wholesale, Transportation and Utilities (WTU): 1,000 square feet per employee

[11] In mixed-use projects (projects with both residential and commercial uses in the same structure), both the residential and commercial employment densities are reported.

- Government/Education: 300 square feet per employee.

These estimates were derived from research previously conducted in Snohomish County, in cooperation with the Snohomish County Economic Development Council (1985 Snohomish County Business and Industrial Land Survey, updated in 1995 as the Employment Land Capacity Analysis for Unincorporated Snohomish County). This information was also compared with recent estimates published by the Institute of Transportation Engineers and was found to compare favorably. Additional work was done by county planning staff to convert former Standard Industrial Classification (SIC) information into the above NAICS employment categories by analyzing comparisons of Assessor parcel data and covered employment data from the Washington State Employment Security Department. (See separately published report entitled *2007 Buildable Lands Employment Density Study*.)

An example of the flow of the employment density calculations performed by zone is shown below:



NAICS	SqFt/Employee
Manufacturing	500
Wholesale, Transportation, Utilities	1,000
Retail	700
Finance, Insurance, Real Estate (FIRE)	350
Services	400
Government/Education	300
Food Services	200
Mini-Storage	20,000

Table from 2007 Snohomish County Employment Density Study

NAICS		SqFt per Acre
Retail	$\frac{15{,}000\ SqFt}{4.50\ Acres}$	3,334
FIRE	$\frac{9{,}000\ SqFt}{4.50\ Acres}$	2,000

NAICS		Emp per Acre
Retail	$\frac{3{,}334\ SqFt/Acre}{700\ SqFt/Emp}$	4.76
FIRE	$\frac{2{,}000\ SqFt/Acre}{350\ Sqft/Emp}$	5.71

NAICS	Emp Per Acre
Retail	4.76
FIRE	5.71
Emp Density	**10.47**

In some instances, the observed densities may no longer accurately represent future densities for a variety of reasons. The creation of a relatively new plan designation or zone may result in very little development experience to draw from at this point in time. In these circumstances, the development history tables have been labeled with a column heading marked "assumed," and the assumptions are based on a review of development in similar situations. There may also be

situations in some jurisdictions where recent development regulations, plan changes or recent density trends may likely increase or decrease future densities compared with those previously observed in the same zone. In these cases, the replacement densities by plan/zone designation were also labeled "assumed" in the development history tables. Finally, if there was no development history experienced within a zone or designation between 1995 and 2018, that portion of the development history tables was labeled "assumed." In all situations described above, if the zone was located in a city, city staff was consulted as to an appropriate and likely substitute future density assumption to use.

Step 3: Capacity Calculations -- Assignment of Future Development Densities to the Buildable Lands Inventory (*What is the land capacity as of 2019?*)

The third step of the buildable lands capacity analysis involved the use of the densities by zone/plan designation as determined in the development history analysis. These residential densities (housing units by type per buildable acre) and commercial/industrial employment densities (employees by employment category per buildable acre) were applied to the buildable acres of land (gross acres minus critical/unbuildable areas and their buffers) within either vacant, partially-used or redevelopable parcels as determined above, to estimate additional housing unit and employment capacity potentially remaining per parcel. (See attached graphic on page 33 comparing gross vs. buildable vs. net density calculations.) The resulting information was mapped by parcel and was reviewed for accuracy.

Calculation of Additional Housing Unit and Population Capacity

When calculating additional residential capacity, the formula that applied observed/assumed densities by plan/zone to vacant, partially-used or redevelopable parcels, was performed on a parcel-by-parcel basis. Any fractional units that resulted from the parcel-level calculation of additional housing unit capacity were truncated (dropped).

An example of how this formula was performed at the parcel level is shown below. Assume that a parcel (whether vacant, partially-used or redevelopable) has an estimate of buildable area of 3.5 acres. Also, assume that the parcel is located in a single family residential zone in which there is an observed buildable density of 4.2 units per buildable acre. This would result in an estimate of 14 additional units for the parcel:

3.5 buildable acres x 4.2 units per buildable acre = 14 units.

Notice that the fractional amount of 0.7 units is dropped from the additional capacity estimate for the parcel since this remainder represents land area assumed to be below minimum lot size requirements. Also, for redevelopable parcels, any existing housing units on parcels that are assumed to be redeveloped (i.e., assumed to be demolished) are subtracted from the estimate of additional housing unit capacity.

Additional housing unit capacity was then translated into estimated additional population capacity based on the demographic information shown below.

Occupancy rates:

- Single Family Detached Units = 0.96
- Townhouse Unit = 0.96
- Multi-family Units = 0.92
- Senior Apartments = 0.98

Average household size:

- Single Family Detached Units = 3.00
- Townhouse Units = 2.65
- Multi-family Units = 2.00
- Senior Apartments = 1.20

For single family, townhouse and multi-family units, these characteristics were obtained from the U.S. Census Bureau's 2019 American Community Survey 1-Year Estimates for Snohomish County. For senior apartments, demographic information provided by senior housing providers in Snohomish County was relied upon. The formula for this calculation is as follows:

> Additional population capacity = additional housing unit capacity x occupancy rate x average household size

Continuing with the example above, 14 additional single family housing units x .96 occupancy rate x 3.0 average household size = an additional population capacity of 40 (rounding down).

When calculating additional residential capacity, vacant building lots were handled separately from the theoretical capacity calculations using observed densities by plan/zone. Instead, if a vacant residentially-designated parcel was at least 3,000 square feet in size, these parcels were counted as representing additional housing unit capacity, even though they may not meet the minimum lot size requirements of the current zone and would consequently not be shown as having additional capacity using the theoretical capacity calculation. It was assumed that these vacant building lots could obtain legal lot status for a residential building permit and thus should be counted as capacity.

In addition, if these vacant residential building lots were platted during the past 20 years, then the additional capacity associated with these parcels (along with all post-April 2019 development and pending development applications) were counted as a special subset of pending vacant capacity that would not be reduced for market reasons (i.e., the market availability reduction factor, discussed later). These lots have been platted and can be developed – the question of whether the market will support their development has already been answered, making the market availability reduction factor unnecessary.

Some commercial zones also generate additional residential capacity since most commercial zones in the county and in most cities allow residential development as a permitted use. This is apparent in the development history summary tables for most commercial zones. Consequently, to the extent that commercial zones have been used for new residential development (almost always multi-family development), these observed residential densities have been applied to

commercial zones to predict future residential development in combination with commercial development in commercial zones.

Calculation of Additional Employment Capacity

When calculating additional employment capacity, the formula multiplies on a parcel-by-parcel basis the assumed employees per buildable acre within each employment category by the amount of buildable acres for each vacant, partially-used or redevelopable parcel.

For redevelopable parcels, existing employment estimated on the parcel (based on the square footage of existing commercial and industrial structures on the parcel, categorized into one of seven employment categories, that are assumed to be redeveloped, i.e., assumed to be demolished) was subtracted from the estimate of additional employment capacity on the parcel using the same average square feet per employee assumptions for the current use classified by employment category described on pages 23-24.

Step 4: Reductions for Uncertainty (*How much of the land capacity is likely to be available for development by 2035?*)

Step 4 applies final reduction factors to the capacity results to account for uncertainties in infrastructure, and market and land availability.

Capital Facilities Analysis

Part of the review and evaluation of the sufficiency of buildable land suitable to accommodate projected growth includes the assessment of infrastructure gaps which may exist within the UGA that would hinder achievement of urban densities and growth targets. Consideration of this potential constraint to urban development was a standard topic on the agenda for all county/city staff one-on-one meetings held during fall 2020 to review the draft base map layers that were being prepared for the 2021 BLR analysis. Staff discussed whether there were locations within the UGA that would likely experience reduced growth relative to zoned capacity due to the difficulties of extending urban infrastructure to these locations within the 20-year GMA planning period.

Most of the difficult-to-serve locations identified during these discussions were ones that were experiencing limited additional urban development due to sewer extension limitations, both for financial and physical/topography reasons. As a result of this review, there were locations within the UGA where the presumed lack of sewer availability during the entire GMA planning period resulted in the preclusion of further subdivision assumptions in some unincorporated UGA locations. This was due to the county's requirement to connect to sewers for subdivision approval within unincorporated UGAs. In these areas, additional capacity through subdivision was not modeled. However, individual single-family residential building permits on vacant building lots were modeled. Examples of these currently unsewered locations include the Wind & Tide area of the Mukilteo MUGA and the SE portion of the Lake Stevens UGA.

In some unincorporated urban locations, however, where connection to public sewer is not

economically or technically feasible, some low-density subdivision is possible using septic systems, although the circumstances allowing such exceptions are limited. These areas require issuance of an "unsewered urban enclave" determination by the relevant sewer purveyor. In these situations, additional capacity at 2 units per buildable acre (assumed to be on septic systems) was modeled. These areas included an area in the northwest portion of the Monroe UGA and portions of the SWUGA near Picnic Point and Norma Beach.

Concurrency Arrearage Reduction Factor

The 2002 buildable lands methodology used by Snohomish County allowed for consideration of a concurrency arrearage reduction factor that was designed to estimate the amount of land affected by arterial units in arrears ("concurrency arrearage") that will still not be able to develop over the entire 20-year GMA planning period. This same approach was used for the 2007 and 2012 reports. A recent analysis (2019) from the Snohomish County Department of Public Works, however, showed that there are currently no arterial units in arrears within the County. Consequently, the concurrency arrearage reduction factor was zero for the 2021 buildable lands report.

CC&R's (Covenants, Conditions and Restrictions)

The 2002 buildable lands methodology used by Snohomish County also allowed for potential removal of buildable parcels that were subject to CC&Rs contained in private deeds that prohibited further subdivision of the property. The present analysis takes this into account. To date, no parcels with additional estimated capacity have been found in the buildable lands database that are also subject to CC&Rs that prohibit further subdivision of the property. A set of 25 CC&Rs provided to the county by the Snohomish County-Camano Association of Realtors in January 2003 was researched by staff and although they contained private restrictions on further development and subdivision of property, none of the plats to which they corresponded had additional housing unit capacity calculated in the 2002 buildable lands database. This was due to the fact that these subdivisions were already platted at the current zoning used for the buildable lands potential yield assumptions. As such, the buildable lands analysis calculated no additional unit yields in these subdivisions since they were already built-out under the zoning.

Miscellaneous Public/Institutional Use Reduction

During the buildable lands parcel map review for the 2021 report, parcels acquired or to be acquired for major public or institutional purposes (where known) were identified and removed from the buildable lands inventory. This included future school sites, parks and other municipal purposes uses. This also included the removal of land identified for future transportation rights-of-way during Step 2 (buildable lands inventory) portion of the analysis. However, this process did not result in all future public purposes uses being accounted for. Other miscellaneous public purpose uses that would have been missed in this review process include future churches, day care facilities, pre-schools, private schools, jails, skateboard parks, small-scale institutional and municipal uses (water storage facilities, etc.).

A 5% reduction factor was used to account for the uncertainty of land availability for

development due to: new stormwater regulations requiring larger detention ponds (especially in the unincorporated UGAs), potential need for regional or local stormwater facilities, potential need for transmission line, utility, or road or rail rights-of-way, potential need of land for public or institutional uses like police/fire stations, churches, water supply storage facilities, wastewater treatment and pump stations, landfills and transfer stations, cemeteries, libraries, daycares, small parks or open space, municipal offices, and other uses where we do not today have a specific map coverage to use (consistent with Section 2.5.4 on pages 5-37 of the Buildable Lands Procedures Report prepared by ECONorthwest).

The use of a 5% miscellaneous public purpose reduction factor was supported by an analysis of the development history database for actual miscellaneous uses developed between 1995 and 2000. It was found that for all designations, the percentage of land developed during this time period that went to non-typical uses (such as churches, utilities, government services and other conditional uses) was only 0.86%. This doesn't entirely account for all public uses, such as parks. However, since steps were taken to remove future public uses such as potential park and school sites from the buildable lands inventory so that they are not counted as buildable land in the first place, this analysis supports the use of an additional 5% reduction for this adjustment. In order to inform future reports, this factor will be monitored over time.

Market Availability Reduction Factor

After a reasonable estimate has been made of parcels within a UGA that have remaining development potential, one of the last steps in calculating additional capacity is to apply a market availability reduction factor. This step is intended to address the fact that not all suitable land will be available for development over the GMA planning timeframe since not all landowners are willing to develop their property for a variety of reasons (investment, future expansion, personal use, participation in open space tax relief programs). The state publications "Providing Adequate Urban Area Land Supply" (1992), the "Buildable Lands Program Guidelines" (2000), and the updated "Buildable Lands Guidelines" (2018) all reinforce the notion the buildable lands methodologies "assume that a certain percentage of vacant, under-utilized, and partially-used lands will always be held out from development."

The 1992 state guidebook acknowledges that "information about land availability is difficult to obtain and confirm." However, some suggestions were provided that were used by Snohomish County jurisdictions during 1993-95 when the original land capacity analyses were developed for the first UGA sizing process under GMA. Research results in the 1992 state publication, which included property owner surveys, were the basis for a 15% market availability reduction factor for vacant land and a 30% market availability reduction factor for partially-used and redevelopable land used in many of the land capacity analyses at that time (including Snohomish County for unincorporated urban areas).

Subsequently, results from a 2005 Snohomish County property owner survey supported the use of reductions of 15% for vacant land and 30% for partially-used and redevelopable land. The county contracted with Gilmore Research Group to research this question by conducting an urban land market availability survey. Gilmore Research conducted a telephone survey of owners of developable property within the Snohomish County UGA, including areas within

cities. The survey was designed to obtain information directly from a random sample of Snohomish County property owners regarding their intent to develop or redevelop their property within the UGA over time. Results from the survey supported the use of the 15% and 30% market availability reduction factors for establishing land availability for development within the UGA to the year 2025. [See the PDS document "Urban Land Availability Survey," published June 14, 2005.]

Based on the above survey evidence, market availability reduction factors of 15% for vacant land and 30% for partially-used and redevelopable land were used in all of Snohomish County's three previous buildable lands reports.

For the 2021 BLR, the new state Buildable Lands Guidelines (2018), on page 51, suggest that the survey research that has been the basis for the market availability reduction factors may need to be reexamined by buildable lands jurisdictions. It states that "surveys of owner intent have greatly focused on subjective willingness of owners to sell or subdivide…as a result, historical market supply factor assumptions employed by jurisdictions may be found to be too high (or too low) for future buildable lands analysis. Jurisdictions should verify whether historical market supply factor assumptions have been updated."

One suggested route in the new Guidelines for verifying the market supply reduction factor is through research on how land in the UGA has actually developed over time by examining historic land records (pages 36-37). The new Guidelines on page 48 also suggest that "Market Supply Factors can and should be distinct for Urban Growth Areas."

Snohomish County, with the assistance of ECONorthwest, took these suggestions into account as part of the buildable lands methodology review and update required by E2SSB 5254. Snohomish County's coverage of nearly 20-years of buildable lands and development data allowed for an evaluation of the market factor unavailable in previous years. Two sample areas were identified that represented different types of markets and geographies:

- Bothell MUGA study area (SWUGA)
- Stanwood/Cedarhome study area (non-SWUGA)

These areas represented locations in the County's UGA where development activity had been intensely focused at some point during the past 20 years. The areas represented a range of different areas in the County's UGA including single-family development in SWUGA and non-SWUGA. Effort was made to examine other land use types (such as multifamily, commercial and mixed-use development) however, unlike for single-family development, it was not possible to find a location with the necessary criteria (zoning and generally "built-out" development) to evaluate the utilization rates of capacity estimated in the 2002 BLR by 2019 for multifamily, commercial and mixed-use areas.

Using 2002 BLR data (based on a 2001 parcel extract), County staff studied properties with additional capacity estimated in the 2002 BLR that remained unchanged since 2001, as indicated by the lack of development or the lack of development proposals as of 2019. These unchanged parcels could be considered parcels that had been held out from development for nearly 20 years

in a rapidly developing area. The unused capacity they represented was then used as a basis for determining the percent of 2002 BLR capacity that was still unused as of 2019. The percentages were used as updated market availability reduction factors for single-family development as follows:

Market Availability Reduction Factors (MARF)

		Observed MARF 2001-2019	
Urban Low Density Residential Areas		SWUGA	Non-SWUGA
Single Family Zoning	Vacant	**6%**	**12%**
	Under-utilized	**10%**	**16%**

		Observed MARF 2001-2019	
Urban Medium Density Residential Areas		SWUGA	Non-SWUGA
Mix of Single Family & Low Density Multi-Family Zoning	Vacant	**11%**	**14%**
	Under-utilized	**20%**	**23%**

Notes:
- Under-utilized includes both partially-used and redevelopable parcels.
- In Urban Medium Density Residential Areas, half the development is assumed to be single-family, thus the percentages are the midpoint between the Urban Low Density Residential percentages and the 15% and 30% reductions factors used for vacant and partially-used non-SF land.

Note that the reduced market reduction factors shown above are only being applied to single family zoned parcels. The use of the 15% reduction for vacant and 30% reduction for partially-used and redevelopable parcels continues for all non-residential uses in both SWUGA and non-SWUGA areas, as well as to multi-family and mixed-use developments in those areas as well.

Snohomish County's updated buildable lands methodology recommends that monitoring of different market factors for other development types (Multi-Family, Commercial, Mixed-Use, etc.) continue in the lead up to the next BLR, since there is currently not enough information over long-term to evaluate capacity utilization rates for these other development types.

Market-ready land status overlay

A methodological refinement was added to the 2012 BLR analysis to address a unique capacity issue brought about by the economic downturn experienced since the last BLR. Specifically, a "market-ready overlay" was added to the land status maps to denote sites without pending development but for which property owner intent to develop was evident. Consequently, the market availability reduction factor was not applied for these parcels during the capacity

calculations. These sites included: developer-owned properties, development sites that are currently for sale, and development sites that are bank-owned due to foreclosure.

Though no longer needed to flag distressed properties in Snohomish County due to the strength of the housing recovery that occurred this past decade, use of a market-ready land status overlay has continued for the 2021 BLR to flag parcels in which property-owner or developer interest in developing the property had been indicated. This was accomplished by researching current property listings in several online commercial real estate listing services.

Steps 5 & 6: UGA Growth Target/Capacity Comparisons *(What are the growth targets, and is there enough land capacity?)*

Steps 5 and 6 compare the remaining population and employment growth anticipated to the year 2035 for cities and unincorporated UGAs/MUGAs with the additional population and employment capacity results obtained under step 4 (how much land capacity is available for development by 2035?), to determine if the UGAs are capable of accommodating the projected growth.

The GMA buildable lands statute requires that adopted growth targets be used for this comparison. In Snohomish County, Appendix B of the Countywide Planning Policies contain the adopted 2035 population and employment targets for cities and unincorporated UGAs/MUGAs. These targets are the result of the Snohomish County Tomorrow target reconciliation effort, completed in 2016 following the 10-year updates of city and county comprehensive plans. Remaining anticipated population and employment growth to the year 2035 is calculated as the difference between the 2035 targets and 2019 population and employment estimates.

This report answers the question of whether there is population and employment capacity sufficient to accommodate the adopted growth targets, at the countywide UGA level, the individual UGA level, the city level, and, within the SWUGA, the MUGA level.

If there is not enough land capacity to accommodate the adopted growth targets, the GMA requires that reasonable measures be evaluated to remedy the capacity shortfall. RCW 36.70A.215 states: “Identify reasonable measures, other than adjusting urban growth areas, that will be taken to comply with the requirements of this chapter”. These requirements apply to both cities and the county. Appendix D of the Countywide Planning Policies provide local guidance on the process for reasonable measures evaluation.

SAMPLE DENSITY CALCULATION AND APPLICATION

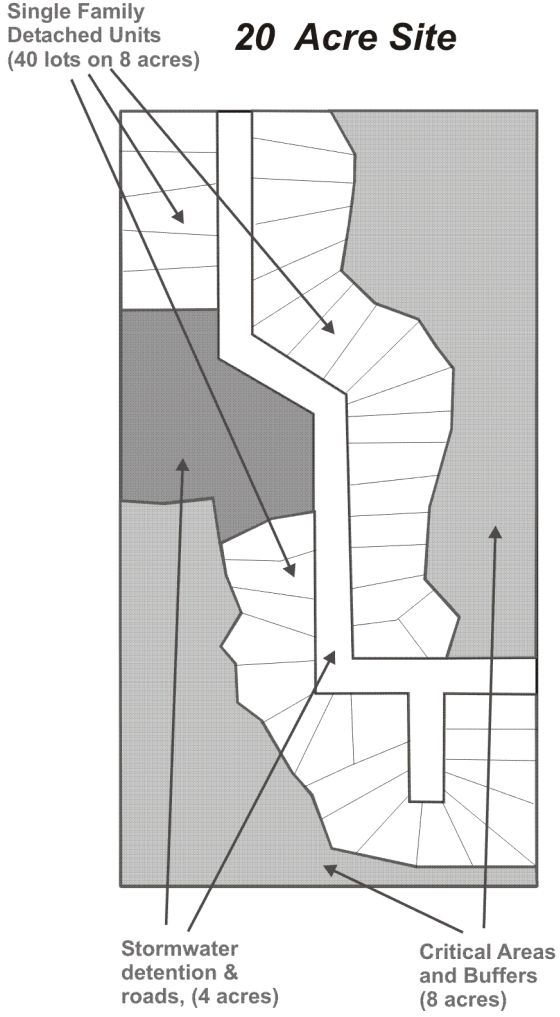
(Gross vs. Buildable vs. Net Density)

Development History:

Observed Density

(1995 - 2000)

20 Acre Site



GROSS DENSITY

$$\frac{\text{Dwelling Units}}{\text{Gross Acres *}} = \frac{40}{20} = \textbf{2 Units per Gross Acre}$$

* Total Site Area (20 acres)

BUILDABLE DENSITY

$$\frac{\text{Dwelling Units}}{\text{Buildable Acres **}} = \frac{40}{(20 - 8)} = \frac{40}{12} = \textbf{3.33 Units per Buildable Acre}$$

** Total Site Area (20 acres)
minus Critical Areas and Buffers (8 acres)

NET DENSITY

$$\frac{\text{Dwelling Units}}{\text{Net Residential Acres ***}} = \frac{40}{(20 - 8 - 4)} = \frac{40}{8} = \textbf{5 Units per Net Residential Acre}$$

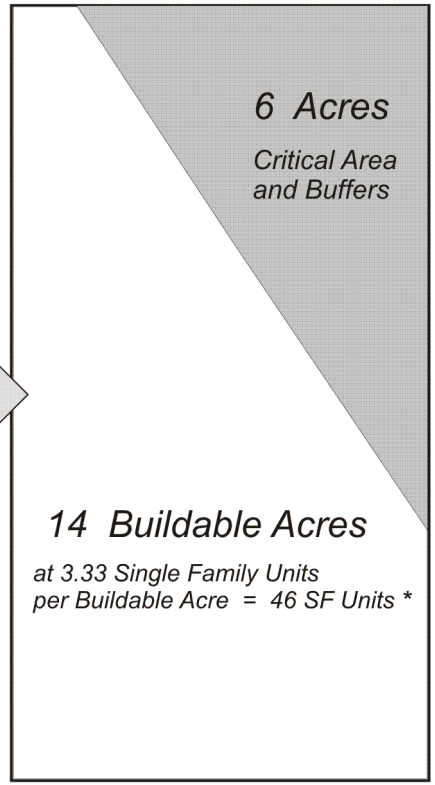
*** Total Site Area (20 acres)
minus Critical Areas and Buffers (8 acres),
minus Non-Residential Uses (4 acres)
(e.g. roads, stormwater detention)

Buildable Land:

Future Density

(2001 - 2012)

Vacant 20 Acre Single Family Residentially Zoned Parcel



* (.62 factional unit is truncated)

Results Summary

Table 1

6/23/2021 DRAFT Comparison of 2035 UGA Population Targets with Total Population Capacity Estimates

(all estimates, targets and capacity comparisons below are based on December 13, 2012 city boundaries)

Area	2019 Estimated Population	CPP 2035 Population Targets	2019-2035 Numeric Change	2035 Total Population Capacity	Additional 2019-2035 Pop Capacity	Pop Capacity Surplus vs. Shortfall ( )
Non-S.W. County UGA	181,338	233,097	51,759	258,612	77,274	25,515
Arlington UGA	20,296	26,002	5,706	35,784	15,488	9,782
Arlington City	19,734	24,937	5,203	33,991	14,257	9,054
Unincorporated	562	1,065	503	1,793	1,231	728
Darrington UGA	1,491	2,161	670	2,201	710	40
Darrington Town	1,410	1,764	354	1,770	360	6
Unincorporated	81	397	315	431	350	35
Gold Bar UGA	3,101	3,319	218	3,353	252	34
Gold Bar City	2,150	2,406	256	2,349	199	(57)
Unincorporated	951	913	(38)	1,004	53	91
Granite Falls UGA	4,060	8,517	4,457	8,625	4,565	108
Granite Falls City	3,900	7,624	3,724	7,845	3,945	221
Unincorporated	160	893	733	780	620	(113)
Index UGA (incorporated)	175	220	45	208	33	(12)
Lake Stevens UGA	39,013	46,380	7,367	50,241	11,228	3,861
Lake Stevens City	33,057	39,340	6,283	40,591	7,534	1,251
Unincorporated	5,956	7,040	1,084	9,650	3,694	2,610
Maltby UGA (unincorporated)	-	-	-	850	850	850
Marysville UGA	68,058	87,798	19,739	89,788	21,730	1,991
Marysville City	67,820	87,589	19,769	89,550	21,730	1,961
Unincorporated	238	209	(30)	238	-	30
Monroe UGA	20,826	24,754	3,928	26,914	6,088	2,160
Monroe City	19,250	22,102	2,852	23,673	4,423	1,571
Unincorporated	1,576	2,652	1,076	3,241	1,665	589
Snohomish UGA	11,650	14,494	2,843	16,404	4,754	1,911
Snohomish City	10,200	12,139	1,939	13,000	2,800	861
Unincorporated	1,450	2,354	904	3,404	1,954	1,050
Stanwood UGA	7,149	11,085	3,936	11,944	4,795	859
Stanwood City	7,013	10,116	3,103	10,632	3,619	516
Unincorporated	136	969	833	1,312	1,176	343
Sultan UGA	5,519	8,369	2,850	12,300	6,781	3,931
Sultan City	5,170	7,345	2,175	9,544	4,374	2,199
Unincorporated	349	1,024	675	2,756	2,407	1,732
S.W. County UGA	506,018	582,035	76,017	655,424	149,406	73,389
Incorporated S.W.	283,231	363,413	80,182	373,479	90,248	10,066
Bothell City (part)	18,180	23,510	5,330	28,357	10,177	4,847
Brier City	6,611	6,972	361	7,074	463	102
Edmonds City	42,170	45,550	3,380	51,663	9,493	6,113
Everett City	111,794	164,812	53,018	151,063	39,269	(13,749)
Lynnwood City	39,596	54,404	14,808	58,145	18,549	3,741
Mill Creek City	20,590	20,196	(394)	21,716	1,126	1,520
Mtlake Terrace City	21,590	24,767	3,177	31,678	10,088	6,911
Mukilteo City	21,350	21,812	462	22,364	1,014	552
Woodway Town	1,350	1,389	39	1,419	69	30
Unincorporated S.W.	222,787	218,623	(4,164)	281,945	59,158	63,322
UGA Total	687,356	815,132	127,776	914,036	226,680	98,904
City Total	453,110	578,994	125,884	606,632	153,522	27,638
Unincorporated UGA Total	234,246	236,138	1,892	307,404	73,158	71,266

Table 2

6/23/2021 DRAFT Comparison of 2035 UGA Population Targets with Total Population Capacity Estimates

for SWUGA Cities and Unincorporated MUGAs

(All estimates, targets and capacity comparisons below are based on December 13, 2012 city boundaries)

Area	2019 Estimated Population	CPP 2035 Population Targets	2019-2035 Numeric Change	2035 Total Population Capacity	Additional 2019-2035 Pop Capacity	Pop Capacity Surplus vs. Shortfall ( )
S.W. County UGA Total	506,018	582,035	76,017	655,424	149,406	73,389
Incorporated S.W. Total	283,231	363,413	80,182	373,479	90,248	10,066
Unincorporated S.W. Total	222,787	218,623	(4,164)	281,945	59,158	63,322
Bothell Area	52,041	53,117	1,076	70,529	18,488	17,412
Bothell City (part)	18,180	23,510	5,330	28,357	10,177	4,847
Unincorporated MUGA	33,861	29,607	(4,254)	42,172	8,311	12,565
Brier Area	8,774	9,327	553	9,555	781	228
Brier City	6,611	6,972	361	7,074	463	102
Unincorporated MUGA	2,163	2,354	191	2,481	318	127
Edmonds Area	46,163	49,574	3,412	56,508	10,345	6,933
Edmonds City	42,170	45,550	3,380	51,663	9,493	6,113
Unincorporated MUGA	3,993	4,024	32	4,845	852	820
Everett Area	158,623	211,968	53,346	207,252	48,629	(4,717)
Everett City	111,794	164,812	53,018	151,063	39,269	(13,749)
Unincorporated MUGA	46,829	47,156	328	56,189	9,360	9,032
Lynnwood Area	75,923	92,022	16,099	107,637	31,714	15,615
Lynnwood City	39,596	54,404	14,808	58,145	18,549	3,741
Unincorporated MUGA	36,327	37,617	1,290	49,492	13,165	11,875
Mill Creek Area	73,147	67,940	(5,207)	81,932	8,785	13,992
Mill Creek City	20,590	20,196	(394)	21,716	1,126	1,520
Unincorporated MUGA	52,557	47,744	(4,813)	60,216	7,659	12,472
Mountlake Terrace Area	21,610	24,797	3,187	31,717	10,107	6,920
Mountlake Terrace City	21,590	24,767	3,177	31,678	10,088	6,911
Unincorporated MUGA	20	30	10	39	19	9
Mukilteo Area	36,604	36,453	(150)	42,195	5,591	5,741
Mukilteo City	21,350	21,812	462	22,364	1,014	552
Unincorporated MUGA	15,254	14,641	(612)	19,831	4,577	5,189
Woodway Area	1,350	4,361	3,011	2,066	716	(2,295)
Woodway Town	1,350	1,389	39	1,419	69	30
Unincorporated MUGA	-	2,972	2,972	647	647	(2,325)
Paine Field Area (Uninc.)	-	-	-	-	-	-
Larch Way Overlap (Uninc.)	5,718	5,007	(712)	8,703	2,985	3,697
Lake Stickney Gap (Uninc.)	10,365	9,786	(580)	15,319	4,954	5,534
Silver Firs Gap (Uninc.)	15,700	17,683	1,983	22,011	6,311	4,328

The following graphs depict the relationship between the population growth targets and additional capacity at the large UGA level (including cities), individual non-SW County UGA level (including cities), and individual jurisdictional level (using December 13, 2012 boundaries).

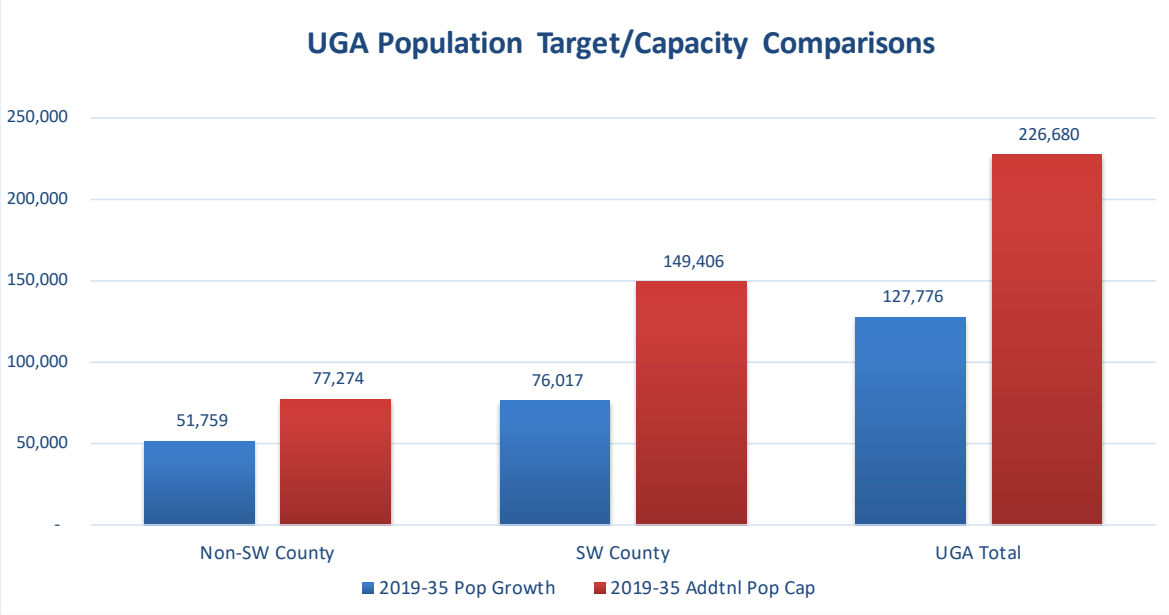
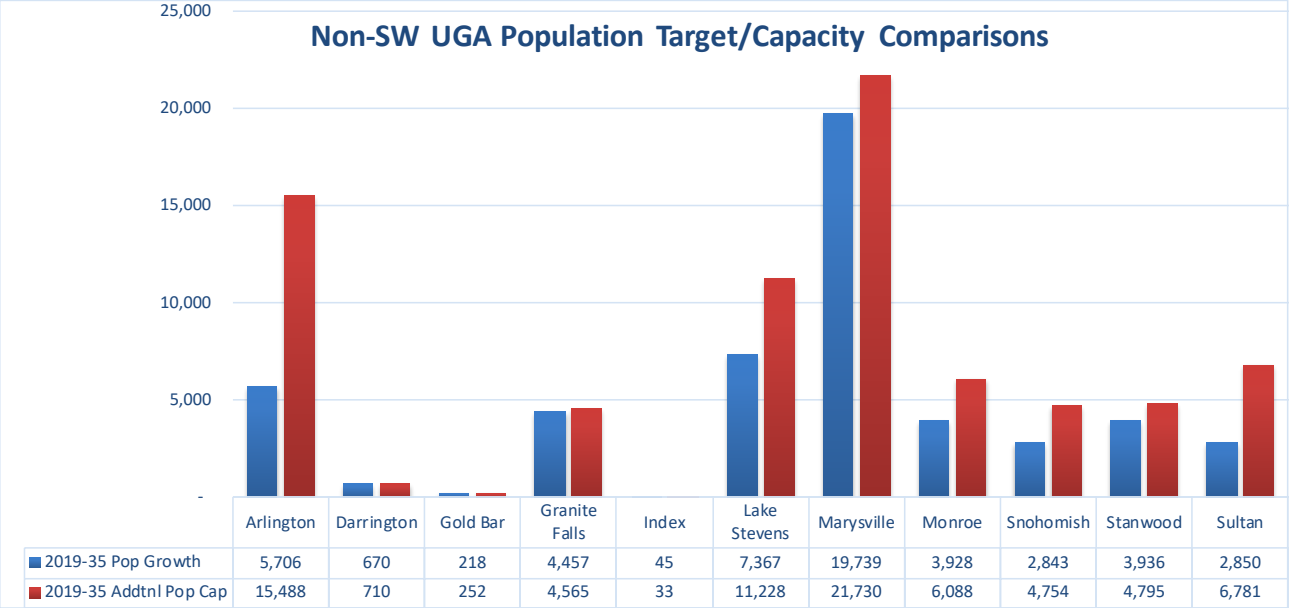
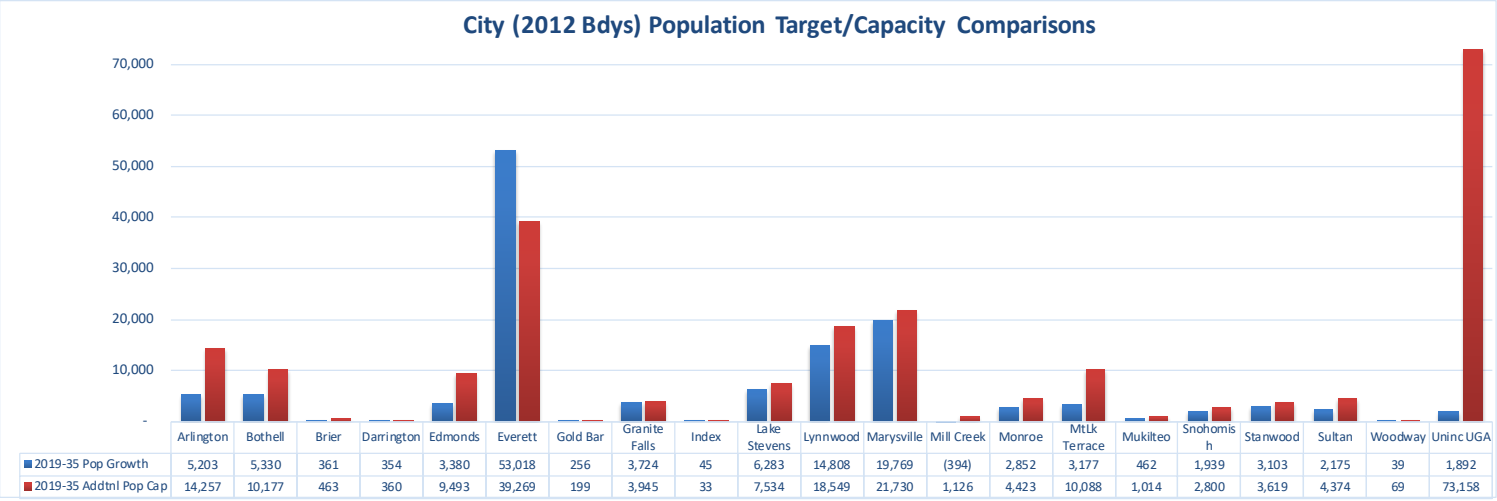


Figure 5



	Arlington	Darrington	Gold Bar	Granite Falls	Index	Lake Stevens	Marysville	Monroe	Snohomish	Stanwood	Sultan
2019-35 Pop Growth	5,706	670	218	4,457	45	7,367	19,739	3,928	2,843	3,936	2,850
2019-35 Addtnl Pop Cap	15,488	710	252	4,565	33	11,228	21,730	6,088	4,754	4,795	6,781

Figure 6



	Arlington	Bothell	Brier	Darrington	Edmonds	Everett	Gold Bar	Granite Falls	Index	Lake Stevens	Lynnwood	Marysville	Mill Creek	Monroe	Mtlk Terrace	Mukilteo	Snohomish	Stanwood	Sultan	Woodway	Uninc UGA
2019-35 Pop Growth	5,203	5,330	361	354	3,380	53,018	256	3,724	45	6,283	14,808	19,769	(394)	2,852	3,177	462	1,939	3,103	2,175	39	1,892
2019-35 Addtnl Pop Cap	14,257	10,177	463	360	9,493	39,269	199	3,945	33	7,534	18,549	21,730	1,126	4,423	10,088	1,014	2,800	3,619	4,374	69	73,158

Figure 7

The following graphs show the breakdown of additional population capacity by housing type (single family, multi-family and senior apartments) within Snohomish County's composite UGA (includes cities) over time, from the 2007 BLR to the 2021 BLR.

2007 BLR:

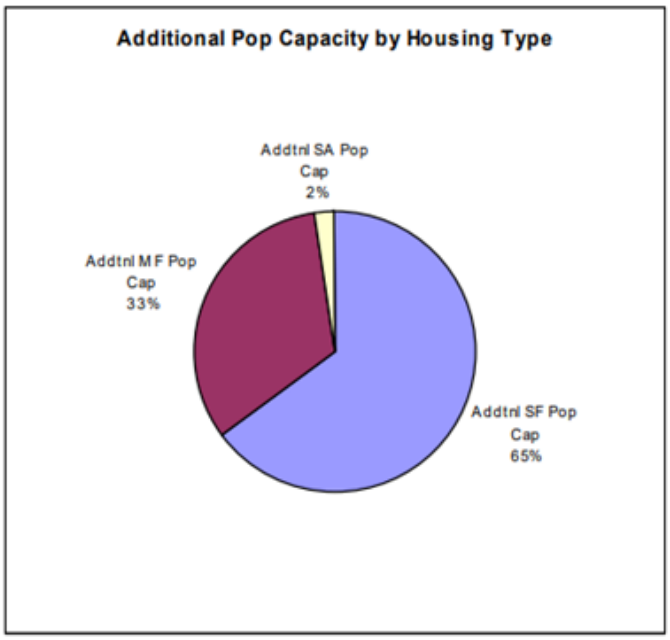


Figure 8

2012 BLR:

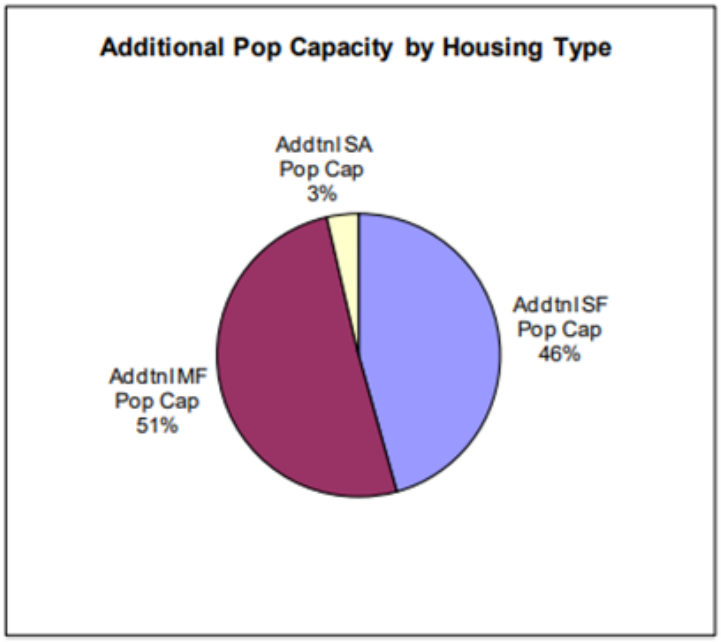


Figure 9

2021 BLR:

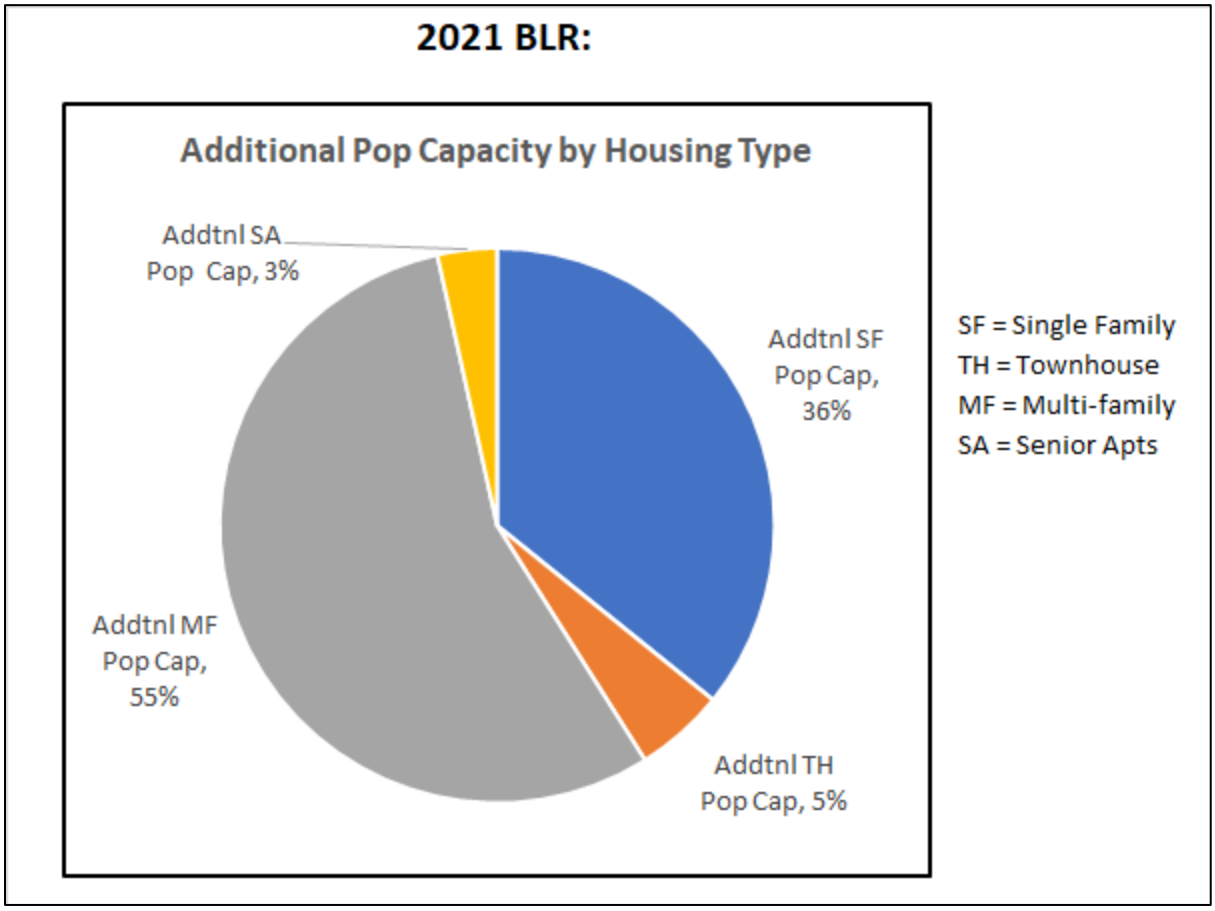


Figure 10

The following table shows the breakdown of additional population capacity by land status classification for cities (using current city boundaries), sorted by the percentage of additional capacity represented by pending development. This is information is intended to show the current pace of residential development activity by jurisdiction, as depicted by the share of additional capacity represented in projects that were pending as of April 1, 2019 or were applied for since that date.

Table 3

Cities (current city boundaries)
Breakdown of additional population capacity by land status classifications

	Additional Population Capacity					Percent Distribution				
Cities:	PENDING	VACANT	PARTUSE	REDEV	Total	PENDING	VACANT	PARTUSE	REDEV	Total
Woodway	136	10	27	-	173	79%	6%	16%	0%	100%
Mill Creek	892	72	49	128	1,140	78%	6%	4%	11%	100%
Lake Stevens	5,263	591	879	2,396	9,129	58%	6%	10%	26%	100%
Monroe	2,287	265	1,062	809	4,423	52%	6%	24%	18%	100%
Sultan	2,968	830	1,170	1,101	6,070	49%	14%	19%	18%	100%
Lynnwood	7,990	239	309	10,025	18,563	43%	1%	2%	54%	100%
Stanwood	1,659	519	270	1,616	4,064	41%	13%	7%	40%	100%
Brier	159	39	157	113	468	34%	8%	34%	24%	100%
Granite Falls	1,278	1,267	666	733	3,945	32%	32%	17%	19%	100%
Mukilteo	284	266	76	388	1,014	28%	26%	7%	38%	100%
Arlington	3,830	4,788	2,574	3,357	14,550	26%	33%	18%	23%	100%
Snohomish	680	438	772	911	2,800	24%	16%	28%	33%	100%
Mountlake Terrace	2,197	202	327	7,363	10,088	22%	2%	3%	73%	100%
Everett	6,960	3,694	700	27,962	39,316	18%	9%	2%	71%	100%
Bothell (part)	1,804	2,107	1,693	4,714	10,320	17%	20%	16%	46%	100%
Marysville	3,450	5,478	5,689	7,113	21,730	16%	25%	26%	33%	100%
Edmonds	1,212	1,161	177	6,944	9,493	13%	12%	2%	73%	100%
Darrington	35	188	131	7	360	10%	52%	36%	2%	100%
Gold Bar	6	104	28	62	199	3%	52%	14%	31%	100%
Index	-	12	10	11	33	0%	36%	30%	33%	100%
Total Cities	43,090	22,270	16,766	75,753	157,878	27%	14%	11%	48%	100%

Table 4

6/23/2021 DRAFT Comparison of 2035 UGA Employment Targets with Total Employment Capacity Estimates

(all estimates, targets and capacity comparisons below are based on December 13, 2012 city boundaries)

Area	2019 Estimated Employment	CPP 2035 Employment Targets	2019-2035 Numeric Change	2035 Total Employment Capacity	Additional 2019-2035 Emp Capacity	Emp Capacity Surplus vs. Shortfall ( )
Non-S.W. County UGA	58,827	93,571	34,744	103,977	45,150	10,406
Arlington UGA	10,289	20,884	10,595	23,518	13,229	2,634
Arlington City	10,265	20,829	10,564	23,441	13,176	2,612
Unincorporated	24	55	31	77	53	22
Darrington UGA	522	886	364	2,321	1,799	1,435
Darrington Town	522	800	278	1,894	1,372	1,094
Unincorporated	-	86	86	427	427	341
Gold Bar UGA	257	666	409	819	562	153
Gold Bar City	250	661	411	812	562	151
Unincorporated	7	5	(2)	7	-	2
Granite Falls UGA	971	2,276	1,305	2,017	1,046	(259)
Granite Falls City	971	2,275	1,304	2,014	1,043	(261)
Unincorporated	*	1	1	3	3	2
Index UGA (incorporated)	27	25	(2)	27	-	2
Lake Stevens UGA	5,732	7,821	2,089	7,795	2,063	(26)
Lake Stevens City	5,500	7,412	1,912	7,307	1,807	(105)
Unincorporated	232	409	177	488	256	79
Maltby UGA	3,623	6,374	2,751	7,352	3,729	978
Marysville UGA	15,974	28,113	12,139	32,098	16,124	3,985
Marysville City	15,310	27,419	12,109	31,434	16,124	4,015
Unincorporated	664	694	30	664	-	(30)
Monroe UGA	10,260	11,781	1,521	11,870	1,610	89
Monroe City	10,096	11,456	1,360	11,705	1,609	249
Unincorporated	164	325	161	165	1	(160)
Snohomish UGA	6,110	6,941	831	7,604	1,494	663
Snohomish City	5,842	6,291	449	7,272	1,430	981
Unincorporated	268	650	382	332	64	(318)
Stanwood UGA	4,057	5,723	1,666	6,304	2,247	581
Stanwood City	3,864	4,688	824	4,821	957	133
Unincorporated	193	1,035	842	1,483	1,290	448
Sultan UGA	1,005	2,081	1,076	2,252	1,247	171
Sultan City	1,005	2,077	1,072	2,252	1,247	175
Unincorporated	*	4	4	-	-	(4)
S.W. County UGA	219,103	279,481	60,378	301,593	82,490	22,112
Incorporated S.W.	184,773	241,272	56,499	253,718	68,945	12,446
Bothell City (part)	16,093	18,576	2,483	22,515	6,422	3,939
Brier City	494	405	(89)	524	30	119
Edmonds City	14,174	13,948	(226)	16,722	2,548	2,774
Everett City	99,796	140,000	40,204	141,075	41,279	1,075
Lynnwood City	28,617	42,229	13,612	42,526	13,909	297
Mill Creek City	6,787	6,310	(477)	7,168	381	858
Mtlake Terrace City	8,431	9,486	1,055	10,740	2,309	1,254
Mukilteo City	10,313	10,250	(63)	12,380	2,067	2,130
Woodway Town	68	68	-	68	-	-
Unincorporated S.W.	34,330	38,209	3,879	47,875	13,545	9,666
UGA Total	277,930	373,052	95,122	405,570	127,640	32,518
City Total	238,425	325,205	86,780	346,697	108,272	21,492
Unincorporated UGA Total	39,505	47,847	8,342	58,873	19,368	11,026

Table 5

6/23/2021 DRAFT Comparison of 2035 Employment Targets with Total Employment Capacity for SWUGA Cities and Unincorporated MUGAs

(All estimates, targets and capacity comparisons below are based on December 13, 2012 city boundaries)

Area	2019 Estimated Employment	CPP 2035 Employment Targets	2019-2035 Numeric Change	2035 Total Employment Capacity	Additional 2019-2035 Emp Capacity	Emp Capacity Surplus vs. Shortfall ( )
S.W. County UGA Total	219,103	279,481	60,378	301,593	82,490	22,112
Incorporated S.W. Total	184,773	241,272	56,499	253,718	68,945	12,446
Unincorporated S.W. Total	34,330	38,209	3,879	47,875	13,545	9,666
Bothell Area	18,314	20,272	1,958	25,098	6,784	4,826
Bothell City (part)	16,093	18,576	2,483	22,515	6,422	3,939
Unincorporated MUGA	2,221	1,696	(525)	2,583	362	887
Brier Area	619	476	(143)	649	30	173
Brier City	494	405	(89)	524	30	119
Unincorporated MUGA	125	71	(54)	125	-	54
Edmonds Area	14,421	14,148	(273)	17,041	2,620	2,893
Edmonds City	14,174	13,948	(226)	16,722	2,548	2,774
Unincorporated MUGA	247	200	(47)	319	72	119
Everett Area	106,229	148,324	42,095	150,011	43,782	1,687
Everett City	99,796	140,000	40,204	141,075	41,279	1,075
Unincorporated MUGA	6,433	8,324	1,891	8,936	2,503	612
Lynnwood Area	33,696	48,225	14,529	50,147	16,451	1,922
Lynnwood City	28,617	42,229	13,612	42,526	13,909	297
Unincorporated MUGA	5,079	5,996	917	7,621	2,542	1,625
Mill Creek Area	12,567	10,279	(2,288)	13,976	1,409	3,697
Mill Creek City	6,787	6,310	(477)	7,168	381	858
Unincorporated MUGA	5,780	3,969	(1,811)	6,808	1,028	2,839
Mountlake Terrace Area	8,431	9,486	1,055	10,740	2,309	1,254
Mountlake Terrace City	8,431	9,486	1,055	10,740	2,309	1,254
Unincorporated MUGA	-	-	-	-	-	-
Mukilteo Area	14,006	15,279	1,273	18,612	4,606	3,333
Mukilteo City	10,313	10,250	(63)	12,380	2,067	2,130
Unincorporated MUGA	3,693	5,029	1,336	6,232	2,539	1,203
Woodway Area	68	246	178	187	119	(59)
Woodway Town	68	68	-	68	-	-
Unincorporated MUGA	-	178	178	119	119	(59)
Paine Field Area (Uninc.)	6,371	8,010	1,639	10,010	3,639	2,000
Larch Way Overlap (Uninc.)	1,636	2,051	415	1,943	307	(108)
Lake Stickney Gap (Uninc.)	911	794	(117)	1,313	402	519
Silver Firs Gap (Uninc.)	1,834	1,891	57	1,866	32	(25)

The following graphs depict the relationship between the employment growth targets and additional capacity at the large UGA level (including cities), individual non-SW County UGA level (including cities), and individual jurisdictional level (using December 13, 2012 boundaries).

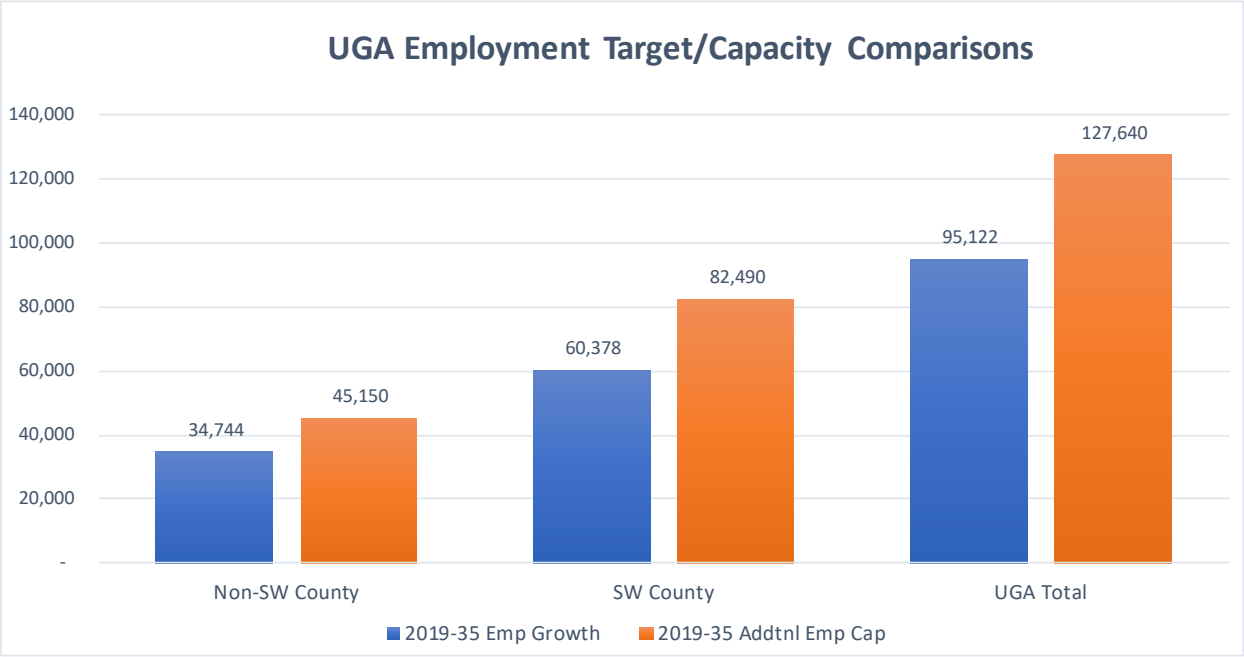
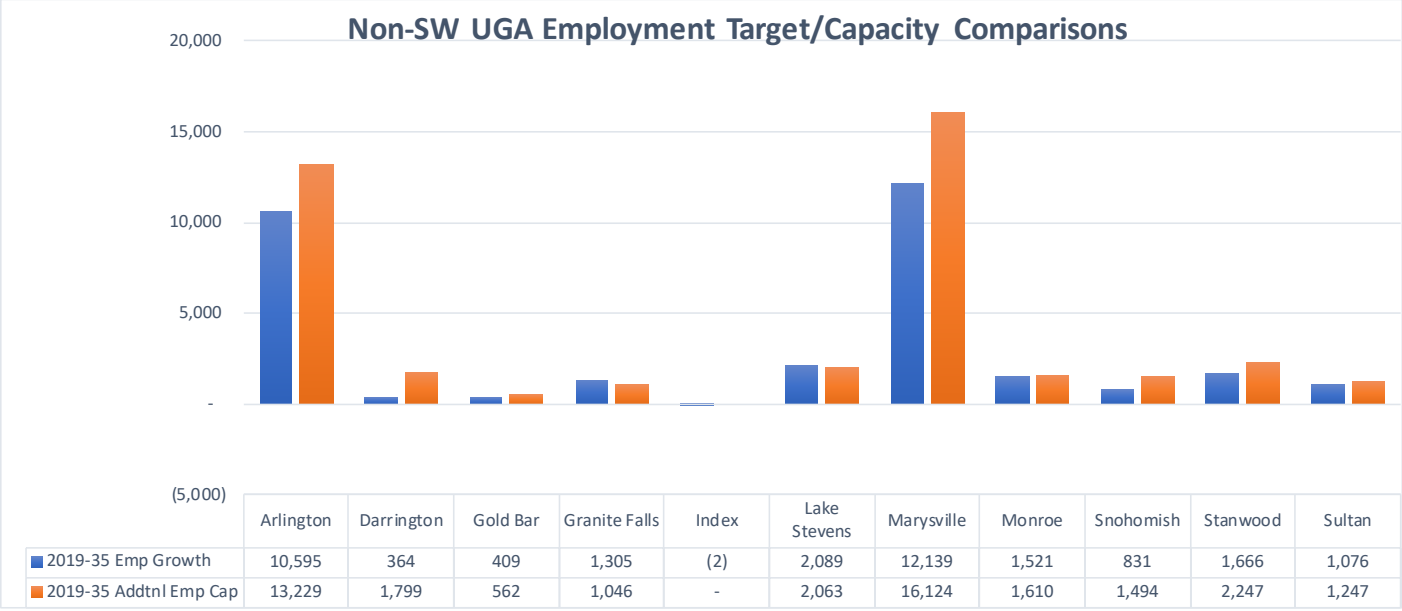


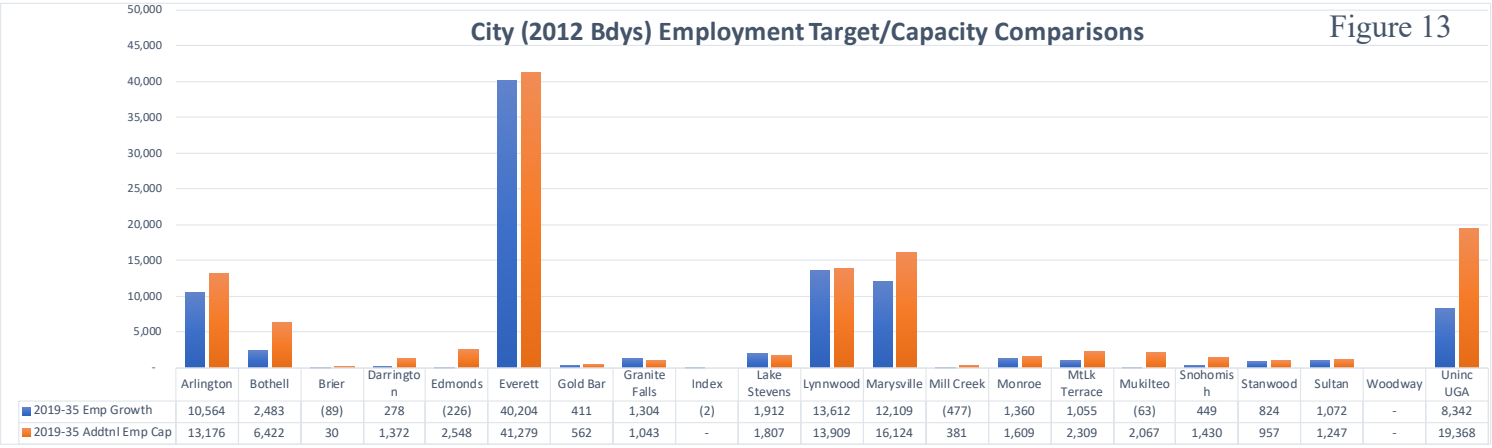
Figure 11

Figure 12



	Arlington	Darrington	Gold Bar	Granite Falls	Index	Lake Stevens	Marysville	Monroe	Snohomish	Stanwood	Sultan
2019-35 Emp Growth	10,595	364	409	1,305	(2)	2,089	12,139	1,521	831	1,666	1,076
2019-35 Addtnl Emp Cap	13,229	1,799	562	1,046	-	2,063	16,124	1,610	1,494	2,247	1,247

Figure 13



	Arlington	Bothell	Brier	Darrington	Edmonds	Everett	Gold Bar	Granite Falls	Index	Lake Stevens	Lynnwood	Marysville	Mill Creek	Monroe	MtLk Terrace	Mukilteo	Snohomish	Stanwood	Sultan	Woodway	Uninc UGA
2019-35 Emp Growth	10,564	2,483	(89)	278	(226)	40,204	411	1,304	(2)	1,912	13,612	12,109	(477)	1,360	1,055	(63)	449	824	1,072	-	8,342
2019-35 Addtnl Emp Cap	13,176	6,422	30	1,372	2,548	41,279	562	1,043	-	1,807	13,909	16,124	381	1,609	2,309	2,067	1,430	957	1,247	-	19,368

Results by UGA

Figure Pop-A. Arlington UGA Population

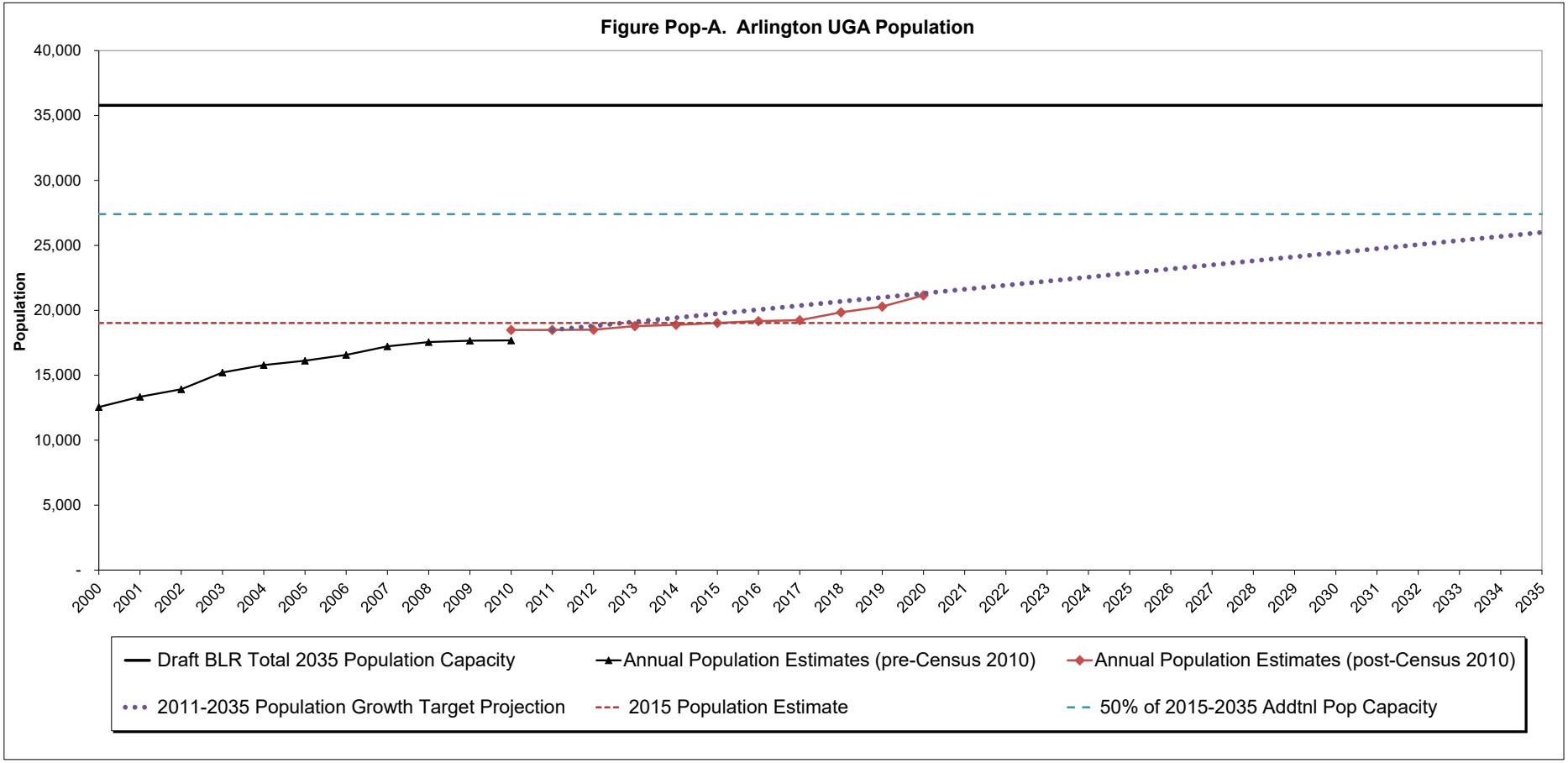


Table Pop-A. Arlington UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B) Post-Census Pop Estimates									(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
2000	2010	Pop	Diff. (Census-Est) No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		2011-20 Numeric Change = (C) - (A)	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap = (G) - (B)	
12,552	17,686	18,489	803	4.5%	18,489	18,512	18,791	18,881	19,026	19,166	19,240	19,850	20,296	21,153		2,664	26,002	7,512	35.5%	35,784	16,758	12.7%

Arlington UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Arlington UGA	CITY12	(1) PENDING		CC	12.281	2.455934	9.825	0	0	0	293	150	443	0	0	293	150	443	0	0	539	176	716
				GC	21.746	0.4922451	21.254	0	0	0	632	0	632	0	0	632	0	632	0	0	1163	0	1163
				HC	15.228	0	15.228	0	0	0	0	425	425	0	0	0	425	425	0	0	0	500	500
				NC	9.412	1.829444	7.582	0	0	0	183	0	183	0	0	183	0	183	0	0	337	0	337
				OTBD - 1	0.891	0	0.891	0	0	0	40	0	40	0	0	40	0	40	0	0	74	0	74
				OTRD	2.686	0.0582842	2.628	0	18	0	0	0	18	18	0	0	0	18	52	0	0	0	52
				RHC	32.298	15.62465	16.674	0	1	0	360	0	361	1	0	360	0	361	3	0	662	0	665
				RLC	3.656	1.71919	1.937	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
				RULC	5.087	2.043009	3.044	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
			Sum		103.286	24.22276	79.063	0	30	0	1508	575	2113	30	0	1508	575	2113	86	0	2775	676	3537
		Sum			103.286	24.22276	79.063	0	30	0	1508	575	2113	30	0	1508	575	2113	86	0	2775	676	3537
		(2) VACANT		CC	16.41	0.3695223	16.04	0	0	0	239	0	239	0	0	193	0	193	0	0	355	0	355
				GC	58.998	6.781916	52.216	0	1	0	455	141	597	1	0	367	114	482	2	0	676	134	812
				HC	1.989	0.3844014	1.604	0	0	0	0	12	12	0	0	0	10	10	0	0	0	11	11
				OTBD - 1	1.196	0.327513	0.869	0	8	0	0	0	8	6	0	0	0	6	19	0	0	0	19
				OTBD - 2	0.105	0	0.105	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				OTRD	1.671	0.7025614	0.969	0	13	0	0	0	13	11	0	0	0	11	31	0	0	0	31
				RHC	19.813	11.92629	7.887	0	9	0	85	33	127	7	0	69	27	103	21	0	126	31	179

				RLC	35.368	26.09657	9.271	0	39	0	2	0	41	33	0	2	0	34	94	0	3	0	97
				RMod	5.829	0.9647351	4.865	0	29	0	4	0	33	24	0	3	0	27	68	0	6	0	74
				RULC	10.474	5.318644	5.155	0	17	0	0	0	17	14	0	0	0	14	41	0	0	0	41
				RULC-EH	180.273	58.64766	121.625	0	728	0	728	0	1456	595	0	595	0	1190	1713	0	1094	0	2807
			Sum		332.124	111.5198	220.604	0	845	0	1513	186	2544	691	0	1229	150	2070	1991	0	2261	177	4428
			MARKET-READY	GC	21.532	2.34931	19.183	0	0	0	167	53	220	0	0	159	50	209	0	0	292	59	351
				HC	1.056	0	1.056	0	0	0	0	8	8	0	0	0	8	8	0	0	0	9	9
			Sum		22.588	2.34931	20.239	0	0	0	167	61	228	0	0	159	58	217	0	0	292	68	360
		Sum			354.712	113.8691	240.843	0	845	0	1680	247	2772	691	0	1387	208	2287	1991	0	2553	245	4788
		(3) PARTUSE		CC	34.57	9.829503	24.741	12.469	0	0	183	0	183	0	0	122	0	122	0	0	224	0	224
				GC	13.581	3.108723	10.472	2.329	0	0	20	6	26	0	0	13	4	17	0	0	24	5	29
				HC	4.671	0.1513232	4.52	2.62	0	0	0	20	20	0	0	0	13	13	0	0	0	16	16
				OTBD - 2	0.449	0.0786997	0.37	0.269	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
				OTRD	3.255	0	3.255	1.454	16	0	0	0	16	12	0	0	0	12	34	0	0	0	34
				RHC	4.042	0	4.042	2.076	1	0	21	7	29	1	0	14	5	19	2	0	26	5	33
				RLC	82.803	33.21354	49.589	33.303	132	0	4	0	136	105	0	3	0	109	303	0	6	0	309
				RMC	2.783	0	2.783	1.106	9	0	1	0	10	7	0	1	0	7	19	0	1	0	20
				RMod	1.408	0.1834787	1.224	0.771	4	0	0	0	4	3	0	0	0	3	8	0	0	0	8
				RULC	124.975	40.2805	84.695	65.372	224	0	0	0	224	179	0	0	0	179	515	0	0	0	515
				RULC-EH	84.669	14.56098	70.108	67.285	401	0	401	0	802	293	0	293	0	587	845	0	540	0	1385
			Sum		357.207	101.4067	255.801	189.055	787	0	631	33	1451	599	0	447	22	1068	1726	0	822	26	2574
		Sum			357.207	101.4067	255.801	189.055	787	0	631	33	1451	599	0	447	22	1068	1726	0	822	26	2574
		(4) REDEV		CC	88.4	5.571625	82.828	0	-44	0	1173	0	1129	-29	0	780	0	751	-84	0	1435	0	1351
				GC	59.275	17.40483	41.87	0	-11	0	361	111	461	-7	0	240	74	307	-21	0	442	87	507
				HC	8.928	0.0004935	8.928	0	-4	0	0	67	63	-3	0	0	45	42	-8	0	0	52	45
				NC	10.219	0	10.219	0	-9	0	164	0	155	-6	0	109	0	103	-17	0	201	0	183
				OTBD - 1	3.042	0.4043178	2.638	0	0	0	9	0	9	0	0	6	0	6	0	0	11	0	11
				OTBD - 2	2.545	0	2.545	0	0	0	7	0	7	0	0	5	0	5	0	0	9	0	9
				OTRD	6.793	0.4173012	6.376	0	55	0	0	0	55	40	0	0	0	40	116	0	0	0	116
				RHC	37.228	10.5127	26.716	0	22	2	280	98	402	15	1	186	65	267	42	3	343	77	465
				RLC	22.809	4.898424	17.91	0	46	0	0	0	46	37	0	0	0	37	106	0	0	0	106
Arlington UGA	CITY12	(4) REDEV		RMC	0.446	0	0.446	0	3	0	0	0	3	2	0	0	0	2	6	0	0	0	6
				RMod	12.1	4.57526	7.525	0	23	0	1	0	24	17	0	1	0	18	48	0	1	0	50
				RULC	9.235	4.473521	4.762	0	14	0	0	0	14	11	0	0	0	11	32	0	0	0	32
				RULC-EH	40.715	22.61496	18.1	0	102	0	106	0	208	75	0	78	0	152	215	0	143	0	358
			Sum		301.736	70.87343	230.862	0	197	2	2101	276	2576	151	1	1404	184	1740	435	3	2584	216	3238
			MARKET-READY	GC	6.6	0	6.6	0	-1	0	58	18	75	-1	0	55	17	71	-3	0	101	20	119
			Sum		6.6	0	6.6	0	-1	0	58	18	75	-1	0	55	17	71	-3	0	101	20	119
		Sum			308.336	70.87343	237.463	0	196	2	2159	294	2651	150	1	1459	201	1812	433	3	2685	236	3357
	Sum				1123.542	310.3721	813.17	189.055	1858	2	5978	1149	8987	1471	1	4802	1006	7279	4236	3	8835	1183	14257
Sum					1123.542	310.3721	813.17	189.055	1858	2	5978	1149	8987	1471	1	4802	1006	7279	4236	3	8835	1183	14257

Arlington UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Arlington UGA	CITY21	(1) PENDING		RHC	29.738	20.768	8.97	0	0	115	0	0	115	0	115	0	0	115	0	293	0	0	293
			Sum		29.738	20.768	8.97	0	0	115	0	0	115	0	115	0	0	115	0	293	0	0	293
		Sum			29.738	20.768	8.97	0	0	115	0	0	115	0	115	0	0	115	0	293	0	0	293
	Sum				29.738	20.768	8.97	0	0	115	0	0	115	0	115	0	0	115	0	293	0	0	293
Sum					29.738	20.768	8.97	0	0	115	0	0	115	0	115	0	0	115	0	293	0	0	293

Arlington UGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Arlington UGA	UNINC	(1) PENDING		ULDR	8.722	2.75271	5.97	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
			Sum		8.722	2.75271	5.97	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
		Sum			8.722	2.75271	5.97	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
		(2) VACANT		ULDR	18.896	18.7797	0.116	0	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
				ULDR-LA	6.63	0.0006209	6.63	0	19	0	19	0	38	16	0	16	0	31	45	0	29	0	73
			Sum		25.526	18.78032	6.746	0	21	0	19	0	40	17	0	16	0	33	50	0	29	0	78
		Sum			25.526	18.78032	6.746	0	21	0	19	0	40	17	0	16	0	33	50	0	29	0	78
		(3) PARTUSE		ULDR	38.787	7.359118	31.428	25.369	90	0	0	0	90	72	0	0	0	72	207	0	0	0	207
				ULDR-LA	66.019	17.38154	48.637	40.358	116	0	116	0	232	85	0	85	0	170	244	0	156	0	401
			Sum		104.806	24.74066	80.065	65.727	206	0	116	0	322	157	0	85	0	242	451	0	156	0	607
		Sum			104.806	24.74066	80.065	65.727	206	0	116	0	322	157	0	85	0	242	451	0	156	0	607
		(4) REDEV		ULDR	10.132	3.601146	6.531	0	21	0	0	0	21	17	0	0	0	17	48	0	0	0	48
				ULDR-LA	24.775	6.078349	18.696	0	49	0	54	0	103	36	0	40	0	75	103	0	73	0	176
			Sum		34.906	9.679494	25.227	0	70	0	54	0	124	53	0	40	0	92	151	0	73	0	224
		Sum			34.906	9.679494	25.227	0	70	0	54	0	124	53	0	40	0	92	151	0	73	0	224
	Sum				173.96	55.95319	118.007	65.727	307	0	189	0	496	236	0	140	0	376	681	0	257	0	938
Sum					173.96	55.95319	118.007	65.727	307	0	189	0	496	236	0	140	0	376	681	0	257	0	938

Figure Emp-A. Arlington UGA Employment

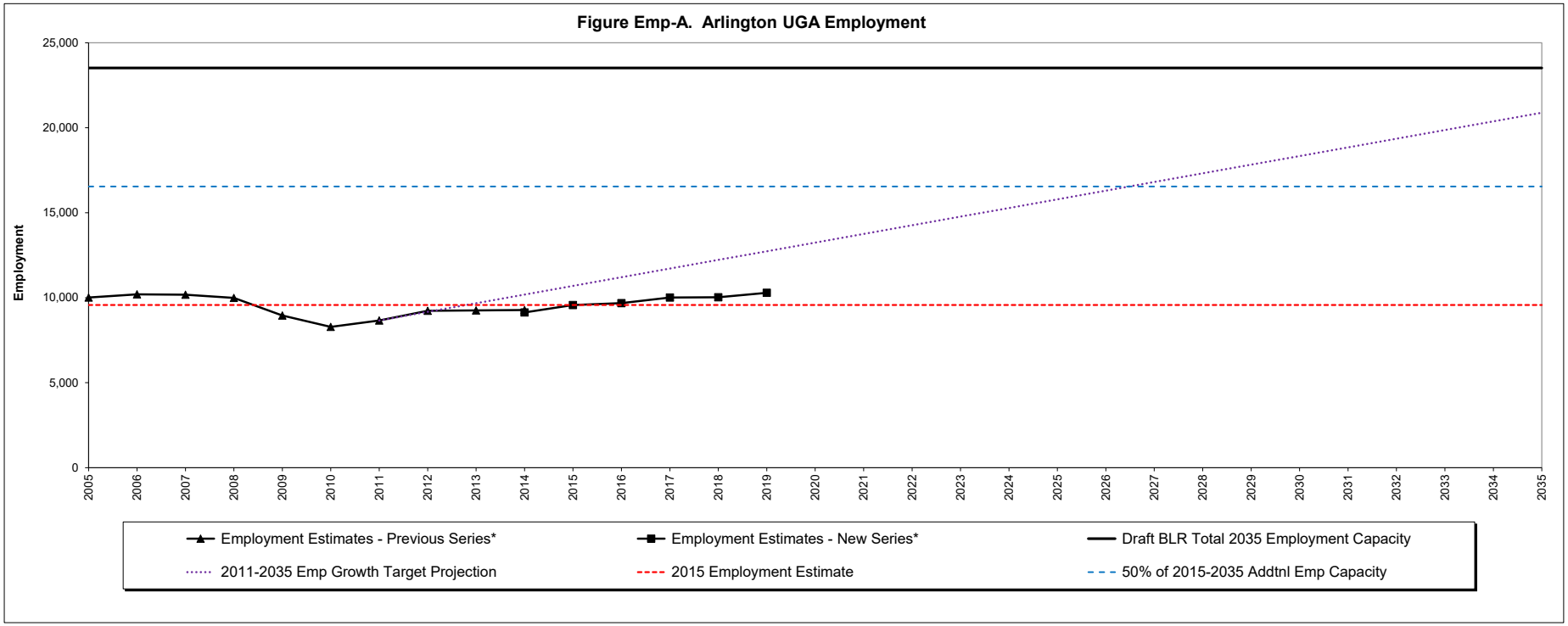


Table Emp-A. Arlington UGA Employment Statistics

	(A)	(B)									(C)	(D)	(E)	(F)		(G)	(H)	
	Employment Estimates																	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
Arlington UGA	8,285	8,660	9,230	9,255	9,279	9,135	9,573	9,684	10,014	10,031	10,289	1,629	20,884	12,224	13.3%	23,518	13,945	5.1%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Arlington UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2 Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Arlington UGA	CITY12	(1) PENDING		BP	17.163	0	17.163	0	0	401	0	401	0	401	0	401
				CC	15.216	0.1853373	15.031	0	107	0	5	112	107	0	5	112
				GC	23.152	0.4922451	22.66	0	184	0	0	184	184	0	0	184
				GI	266.446	17.70281	248.743	0	22	2027	783	2833	22	2027	783	2833
				HC	11.363	0	11.363	0	96	84	0	179	96	84	0	179
				HC-N	27.631	3.741033	23.89	0	30	0	0	30	30	0	0	30
				LI	167.423	41.24336	126.179	0	0	3175	0	3175	0	3175	0	3175
				NC	9.412	1.829444	7.582	0	14	0	0	14	14	0	0	14
				OTBD - 1	0.891	0	0.891	0	26	0	0	26	26	0	0	26
			Sum		538.697	65.19423	473.502	0	479	5687	789	6955	479	5687	789	6955
		Sum			538.697	65.19423	473.502	0	479	5687	789	6955	479	5687	789	6955

		(2) VACANT		CC	16.41	0.3695223	16.04	0	129	0	9	138	104	0	7	111
				GC	55.353	3.136949	52.216	0	627	0	0	627	506	0	0	506
				GI	24.792	1.071007	23.721	0	0	301	0	301	0	275	0	275
				HC	1.989	0.3844014	1.604	0	14	2	2	18	12	1	1	14
				HC-N	28.57	1.767489	26.803	0	72	0	0	72	58	0	0	58
				OTBD - 1	1.196	0.327513	0.869	0	17	0	13	30	14	0	10	24
				OTBD - 2	0.105	0	0.105	0	2	0	2	4	2	0	1	3
			Sum		128.414	7.056882	121.357	0	861	303	25	1189	695	276	20	992
			MARKET-READY	BP	48.997	0	48.997	0	196	441	0	637	186	419	0	605
				GC	21.532	2.34931	19.183	0	230	0	0	230	219	0	0	219
				GI	15.474	2.619837	12.855	0	0	90	0	90	0	85	0	85
				HC	1.056	0	1.056	0	10	1	1	12	9	1	1	11
				LI	1.026	0	1.026	0	0	11	0	11	0	10	0	10
			Sum		88.086	4.969147	83.116	0	436	543	1	979	414	515	1	930
		Sum			216.5	12.02603	204.473	0	1297	845	26	2168	1109	792	21	1922
Arlington UGA	CITY12	(3) PARTUSE		AF	137.235	0	137.235	59.099	80	554	0	634	53	368	0	422
				CC	35.611	9.829503	25.781	12.492	100	0	7	107	67	0	5	71
				GC	13.581	3.108723	10.472	2.329	28	0	0	28	19	0	0	19
				GI	33.117	3.724305	29.393	11.104	0	108	0	108	0	72	0	72
				HC	4.671	0.1513232	4.52	2.62	65	0	0	65	43	0	0	43
				HC-N	21.334	0.2743275	21.059	17.07	46	0	0	46	31	0	0	31
				LI	6.855	0.8400277	6.015	0.415	0	4	0	4	0	3	0	3
				OTBD - 2												

					0.449	0.0786997	0.37	0.269	5	0	4	9	3	0	3	6
			Sum		252.853	18.00691	234.846	105.398	325	666	11	1002	216	443	7	666
			MARKET-READY	BP	116.925	0	116.925	104.173	417	938	0	1354	396	891	0	1287
			Sum		116.925	0	116.925	104.173	417	938	0	1354	396	891	0	1287
		Sum			369.778	18.00691	351.771	209.571	742	1603	11	2356	612	1333	7	1953
		(4) REDEV		BP	11.558	1.209408	10.348	0	41	93	0	135	28	62	0	89
				CC	88.4	5.571625	82.828	0	615	0	45	661	409	0	30	439
				GC	59.275	17.40483	41.87	0	473	0	0	473	315	0	0	315
				GI	162.446	5.725083	156.721	0	0	675	0	675	0	449	0	449
				HC	8.928	0.0004935	8.928	0	70	9	7	86	46	6	5	57
				HC-N	16.348	0.205244	16.143	0	43	0	0	43	28	0	0	28
				LI	79.014	2.717517	76.296	0	0	777	0	777	0	517	0	517
				MS	1.995	0	1.995	0	110	0	0	110	73	0	0	73
				NC	10.219	0	10.219	0	51	0	0	51	34	0	0	34
				OTBD - 1	4.232	0.7168902	3.516	0	57	0	52	109	38	0	35	72
				OTBD - 2	5.544	0.1496264	5.395	0	94	0	76	170	62	0	51	113
				OTBD - 3	4.192	0.5151061	3.677	0	71	0	55	126	47	0	36	84
			Sum		452.151	34.21583	417.935	0	1625	1554	236	3415	1081	1033	157	2271
Arlington UGA	CITY12	(4) REDEV	MARKET-READY	GC	6.6	0	6.6	0	79	0	0	79	75	0	0	75
			Sum		6.6	0	6.6	0	79	0	0	79	75	0	0	75
		Sum			458.751	34.21583	424.535	0	1704	1554	236	3494	1156	1033	157	2346
	Sum				1583.725	129.443	1454.282	209.571	4222	9690	1061	14973	3356	8846	974	13176
Sum					1583.725	129.443	1454.282	209.571	4222	9690	1061	14973	3356	8846	974	13176

Arlington UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

N/A

Arlington UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Arlington UGA	UNINC	(2) VACANT		UI	3.533	0.0004184	3.533	0	26	11	0	37	21	9	0	30
			Sum		3.533	0.0004184	3.533	0	26	11	0	37	21	9	0	30
		Sum			3.533	0.0004184	3.533	0	26	11	0	37	21	9	0	30
		(3) PARTUSE		UI	2.32	0.3057993	2.014	0.609	5	2	0	6	3	1	0	4
			Sum		2.32	0.3057993	2.014	0.609	5	2	0	6	3	1	0	4
		Sum			2.32	0.3057993	2.014	0.609	5	2	0	6	3	1	0	4
		(4) REDEV		UI	3.171	0.4512004	2.72	0	20	8	0	29	13	6	0	19
			Sum		3.171	0.4512004	2.72	0	20	8	0	29	13	6	0	19
		Sum			3.171	0.4512004	2.72	0	20	8	0	29	13	6	0	19
	Sum				9.024	0.7574181	8.267	0.609	51	21	0	72	38	16	0	53
Sum					9.024	0.7574181	8.267	0.609	51	21	0	72	38	16	0	53

Arlington UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
RMC (4)											
	Single Family	No Development; New Zone				10.00	-	-	-	-	-
	Multi-Family					2.00					
	Total					**12.00**					
(4) The Residential Medium Capacity has an established minimum density of 12 dwelling units per acre.											
RHC (5)											
	Single Family	17.02	24%	108	1.55	1.55	-	-	-	-	-
	Townhouse	0.69	1%	12	0.17	0.17	-	-	-	-	-
	Multi-Family	39.93	57%	766	11.01	11.01	-	-	-	-	-
	Senior Apartments	11.95	17%	303	4.35	4.35					
	Total	**69.59**	**100%**	**1,189**	**17.08**	**17.08**	**-**	**-**	**-**	**-**	**-**
(5) The densities for the RHC zone are based on the R-HD zone it replaced. The RHC zone has an established minimum denisty of 17 dwelling units per acre.											
OTRD											
	Single Family	0.30	100%	4	13.21	13.21	-	-	-	-	-
NC											
	Mixed-Use	No Development				17.32 (6)	No Development				.86 (6)
	Non-Residential	3.09	100%	-	-	-	11,665	0.09	44	14.36	3.73
	Total	**3.09**	**100%**	**-**	**-**	**17.32 (6)**	**11,665**	**0.09**	**44**	**14.36**	**4.59 (6)**
(6) Post-2018 actual and proposed projects are averaged with the development history to arrive at an assumed residential and employment density for the NC zone. The assumed job sector breakdown is 3 Food Services, 1 FIRE, and 1 Retail.											
OTBD											
	Multi-Family	0.57	14%	17	4.11	4.11	-	-	-	-	-
	Non-Residential	3.57	86%	-	-	-	54,608	0.30	142	34.33	34.33
	Total	**4.14**	**100%**	**17**	**4.11**	**4.11**	**54,608**	**0.30**	**142**	**34.33**	**34.33**

Arlington UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Employment	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
GC											
	Mixed-Use	No Development				8.80 (7)	No Development				2.89(7)
	Senior apartments					2.82 (7)					
	Non-Residential	30.48	100%	-	-	-	249,064	0.19	509	16.69	9.56 (7)
	Total	**30.48**	**100%**	**-**	**-**	**11.62 (7)**	**249,064**	**0.19**	**509**	**16.69**	**12.45 (7)**
(7) Post-2018 actual and proposed projects are averaged with the development history to determine the assumed densities for the GC zone. The assumed job sector breakdown is 6 Retail, 3 Services, 2 Food Services, 1 FIRE.											
HC - North											
	Non-Residential	26.71	100%	-	-	-	50,407	0.04	72	2.70	2.70
HC - South (New Projects)											
	Mixed-Use	No Development				0.33 (8)	No Development				0.07 (8)
	Senior Apartment					7.85 (8)					-
	Non-Residential	40.97	100%	-	-	-	489,488	0.27	912	22.25	10.67 (8)
	Total	**40.97**	**100%**	**-**	**-**	**8.18 (8)**	**489,488**	**0.27**	**912**	**22.25**	**10.74 (8)**
(8) Post-2018 actual and proposed projects determine the assumed density for the HC zone. The assumed job sector breakdown is 6 Services, 1 FIRE, 1 Retail, 1 Food Services, 1 Government, 1 WTU.											
HC - South (Infill Projects)											
	Non-Residential	9.71	100%	-	-	-	97,983	0.23	242	24.93	24.93
CC											
	Multi-Family	No Development; New Zone				15.00 (9)	No Development; New Zone				-
	Non-Residential					-					8.58 (9)
	Total					**15.00 (9)**					**8.58 (9)**
(9) Residential and employment densities derived from 2017 code changes. The assumed job sector breakdown is 3 Retail, 2 Services, 2 Food Services, 1 FIRE, and 1 Government.											

Arlington UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
BP			No Development			-		No Development			13.00 (10)
(10) BP is a new zone created in tandem with an update to the airport area master plan. It allows for a range of typical industrial- and airport-related uses. The assumed job sector breakdown is 6 WTU, 4 Services, and 3 Manufacturing.											
LI											
	Non-Residential	14.91	100%	-	-	-	153,538	0.24	153.54	10.30	10.30
AF (11)											
	Non-Resdential	6.73	100%	-	-	-	89,904	0.31	72	10.73	10.73
(11) Aviation Flightline is a relatively new zone that relies on a sample from projects from a now obsolete zone called simply "Industrial" when the permits were issued. All of the projects modeled here are now zoned Aviation Flighline and are typical development type that would be expected in AF.											
GI (New Projects) (12)											
	Non-Residential	130.18	100%	-	-	-	848,719	0.15	1,413	10.85	7.21 (13)
(12) The General Industrial data includes a number of projects with Industrial zoning when the permits were issued. All of the projects modeled here are now zoned General Industrial and are typical development type that would be expected in GI.											
(13) Post-2018 actual and proposed projects are averaged with the development history to generate an assumed employment density. The assumed job sector breakdown is 6 Manufacturing, 1 WTU.											
GI (Infill Projects)											
	Non-Residential	270.53	100%	-	-	-	1,383,988	0.12	2,626	9.71	9.71

Arlington UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
MS (14)											
	Non-Residential	7.19	100%	-	-	-	158,353	0.51	396	55.04	55.04
(14) Medical Services is a relatively new zone that only applies to Cascade Valley Hospital (CVH) and surrounding parcels. The data here is a combination of past expansions at CVH and an estimate of a future expansion. The data also anticipates the redevelopment of an existing house on the CVH site.											
P/SP	Development Occurs on a Case-by-Case Basis					-	Development Occurs on a Case-by-Case Basis				-
Within Unincorporated Plan Designations											
Urban Low Density Residential											
	Single Family	87.62	100%	415	4.74	3.68 (14)	-	-	-	-	-
(14) The City of Arlington currently requires that unincorporated subdivisions conform to R-LMD standards in order to receive city utilities. This has not always been the case and the sample of unincorporated projects includes a mixture of projects that meet ULDR and R-LMD standards. Most of the uncorporated areas designated as ULDR are pre-zoned as R-LMD.											
Urban Medium Density Residential											
	Single Family	35.35	100%	244	6.90	Note (15)	-	-	-	-	-
(15) Very little unincorporated UMDR designated land remains in the Arlington UGA. The City has pre-zoned the UMDR areas as R-HD, a zone that is modeled to produce 18.56 units/acre (see R-HD for more).											
Urban Industrial											
	Non-Residential	8.85	100%	-	-	-	107,460	0.28	93	10.54	10.54

Figure Pop-B. Darrington UGA Population

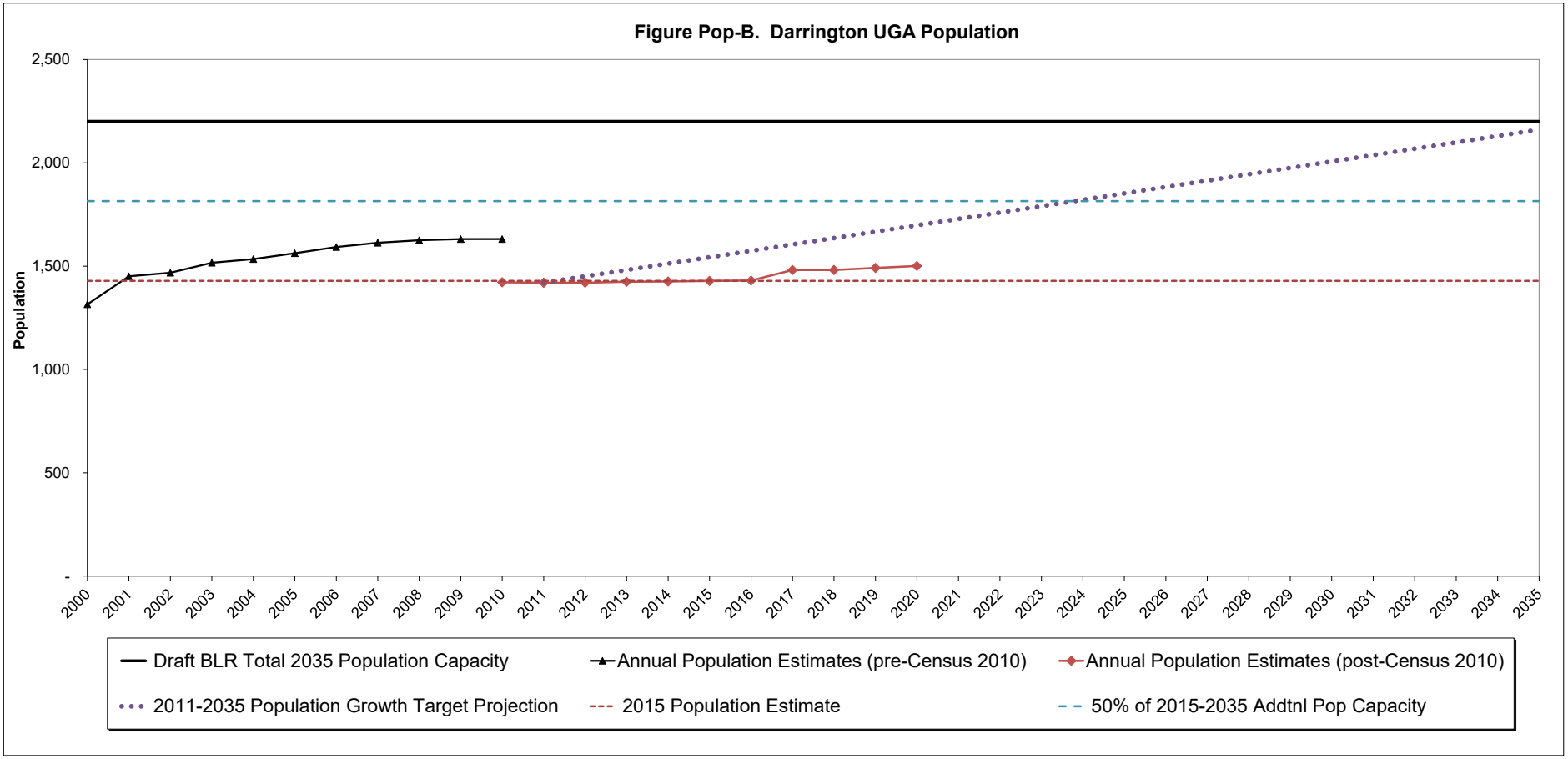


Table Pop-B. Darrington UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B)	= (C-B)/(H)*100
1,315	1,631	1,422	-209	-12.8%	1,420	1,420	1,425	1,426	1,429	1,431	1,481	1,481	1,491	1,501	81	2,161	741	10.9%	2,201	772	9.3%

Population

Darrington UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Darrington UGA	CITY12	(1) PENDING		RSF	10.168	3.205076	6.962	.000	12	0	0	0	12	12	0	0	0	12	35	0	0	0	35
			Sum		10.168	3.205076	6.962	.000	12	0	0	0	12	12	0	0	0	12	35	0	0	0	35
		Sum			10.168	3.205076	6.962	.000	12	0	0	0	12	12	0	0	0	12	35	0	0	0	35
		(2) VACANT		RSF	37.829	9.162339	28.667	.000	78	0	0	0	78	65	0	0	0	65	188	0	0	0	188
			Sum		37.829	9.162339	28.667	.000	78	0	0	0	78	65	0	0	0	65	188	0	0	0	188
		Sum			37.829	9.162339	28.667	.000	78	0	0	0	78	65	0	0	0	65	188	0	0	0	188
		(3) PARTUSE		RSF	42.993	6.941483	36.051	24.164	57	0	0	0	57	45	0	0	0	45	131	0	0	0	131
			Sum		42.993	6.941483	36.051	24.164	57	0	0	0	57	45	0	0	0	45	131	0	0	0	131
		Sum			42.993	6.941483	36.051	24.164	57	0	0	0	57	45	0	0	0	45	131	0	0	0	131
		(4) REDEV		RSF	2.940	.0000000	2.940	.000	3	0	0	0	3	2	0	0	0	2	7	0	0	0	7
			Sum		2.940	.0000000	2.940	.000	3	0	0	0	3	2	0	0	0	2	7	0	0	0	7
		Sum			2.940	.0000000	2.940	.000	3	0	0	0	3	2	0	0	0	2	7	0	0	0	7
	Sum				93.930	19.30890	74.621	24.164	150	0	0	0	150	125	0	0	0	125	360	0	0	0	360
Sum					93.930	19.30890	74.621	24.164	150	0	0	0	150	125	0	0	0	125	360	0	0	0	360

Darrington UGA - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Darrington UGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Darrington UGA	UNINC	(2) VACANT		ULDR3	15.047	14.26721	.779	.000	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
			Sum		15.047	14.26721	.779	.000	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
		Sum			15.047	14.26721	.779	.000	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
		(3) PARTUSE		ULDR3	54.653	17.34667	37.307	29.409	76	0	0	0	76	61	0	0	0	61	175	0	0	0	175
			Sum		54.653	17.34667	37.307	29.409	76	0	0	0	76	61	0	0	0	61	175	0	0	0	175
		Sum			54.653	17.34667	37.307	29.409	76	0	0	0	76	61	0	0	0	61	175	0	0	0	175
		(4) REDEV		ULDR3	34.368	5.197103	29.171	.000	73	0	0	0	73	58	0	0	0	58	168	0	0	0	168
			Sum		34.368	5.197103	29.171	.000	73	0	0	0	73	58	0	0	0	58	168	0	0	0	168
		Sum			34.368	5.197103	29.171	.000	73	0	0	0	73	58	0	0	0	58	168	0	0	0	168
	Sum				104.068	36.81099	67.257	29.409	152	0	0	0	152	121	0	0	0	121	350	0	0	0	350
Sum					104.068	36.81099	67.257	29.409	152	0	0	0	152	121	0	0	0	121	350	0	0	0	350

Figure Emp-B. Darrington UGA Employment

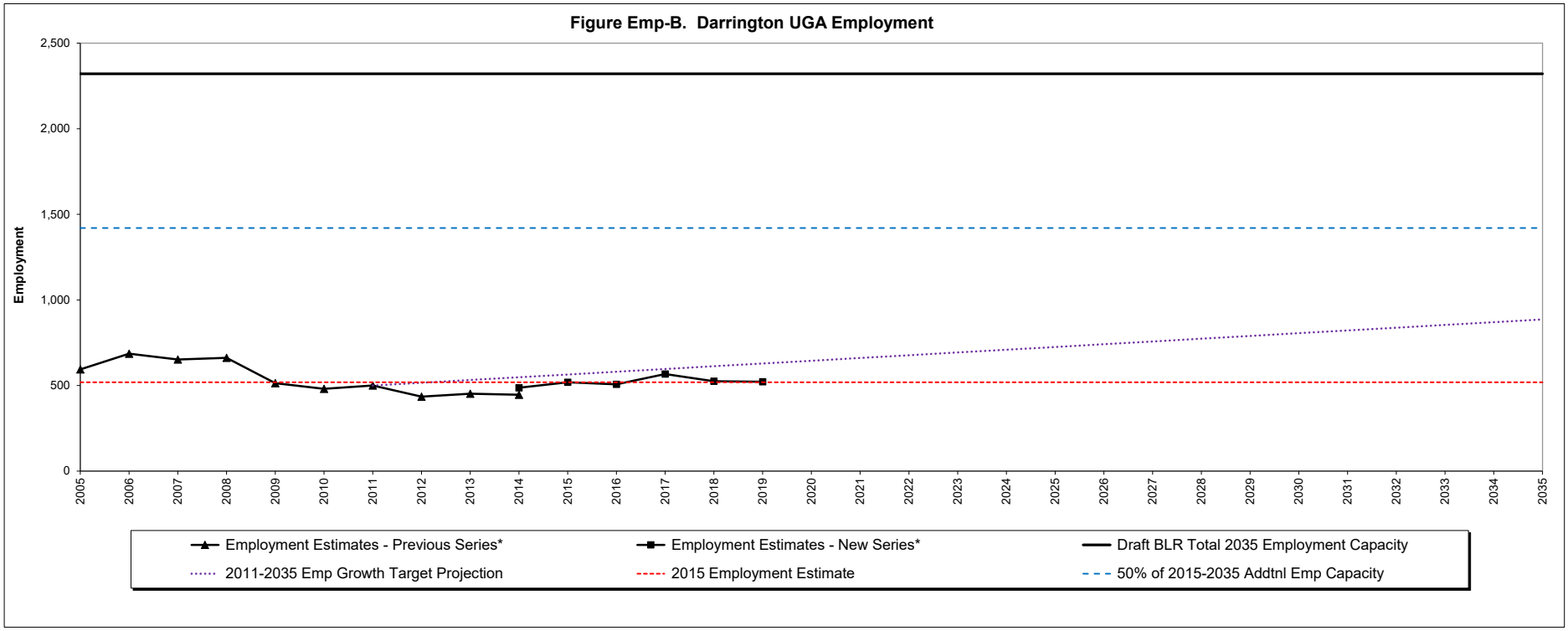


Table Emp-B. Darrington UGA Employment Statistics

	(A)				(B)						(C)	(D)	(E)	(F)		(G)	(H)	
	Employment Estimates																	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
Darrington UGA	481	500	435	452	446	487	519	507	567	525	522	22	886	386	5.7%	2,321	1,802	0.2%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Darrington UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Darrington UGA	CITY12	(2) VACANT		C	9.651	.0000000	9.651	.000	28	84	0	112	23	68	0	90
				LI	289.977	68.51752	221.460	.000	51	1307	0	1358	41	1055	0	1096
			Sum		299.628	68.51752	231.110	.000	79	1391	0	1470	64	1123	0	1187
		Sum			299.628	68.51752	231.110	.000	79	1391	0	1470	64	1123	0	1187
		(3) PARTUSE		C	16.038	.2510710	15.786	7.114	89	0	0	89	59	0	0	59
				LI	96.758	53.73929	43.019	9.267	2	55	0	57	1	36	0	38
			Sum		112.796	53.99037	58.805	16.381	91	55	0	146	61	36	0	97
		Sum			112.796	53.99037	58.805	16.381	91	55	0	146	61	36	0	97
		(4) REDEV		C	3.180	.0000000	3.180	.000	7	28	0	35	5	18	0	23
				LI	17.610	1.539667	16.070	.000	4	95	0	99	2	63	0	66
			Sum		20.790	1.539667	19.250	.000	11	123	0	133	7	81	0	89
		Sum			20.790	1.539667	19.250	.000	11	123	0	133	7	81	0	89
	Sum				433.214	124.0476	309.166	16.381	181	1568	0	1749	131	1241	0	1372
Sum					433.214	124.0476	309.166	16.381	181	1568	0	1749	131	1241	0	1372

Darrington UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Darrington UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Darrington UGA	UNINC	(1) PENDING		UI	66.134	12.02180	54.112	.000	0	150	0	150	0	150	0	150
			Sum		66.134	12.02180	54.112	.000	0	150	0	150	0	150	0	150
		Sum			66.134	12.02180	54.112	.000	0	150	0	150	0	150	0	150
		(2) VACANT		UI	90.917	42.46788	48.449	.000	11	286	0	297	9	231	0	240
			Sum		90.917	42.46788	48.449	.000	11	286	0	297	9	231	0	240
		Sum			90.917	42.46788	48.449	.000	11	286	0	297	9	231	0	240
		(3) PARTUSE		UI	19.060	10.93853	8.121	7.333	2	43	0	45	1	29	0	30
			Sum		19.060	10.93853	8.121	7.333	2	43	0	45	1	29	0	30
		Sum			19.060	10.93853	8.121	7.333	2	43	0	45	1	29	0	30
		(4) REDEV		UI	1.852	.0000000	1.852	.000	0	11	0	11	0	7	0	8
			Sum		1.852	.0000000	1.852	.000	0	11	0	11	0	7	0	8
		Sum			1.852	.0000000	1.852	.000	0	11	0	11	0	7	0	8
	Sum				177.962	65.42821	112.534	7.333	13	490	0	503	10	417	0	427
Sum					177.962	65.42821	112.534	7.333	13	490	0	503	10	417	0	427

Darrington UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Within Town Zones (and assumed for *County Plan Designations*)											
SFR *(ULDR-3)*											
	Single Family	4.37	100%	12	2.75	2.75	-	-	-	-	-
Commercial (New Projects)											
	Non-Residential	9.09	100%	-	-	-	60,690	0.15	106	11.61	11.61
Commercial (Infill Projects)											
	Non-Residential	2.03	100%	-	-	-	16,154	0.18	25	12.54	12.54
Industrial *(LI)*											
	Non-Residential	109.06	100%	-	-	-	335,139	0.07	669	6.13	6.13

Figure Pop-C. Gold Bar UGA Population

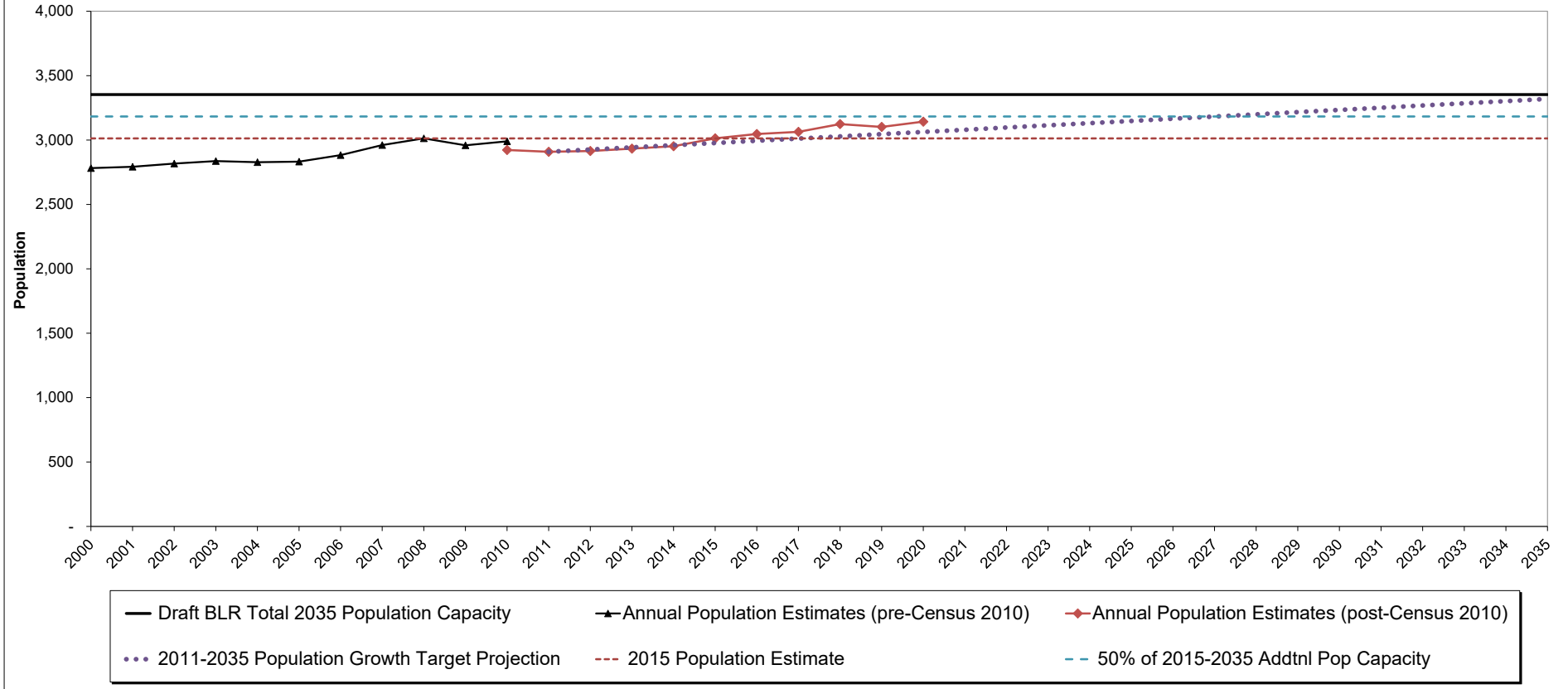


Table Pop-C. Gold Bar UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B	= (C-B)/(H)*100
2,782	2,990	2,923	-67	-2.3%	2,909	2,915	2,933	2,952	3,013	3,047	3,064	3,124	3,101	3,143	234	3,319	411	57.0%	3,353	340	38.3%

Population

Gold Bar UGA - Additional Population Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Gold Bar UGA	CITY12	(1) PENDING		GC	1.803	.0000000	1.803	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				R9600	.739	.0000000	.739	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
			Sum		2.543	.0000000	2.543	.000	2	0	0	0	2	2	0	0	0	2	6	0	0	0	6
		Sum			2.543	.0000000	2.543	.000	2	0	0	0	2	2	0	0	0	2	6	0	0	0	6
		(2) VACANT		R12500	45.984	30.99942	14.984	.000	39	0	0	0	39	33	0	0	0	33	94	0	0	0	94
				R9600	1.068	.3009605	.767	.000	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
			Sum		47.051	31.30038	15.751	.000	42	0	0	0	42	35	0	0	0	35	101	0	0	0	101
			MARKET-READY	R12500	.301	.3014580	.000	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
			Sum		.301	.3014580	.000	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
		Sum			47.353	31.60184	15.751	.000	43	0	0	0	43	36	0	0	0	36	104	0	0	0	104
		(3) PARTUSE		R12500	26.530	17.55853	8.972	5.714	12	0	0	0	12	10	0	0	0	10	28	0	0	0	28
			Sum		26.530	17.55853	8.972	5.714	12	0	0	0	12	10	0	0	0	10	28	0	0	0	28
		Sum			26.530	17.55853	8.972	5.714	12	0	0	0	12	10	0	0	0	10	28	0	0	0	28
		(4) REDEV		R12500	14.243	9.379931	4.863	.000	9	0	0	0	9	7	0	0	0	7	21	0	0	0	21
				R7200	3.577	.0309202	3.546	.000	7	0	0	0	7	6	0	0	0	6	16	0	0	0	16
				R9600	10.972	5.920500	5.052	.000	11	0	0	0	11	9	0	0	0	9	25	0	0	0	25
			Sum		28.793	15.33135	13.462	.000	27	0	0	0	27	22	0	0	0	22	62	0	0	0	62
		Sum			28.793	15.33135	13.462	.000	27	0	0	0	27	22	0	0	0	22	62	0	0	0	62
	Sum				105.218	64.49171	40.727	5.714	84	0	0	0	84	69	0	0	0	69	199	0	0	0	199
Sum					105.218	64.49171	40.727	5.714	84	0	0	0	84	69	0	0	0	69	199	0	0	0	199

Gold Bar UGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Gold Bar UGA - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Gold Bar UGA	UNINC	(2) VACANT		ULDR3	6.936	4.444104	2.492	.000	22	0	0	0	22	18	0	0	0	18	53	0	0	0	53
			Sum		6.936	4.444104	2.492	.000	22	0	0	0	22	18	0	0	0	18	53	0	0	0	53
		Sum			6.936	4.444104	2.492	.000	22	0	0	0	22	18	0	0	0	18	53	0	0	0	53
	Sum				6.936	4.444104	2.492	.000	22	0	0	0	22	18	0	0	0	18	53	0	0	0	53
Sum					6.936	4.444104	2.492	.000	22	0	0	0	22	18	0	0	0	18	53	0	0	0	53

Figure Emp-C. Gold Bar UGA Employment

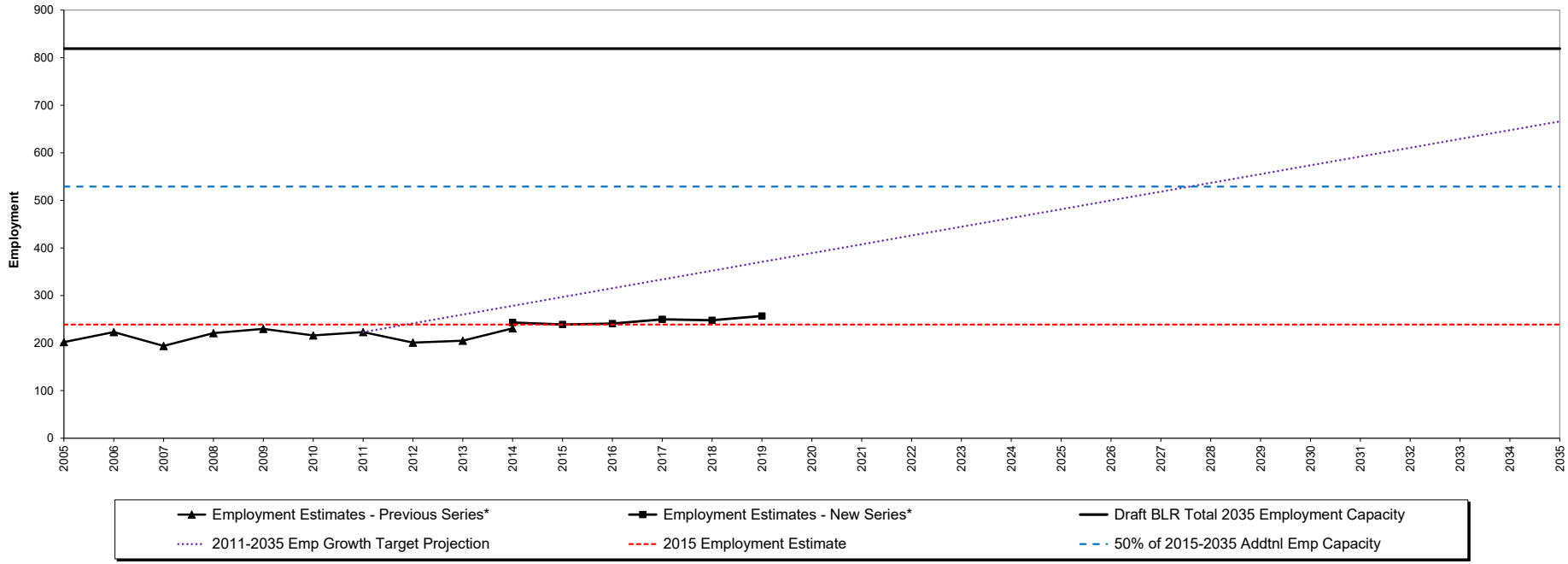


Table Emp-C. Gold Bar UGA Employment Statistics

	(A)				(B)						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
	Employment Estimates											2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019							
Gold Bar UGA	216	223	201	205	231	243	239	241	250	248	257	34	666	443	7.7%	819	580	3.1%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Gold Bar UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Gold Bar UGA	CITY12	(2) VACANT		CB	.642	.0000000	.642	.000	9	0	0	9	8	0	0	8
				GC	19.405	7.287733	12.117	.000	182	0	0	182	147	0	0	147
			Sum		20.047	7.287733	12.759	.000	191	0	0	191	154	0	0	154
		Sum			20.047	7.287733	12.759	.000	191	0	0	191	154	0	0	154
		(3) PARTUSE		CB	.490	.0000000	.490	.111	2	0	0	2	1	0	0	1
				GC	8.846	.0000000	8.846	5.986	90	0	0	90	60	0	0	60
			Sum		9.336	.0000000	9.336	6.097	91	0	0	91	61	0	0	61
		Sum			9.336	.0000000	9.336	6.097	91	0	0	91	61	0	0	61
		(4) REDEV		CB	31.173	16.29650	14.877	.000	217	0	0	217	144	0	0	144
				GC	27.895	7.446260	20.449	.000	295	0	0	295	196	0	0	196
			Sum		59.068	23.74277	35.326	.000	512	0	0	512	340	0	0	340
			MARKET-READY	CB	.657	.0000000	.657	.000	7	0	0	7	6	0	0	6
			Sum		.657	.0000000	.657	.000	7	0	0	7	6	0	0	6
		Sum			59.725	23.74277	35.983	.000	518	0	0	518	347	0	0	347

Sum	89.108	31.03050	58.078	6.097	801	0	0	801	562	0	0	562
Sum	89.108	31.03050	58.078	6.097	801	0	0	801	562	0	0	562

Gold Bar UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Gold Bar UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

N/A

Gold Bar UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Within City Zones (and as modeled for County Designations)											
R 12500 (and ULDR-3)											
	Single Family	84.76	100%	221	2.61	2.61	-	-	-	-	-
R 9600											
	Single Family	4.82	100%	16	3.32	3.32	-	-	-	-	-
R 7200											
	Single Family		No Data			3.32	-	-	-	-	-
CB											
	Non-Residential	2.99	100%	-	-	-	25,299	0.19	44	14.62	14.62
GC											
	Non-Residential	5.50	100%	-	-	-	53,200	0.22	53	9.68	15.00 (1)

(1) The sample for GC is limited to one project, Arctic Refrigeration, that is a low-employment-density wholesale distributor. It is likely that future retail, service, and restaurant development in GC will provide higher densities per acre. For modeling purposes, the assumed employment density by job sector in GC is: 6 Retail, 6 Services, 2 Food Services, and 1 FIRE.

Figure Pop-D. Granite Falls UGA Population

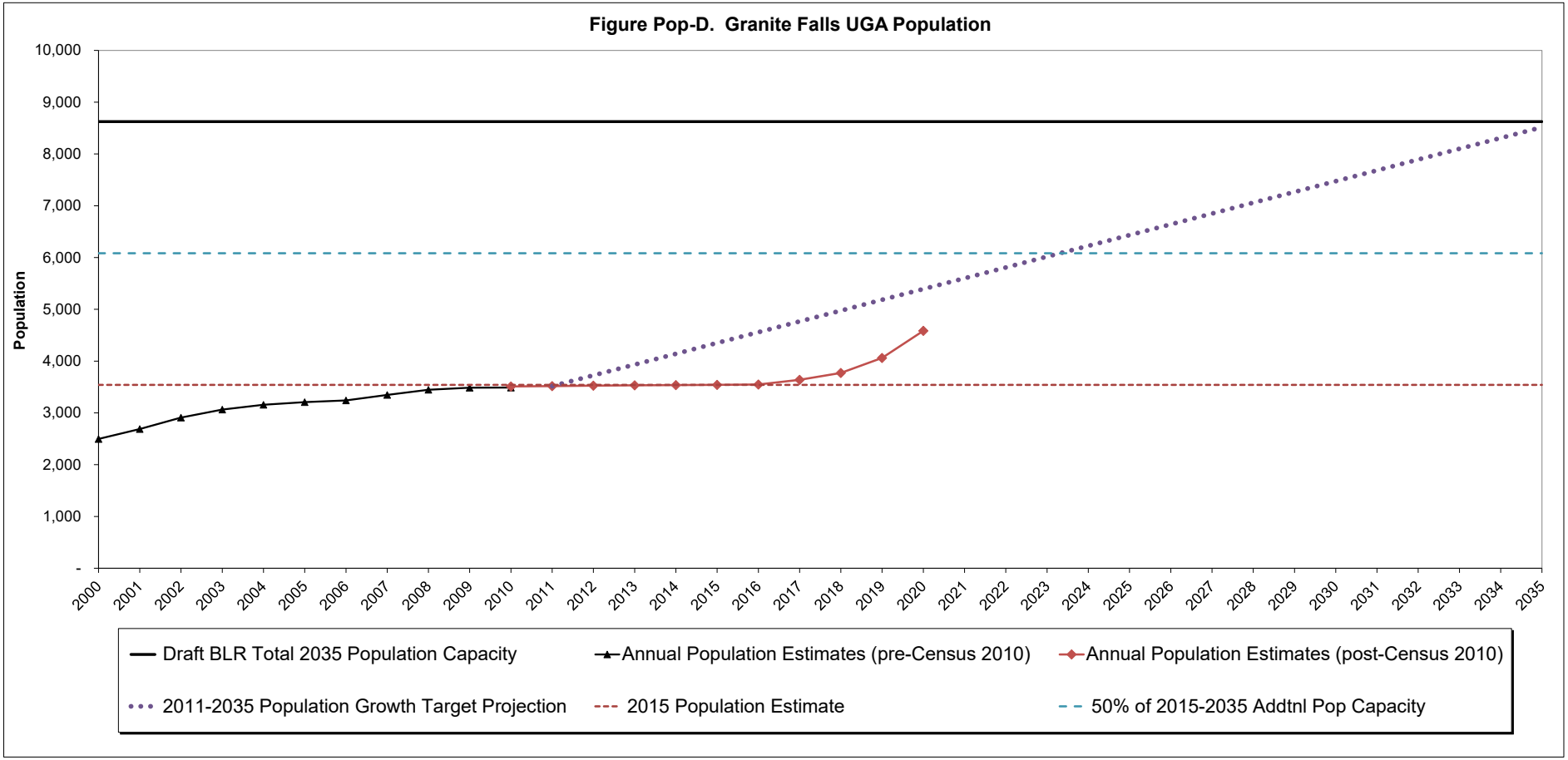


Table Pop-D. Granite Falls UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B	= (C-B)/(H)*100
2,497	3,489	3,511	22	0.6%	3,517	3,527	3,532	3,538	3,541	3,548	3,639	3,772	4,060	4,585	1,068	8,517	5,000	21.4%	8,625	5,084	20.5%

Granite Falls UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Granite Falls UGA	CITY12	(1) PENDING		MEDIUM DENSITY RESIDENTIAL	65.984	15.61556	50.369	0	283	0	0	0	283	283	0	0	0	283	815	0	0	0	815
				MULTIPLE RESIDENTIAL	11.728	0	11.728	0	76	96	0	0	172	76	96	0	0	172	219	244	0	0	463
			Sum		77.713	15.61556	62.097	0	359	96	0	0	455	359	96	0	0	455	1034	244	0	0	1278
		Sum			77.713	15.61556	62.097	0	359	96	0	0	455	359	96	0	0	455	1034	244	0	0	1278
		(2) VACANT		CENTRAL BUSINESS DISTRICT	1.057	0.3441957	0.712	0	4	0	0	0	4	3	0	0	0	3	9	0	0	0	9
				DOWNTOWN RESIDENTIAL	2.384	1.076404	1.308	0	1	0	8	0	9	1	0	7	0	7	2	0	12	0	14
				GENERAL COMMERCIAL	11.286	2.550725	8.735	0	0	0	25	0	25	0	0	20	0	20	0	0	37	0	37
				LOW DENSITY RESIDENTIAL	151.089	72.17903	78.91	0	294	0	0	0	294	246	0	0	0	246	708	0	0	0	708
				MEDIUM DENSITY RESIDENTIAL	63.176	48.02146	15.155	0	65	0	0	0	65	54	0	0	0	54	156	0	0	0	156
				MULTIPLE RESIDENTIAL	26.648	16.96432	9.684	0	0	0	193	39	232	0	0	156	31	187	0	0	287	37	324
			Sum		255.64	141.1361	114.504	0	364	0	226	39	629	304	0	183	31	518	876	0	336	37	1249
			MARKET-READ	CENTRAL BUSINESS DISTRICT	6.207	5.761749	0.445	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				GENERAL	3.248	0.1515043	3.096	0	0	0	9	0	9	0	0	9	0	9	0	0	16	0	16

				COMMERCIAL																		
			Sum		9.454	5.913253	3.541	0	1	0	9	0	10	1	0	9	0	10	3	0	16	0	18
		Sum			265.095	147.0494	118.045	0	365	0	235	39	639	305	0	191	31	528	879	0	352	37	1267
Granite Falls UGA	CITY12	(3) PARTUSE		DOWNTOWN RESIDENTIAL	5.38	0.0659742	5.314	3.83	0	0	26	0	26	0	0	19	0	19	0	0	35	0	35
				LOW DENSITY RESIDENTIAL	27.579	21.5645	6.014	4.319	16	0	0	0	16	13	0	0	0	13	37	0	0	0	37
				MEDIUM DENSITY RESIDENTIAL	40.222	0.5158967	39.706	33.068	144	0	0	0	144	115	0	0	0	115	331	0	0	0	331
				MULTIPLE RESIDENTIAL	24.588	13.629	10.959	9.449	0	0	189	41	230	0	0	126	27	153	0	0	231	32	263
			Sum		97.769	35.77537	61.994	50.666	160	0	215	41	416	128	0	145	27	300	368	0	266	32	666
		Sum			97.769	35.77537	61.994	50.666	160	0	215	41	416	128	0	145	27	300	368	0	266	32	666
		(4) REDEV		CENTRAL BUSINESS DISTRICT	10.168	0.4975665	9.671	0	-1	0	14	0	13	-1	0	9	0	9	-2	0	17	0	15
				DOWNTOWN RESIDENTIAL	15.277	8.640962	6.636	0	-4	0	44	0	40	-3	0	32	0	29	-8	0	59	0	51
				GENERAL COMMERCIAL	7.158	1.416133	5.742	0	-3	0	12	0	9	-2	0	8	0	6	-6	0	15	0	9
				MEDIUM DENSITY RESIDENTIAL	14.873	2.291978	12.581	0	51	0	0	0	51	41	0	0	0	41	117	0	0	0	117
				MULTIPLE RESIDENTIAL	41.345	18.54191	22.803	0	-44	0	452	92	500	-29	0	301	61	333	-84	0	553	72	541
			Sum		88.82	31.38855	57.432	0	-1	0	522	92	613	6	0	350	61	417	17	0	644	72	733
		Sum			88.82	31.38855	57.432	0	-1	0	522	92	613	6	0	350	61	417	17	0	644	72	733
	Sum				529.397	229.8289	299.568	50.666	883	96	972	172	2123	798	96	686	120	1699	2297	244	1262	141	3945
Sum					529.397	229.8289	299.568	50.666	883	96	972	172	2123	798	96	686	120	1699	2297	244	1262	141	3945

Granite Falls UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Granite Falls UGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Granite Falls UGA	UNINC	(1) PENDING		ULDR	0.935	0.408084	0.527	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
			Sum		0.935	0.408084	0.527	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
		Sum			0.935	0.408084	0.527	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
Granite Falls UGA	UNINC	(2) VACANT		ULDR	62.182	40.3227	21.859	0	84	0	0	0	84	70	0	0	0	70	202	0	0	0	202
			Sum		62.182	40.3227	21.859	0	84	0	0	0	84	70	0	0	0	70	202	0	0	0	202

	Sum		62.182	40.3227	21.859	0	84	0	0	0	84	70	0	0	0	70	202	0	0	0	202
	(3) PARTUSE	ULDR	48.225	13.18989	35.035	25.78	91	0	0	0	91	73	0	0	0	73	209	0	0	0	209
		UMDR	0.926	0	0.926	0.669	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
		Sum	49.151	13.18989	35.961	26.449	93	0	0	0	93	74	0	0	0	74	214	0	0	0	214
	Sum		49.151	13.18989	35.961	26.449	93	0	0	0	93	74	0	0	0	74	214	0	0	0	214
	(4) REDEV	ULDR	38.349	14.13793	24.211	0	78	0	0	0	78	62	0	0	0	62	179	0	0	0	179
		Sum	38.349	14.13793	24.211	0	78	0	0	0	78	62	0	0	0	62	179	0	0	0	179
		MARKET-REAL UMDR	2.509	0	2.509	0	8	0	0	0	8	8	0	0	0	8	22	0	0	0	22
		Sum	2.509	0	2.509	0	8	0	0	0	8	8	0	0	0	8	22	0	0	0	22
	Sum		40.857	14.13793	26.719	0	86	0	0	0	86	70	0	0	0	70	201	0	0	0	201
Sum			153.125	68.0586	85.066	26.449	264	0	0	0	264	215	0	0	0	215	620	0	0	0	620
Sum			153.125	68.0586	85.066	26.449	264	0	0	0	264	215	0	0	0	215	620	0	0	0	620

Figure Emp-D. Granite Falls UGA Employment

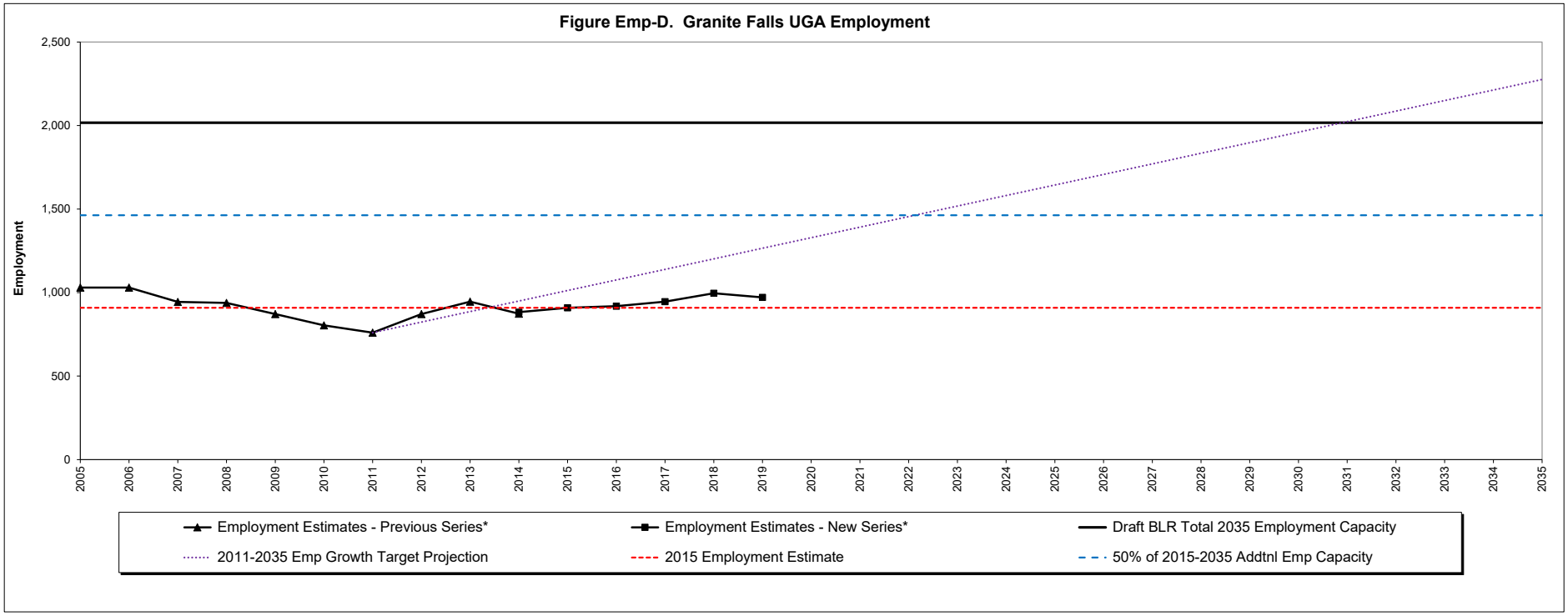


Table Emp-D. Granite Falls UGA Employment Statistics

	(A)				(B)						(C)	(D)	(E)	(F)		(G)	(H)	
	Employment Estimates																	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
Granite Falls UGA	804	760	871	946	874	883	909	919	946	996	971	211	2,276	1,516	13.9%	2,017	1,108	5.6%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Granite Falls UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Granite Falls UGA	CITY12	(1) PENDING		CENTRAL BUSINESS DISTRICT	6.359	.5212177	5.838	.000	23	0	0	23	23	0	0	23
			Sum		6.359	.5212177	5.838	.000	23	0	0	23	23	0	0	23
		Sum			6.359	.5212177	5.838	.000	23	0	0	23	23	0	0	23
		(2) VACANT		CENTRAL BUSINESS DISTRICT	1.057	.3441957	.712	.000	16	0	0	16	13	0	0	13
				GENERAL COMMERCIAL	11.286	2.550725	8.735	.000	157	0	0	157	127	0	0	127
				INDUSTRIAL	18.648	4.312399	14.335	.000	14	100	0	115	12	81	0	93
				LIGHT INDUSTRIAL	4.920	4.900969	.019	.000	0	0	0	0	0	0	0	0
			Sum		35.910	12.10829	23.802	.000	188	100	0	288	152	81	0	233
			MARKET-READY	CENTRAL BUSINESS DISTRICT	6.207	5.761749	.445	.000	10	0	0	10	10	0	0	10
				GENERAL COMMERCIAL	3.248	.1515043	3.096	.000	56	0	0	56	53	0	0	53
			Sum		9.454	5.913253	3.541	.000	66	0	0	66	63	0	0	63
		Sum			45.364	18.02154	27.343	.000	254	100	0	354	214	81	0	295
		(3) PARTUSE		CENTRAL												

				BUSINESS DISTRICT	.837	.0000000	.837	.303	3	0	0	3	2	0	0	2
				GENERAL COMMERCIAL	6.067	2.009004	4.058	2.134	43	0	0	43	28	0	0	28
				INDUSTRIAL	58.268	21.40474	36.864	30.122	30	211	0	241	20	140	0	160
				INDUSTRIAL/RETAIL	2.073	.7961886	1.277	.791	3	5	0	8	2	3	0	5
				LIGHT INDUSTRIAL	14.763	2.042307	12.721	9.718	8	28	0	36	5	18	0	24
			Sum		82.008	26.25224	55.756	43.067	87	243	0	331	58	162	0	220
		Sum			82.008	26.25224	55.756	43.067	87	243	0	331	58	162	0	220
		(4) REDEV		CENTRAL BUSINESS DISTRICT	24.663	.7048667	23.958	.000	474	0	0	474	315	0	0	315
				GENERAL COMMERCIAL	9.672	1.891808	7.780	.000	134	0	0	134	89	0	0	89
				INDUSTRIAL	30.153	21.15749	8.996	.000	1	63	0	64	1	42	0	43
				INDUSTRIAL/RETAIL	4.505	.0000000	4.505	.000	18	27	0	45	12	18	0	30
				LIGHT INDUSTRIAL	10.939	.0007158	10.939	.000	9	31	0	40	6	21	0	27
			Sum		79.932	23.75489	56.177	.000	636	121	0	757	423	81	0	503
			MARKET-READY	CENTRAL BUSINESS DISTRICT	.124	.0000000	.124	.000	2	0	0	2	2	0	0	2
			Sum		.124	.0000000	.124	.000	2	0	0	2	2	0	0	2
		Sum			80.056	23.75489	56.301	.000	638	121	0	759	424	81	0	505
	Sum				213.788	68.54988	145.238	43.067	1001	465	0	1466	720	323	0	1043
Sum					213.788	68.54988	145.238	43.067	1001	465	0	1466	720	323	0	1043

Granite Falls UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Granite Falls UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2

Granite Falls UGA	UNINC	(4) REDEV	UI	2.769	2.156527	.612	.000	1	4	0	5	0	3	0	3
		Sum		2.769	2.156527	.612	.000	1	4	0	5	0	3	0	3
	Sum			2.769	2.156527	.612	.000	1	4	0	5	0	3	0	3
Sum				2.769	2.156527	.612	.000	1	4	0	5	0	3	0	3

Granite Falls UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Within City Zones											
Rural 2.3 acre											
	Single Family		No Data			0.43		No Data			-
R-9600											
	Single Family	83.32	100%	311	3.73	3.73	-	-	-	-	-
R-7200											
	Single Family	27.37	100%	105	3.84	4.43 (1)	-	-	-	-	-
(1) Post-2018 actual and proposed projects are averaged with the development history to determine an assumed residential density.											
DT-2500											
	Multi-Family	0.79	100%	6	7.56	7.56	-	-	-	-	-
MR											
	Multi-Family	2.71	86%	64	20.24	20.24	-	-	-	-	-
	Senior Apartments	0.45	14%	14	4.43	4.43	-	-	-	-	-
	Total	**3.16**	**100%**	**78**	**24.67**	**24.67**	**-**	**-**	**-**	**-**	**-**
CBD (New Projects)											
	Multi-Family	0.59	14%	7	1.70	1.70	-	-	-	-	-
	Non-Residential	3.53	86%	-	-	-	32,960	0.18	94	22.76	22.76
	Total	**4.12**	**100%**	**7**	**1.70**	**1.70**	**32,960**	**0.18**	**94**	**22.76**	**22.76**
CBD (Infill Projects)											
	Non-Residential	10.88	100%	-	-	-	57,783	0.12	117	10.74	10.74

Granite Falls UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
GC (New Projects)											
	Multi-Family	2.52	36%	32	4.55	3.00 (2)	-	-	-	-	-
	Senior Apartments	1.68	24%	45	6.40	-	-	-	-	-	-
	Non-Residential	2.84	40%	-	-	-	7,000	0.02	36	5.08	18.00 (2)
	Total	**7.04**	**100%**	**77**	**10.95**	**3.00 (2)**	**7,000**	**0.02**	**36**	**5.08**	**18.00 (2)**
(2) GC has had a disproportionate share of residential development on sites lacking a high degree of commercial visibility. The remaining developable sites have better access and higher traffic counts; therefore, the City expects most of the future development in GC to be commercial in nature. The expected distribution of jobs by sector in GC is: 7 Retail, 7 Services, 3 Food Services, and 1 FIRE.											
GC (Infill Projects)											
	Non-Residential		No Data			0.00 (3)		No Data			20.00 (3)
(3) There have not been any examples of commercial infill in GC yet; however, the expectation is that any new buildings or additions will be entirely commercial. The expected distribution of jobs by sector for GC infill projects is: 8 Retail, 8 Services, 3 Food Services, and 1 FIRE.											
HI	Non-Residential		No Data			-		No Data			8.00 (4)
(4) There has been no development in Industrial yet. The expected distribution of jobs by sector is: 4 Manufacturing, 3 WTU, and 1 Services.											
IR	Non-Residential		No Data			-		No Data			10.00 (5)
(5) There has been no development in Industrial/Retail yet. The expected distribution of jobs by sector is: 3 Manufacturing, 3 WTU, and 3 Services, 1 Retail.											
LI											
	Non-Residential	21.01	100%	-	-	-	124,966	0.14	78	3.69	3.69

Figure Pop-E. Index UGA Population

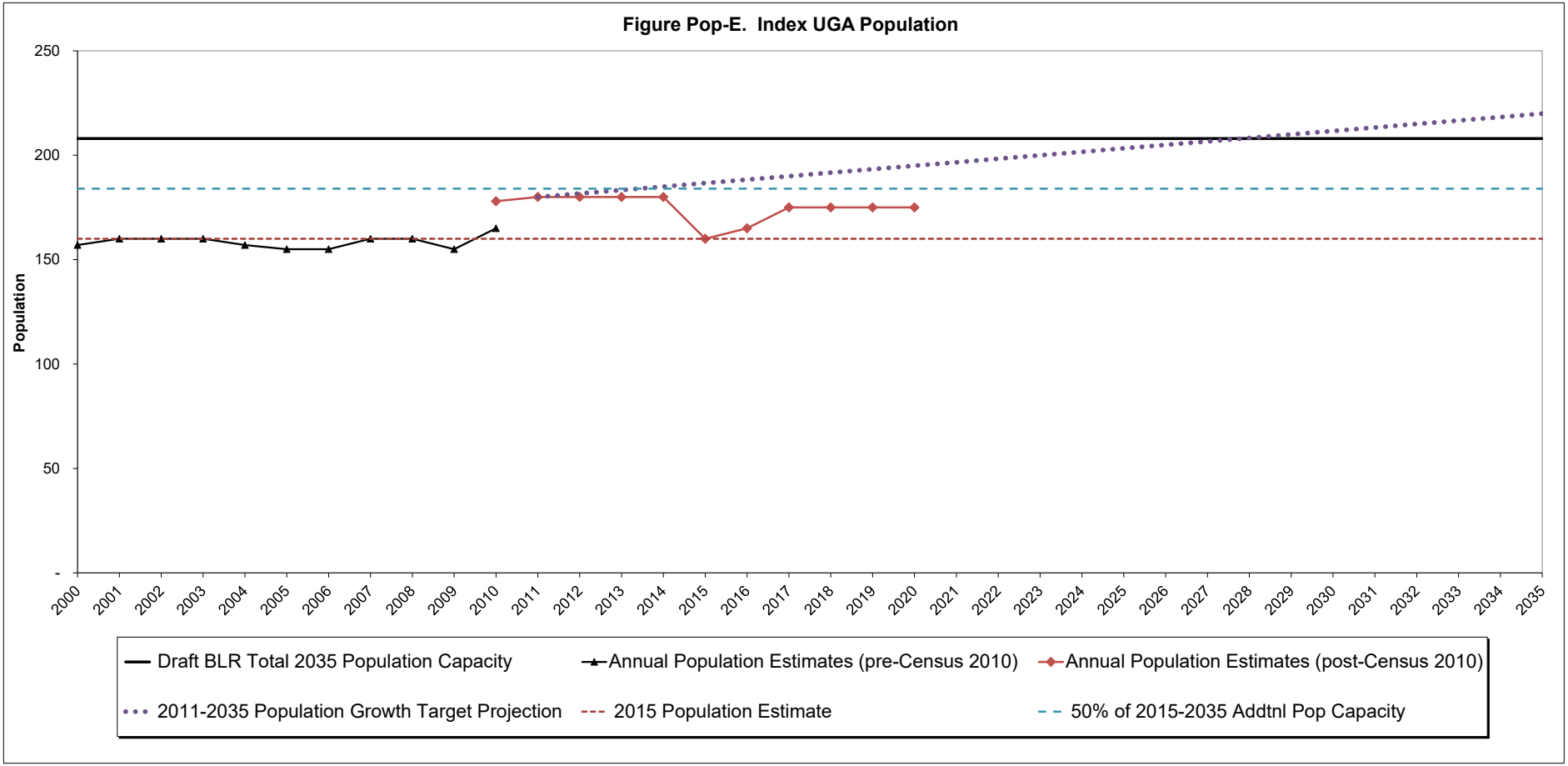


Table Pop-E. Index UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B	= (C-B)/(H)*100
157	165	178	13	7.9%	180	180	180	180	160	165	175	175	175	175	-5	220	40	-12.5%	208	48	31.3%

Population

Index UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Index UGA	CITY12	(2) VACANT		EXISTING SINGLE FAMILY RESIDENTIAL	1.334	.0541827	1.280	.000	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
			Sum		1.334	.0541827	1.280	.000	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
		Sum			1.334	.0541827	1.280	.000	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
		(3) PARTUSE		EXISTING SINGLE FAMILY RESIDENTIAL	1.936	.5872867	1.349	1.187	5	0	0	0	5	3	0	0	0	3	10	0	0	0	10
			Sum		1.936	.5872867	1.349	1.187	5	0	0	0	5	3	0	0	0	3	10	0	0	0	10
		Sum			1.936	.5872867	1.349	1.187	5	0	0	0	5	3	0	0	0	3	10	0	0	0	10
		(4) REDEV		EXISTING SINGLE FAMILY RESIDENTIAL	2.425	.0499245	2.375	.000	6	0	0	0	6	4	0	0	0	4	11	0	0	0	11
			Sum		2.425	.0499245	2.375	.000	6	0	0	0	6	4	0	0	0	4	11	0	0	0	11
		Sum			2.425	.0499245	2.375	.000	6	0	0	0	6	4	0	0	0	4	11	0	0	0	11
	Sum				5.695	.6913939	5.004	1.187	16	0	0	0	16	11	0	0	0	11	33	0	0	0	33
Sum					5.695	.6913939	5.004	1.187	16	0	0	0	16	11	0	0	0	11	33	0	0	0	33

Index UGA - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Index UGA - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

There are no cases available for REPORT to process.

Figure Emp-E. Index UGA Employment

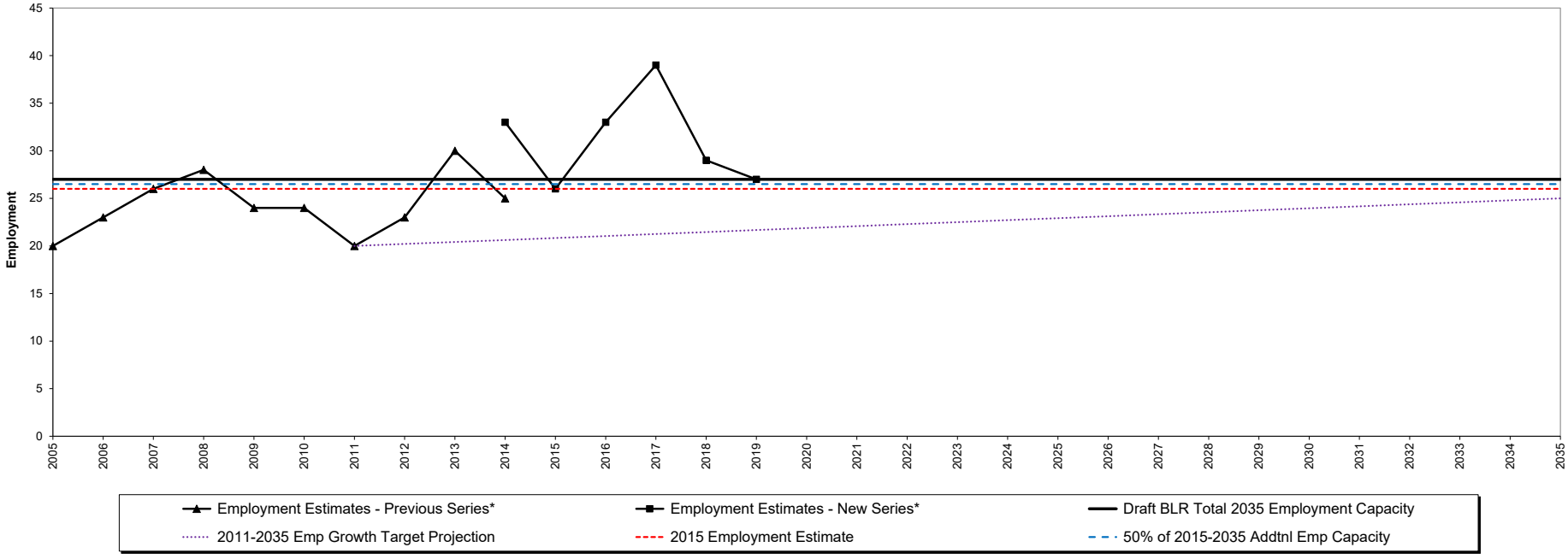


Table Emp-E. Index UGA Employment Statistics

	(A)				(B)						(C)	(D)	(E)	(F)		(G)	(H)	
	Employment Estimates																	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
Index UGA	24	20	23	30	25	33	26	33	39	29	27	7	25	5	140.0%	27	1	-

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Town of Index

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
Constrained Residential	Single Family		No Data			0.00	-	-	-	-	-
Existing Single Family	Single Family		No Data			5.26	-	-	-	-	-
Commercial	Non-Residential		No Data			0.00		No Data			8.00 (1)

(1) The distribution of jobs by employment sector in Commercial zoning is expected to be: 6 Services and 2 Retail.

Figure Pop-F. Lake Stevens UGA Population

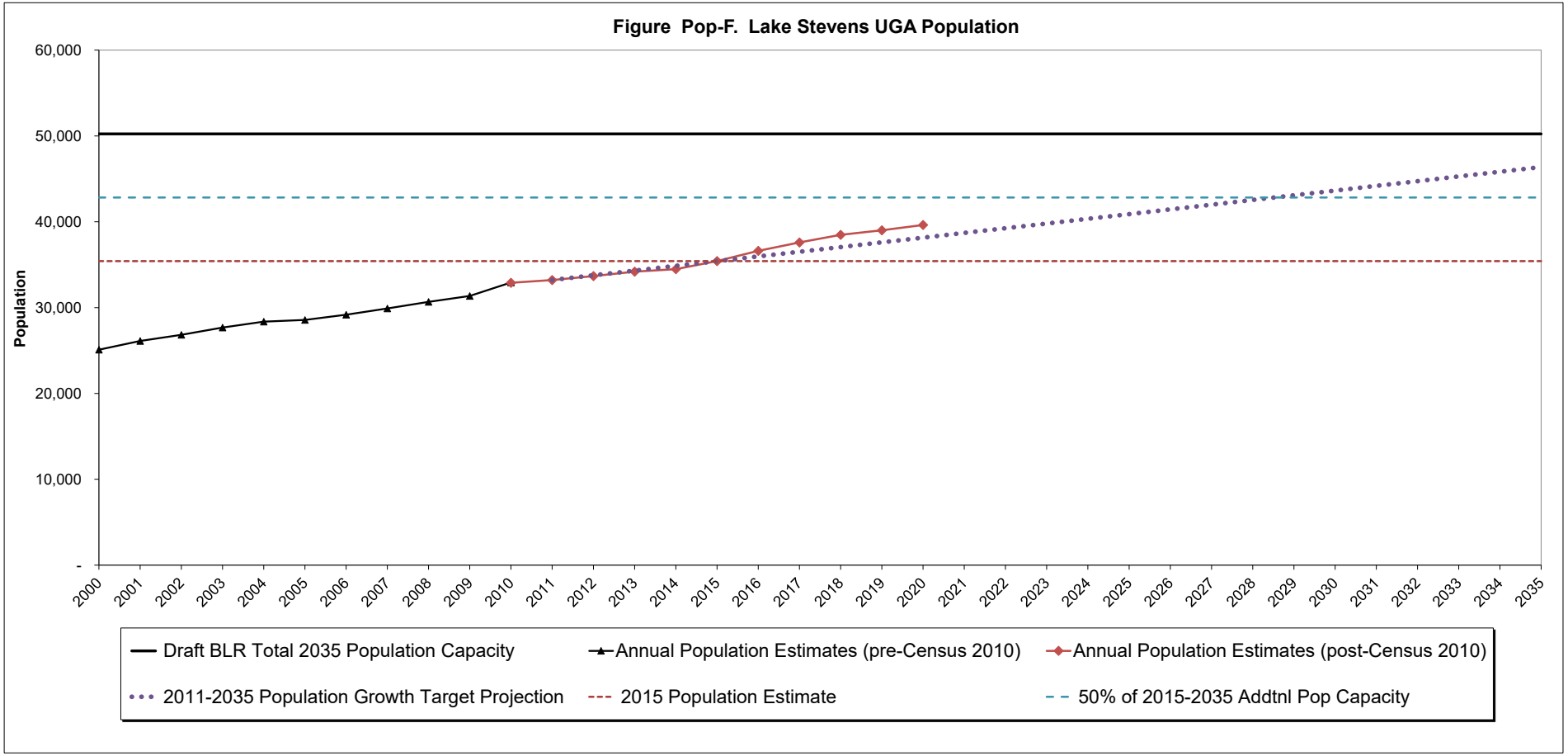


Table Pop-F. Lake Stevens UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B	= (C-B)/(H)*100
25,096	32,930	32,896	-34	-0.1%	33,218	33,676	34,186	34,477	35,418	36,615	37,594	38,483	39,013	39,629	6,411	46,380	13,162	48.7%	50,241	14,823	28.4%

Population

Lake Stevens UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Lake Stevens UGA	CITY12	(1) PENDING		CD	8.329	2.361742	5.967	0	0	0	0	250	250	0	0	0	250	250	0	0	0	294	294
				LB	0.965	0	0.965	0	0	0	16	0	16	0	0	16	0	16	0	0	29	0	29
Lake Stevens UGA	CITY12	(1) PENDING		MFDA	70.512	39.59608	30.916	0	288	0	0	0	288	288	0	0	0	288	829	0	0	0	829
				MFR	2.343	1.393835	0.949	0	0	0	42	0	42	0	0	42	0	42	0	0	77	0	77
				MUN	16.569	3.819928	12.749	0	0	0	167	0	167	0	0	167	0	167	0	0	307	0	307
				R4	13.098	5.853394	7.245	0	37	0	4	0	41	37	0	4	0	41	107	0	7	0	114
				R6	76.773	28.94102	47.832	0	230	0	2	0	232	230	0	2	0	232	662	0	4	0	666
				R8-12	99.858	33.69727	66.161	0	570	77	6	0	653	570	77	6	0	653	1642	196	11	0	1849
				WR	2.268	1.318523	0.949	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
			Sum		290.714	116.9818	173.733	0	1130	77	237	250	1694	1130	77	237	250	1694	3254	196	436	294	4180
		Sum			290.714	116.9818	173.733	0	1130	77	237	250	1694	1130	77	237	250	1694	3254	196	436	294	4180
		(2) VACANT		LB	4.345	0.8081688	3.537	0	0	0	26	0	26	0	0	21	0	21	0	0	39	0	39
				MFR	13.627	12.54861	1.079	0	4	0	8	13	25	3	0	6	10	20	9	0	12	12	34
				MUN	0.324	0	0.324	0	0	0	4	0	4	0	0	3	0	3	0	0	6	0	6
				R4	63.453	43.75421	19.699	0	83	0	0	0	83	69	0	0	0	69	200	0	0	0	200
				R6	44.26	27.56282	16.697	0	82	0	0	0	82	69	0	0	0	69	197	0	0	0	197
				R8-12	17.496	12.35136	5.144	0	26	13	0	3	42	21	11	0	2	34	61	27	0	3	91

			WR	3.555	1.628663	1.926	0	8	0	0	0	8	7	0	0	0	7	19	0	0	0	19
		Sum		147.061	98.65384	48.407	0	203	13	38	16	270	169	11	31	13	223	487	27	56	15	586
	Sum			147.061	98.65384	48.407	0	203	13	38	16	270	169	11	31	13	223	487	27	56	15	586
		(3) PARTUSE	R4	68.792	9.31072	59.481	34.82	119	0	0	0	119	95	0	0	0	95	273	0	0	0	273
			R6	77.15	14.73452	62.415	35.77	150	0	0	0	150	120	0	0	0	120	345	0	0	0	345
			R8-12	6.545	0.5323782	6.012	3.056	13	6	0	0	19	10	4	0	0	14	27	11	0	0	39
			WR	11.965	3.444268	8.52	5.592	19	0	0	0	19	15	0	0	0	15	44	0	0	0	44
		Sum		164.451	28.02188	136.429	79.237	301	6	0	0	307	239	4	0	0	244	689	11	0	0	700
	Sum			164.451	28.02188	136.429	79.237	301	6	0	0	307	239	4	0	0	244	689	11	0	0	700
		(4) REDEV	LB	4.299	0.784145	3.515	0	-1	0	24	0	23	-1	0	16	0	15	-2	0	29	0	27
			MFR	17.077	6.618699	10.458	0	-7	0	72	121	186	-5	0	48	80	124	-13	0	88	95	169
			MUN	12.012	1.348117	10.664	0	-22	0	129	0	107	-15	0	86	0	71	-42	0	158	0	116
			R4	76.134	26.7525	49.381	0	131	0	0	0	131	105	0	0	0	105	301	0	0	0	301
			R6	84.999	19.06374	65.935	0	216	0	1	0	217	172	0	1	0	173	496	0	1	0	498
			R8-12	113.252	39.4737	73.778	0	257	192	0	35	484	188	140	0	26	354	541	357	0	30	929
			WR	4.955	0.95611	3.999	0	12	0	0	0	12	10	0	0	0	10	28	0	0	0	28
		Sum		312.728	94.99701	217.731	0	586	192	226	156	1160	455	140	150	106	851	1309	357	277	125	2068
	Sum			312.728	94.99701	217.731	0	586	192	226	156	1160	455	140	150	106	851	1309	357	277	125	2068
Sum				914.953	338.6545	576.299	79.237	2220	288	501	422	3431	1993	232	418	369	3013	5740	591	769	434	7534
Sum				914.953	338.6545	576.299	79.237	2220	288	501	422	3431	1993	232	418	369	3013	5740	591	769	434	7534

Lake Stevens UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Lake Stevens UGA	CITY21	(1) PENDING		R4	11.121	5.227729	5.893	0	20	0	0	0	20	20	0	0	0	20	58	0	0	0	58
				R8-12	50.182	1.632058	48.55	0	356	0	0	0	356	356	0	0	0	356	1025	0	0	0	1025
			Sum		61.303	6.859787	54.443	0	376	0	0	0	376	376	0	0	0	376	1083	0	0	0	1083
		Sum			61.303	6.859787	54.443	0	376	0	0	0	376	376	0	0	0	376	1083	0	0	0	1083
		(2) VACANT		R4	0.3	0	0.3	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				R8-12	2.079	1.778307	0.3	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
			Sum		2.379	1.778307	0.6	0	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
		Sum			2.379	1.778307	0.6	0	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
		(3) PARTUSE		R4	10.591	2.795405	7.796	6.293	24	0	0	0	24	19	0	0	0	19	55	0	0	0	55
				R6	7.004	2.270759	4.734	4.095	19	0	0	0	19	15	0	0	0	15	44	0	0	0	44
				R8-12	6.544	1.194527	5.35	4.839	24	14	0	4	42	18	10	0	3	31	51	26	0	3	80
			Sum		24.14	6.260691	17.879	15.227	67	14	0	4	85	52	10	0	3	65	149	26	0	3	179
		Sum			24.14	6.260691	17.879	15.227	67	14	0	4	85	52	10	0	3	65	149	26	0	3	179
Lake Stevens UGA	CITY21	(4) REDEV		R8-12	25.458	2.722903	22.735	0	94	62	0	17	173	69	45	0	12	127	198	115	0	15	328
			Sum		25.458	2.722903	22.735	0	94	62	0	17	173	69	45	0	12	127	198	115	0	15	328
		Sum			25.458	2.722903	22.735	0	94	62	0	17	173	69	45	0	12	127	198	115	0	15	328

	Sum				113.279	17.62169	95.658	15.227	539	76	0	21	636	498	56	0	15	569	1435	141	0	18	1595
Sum					113.279	17.62169	95.658	15.227	539	76	0	21	636	498	56	0	15	569	1435	141	0	18	1595

Lake Stevens UGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Lake Stevens UGA	UNINC	(1) PENDING		ULDR	1.565	0	1.565	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
			Sum		1.565	0	1.565	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
		Sum			1.565	0	1.565	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
		(2) VACANT		ULDR	33.225	8.737297	24.488	0	123	0	0	0	123	103	0	0	0	103	296	0	0	0	296
			Sum		33.225	8.737297	24.488	0	123	0	0	0	123	103	0	0	0	103	296	0	0	0	296
		Sum			33.225	8.737297	24.488	0	123	0	0	0	123	103	0	0	0	103	296	0	0	0	296
		(3) PARTUSE		ULDR	201.542	47.26549	154.277	108.809	507	0	0	0	507	405	0	0	0	405	1165	0	0	0	1165
				UMDR	0.581	0	0.581	0.392	2	0	1	0	3	1	0	1	0	2	4	0	1	0	6
			Sum		202.123	47.26549	154.858	109.201	509	0	1	0	510	406	0	1	0	407	1169	0	1	0	1171
		Sum			202.123	47.26549	154.858	109.201	509	0	1	0	510	406	0	1	0	407	1169	0	1	0	1171
		(4) REDEV		ULDR	90.017	25.82109	64.196	0	262	0	0	0	262	209	0	0	0	209	602	0	0	0	602
				UMDR	0.299	0	0.299	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
			Sum		90.315	25.82109	64.494	0	262	0	1	0	263	209	0	1	0	210	602	0	1	0	603
		Sum			90.315	25.82109	64.494	0	262	0	1	0	263	209	0	1	0	210	602	0	1	0	603
	Sum				327.228	81.82388	245.405	109.201	904	0	2	0	906	728	0	1	0	729	2097	0	3	0	2099
Sum					327.228	81.82388	245.405	109.201	904	0	2	0	906	728	0	1	0	729	2097	0	3	0	2099

Figure Emp-F. Lake Stevens UGA Employment

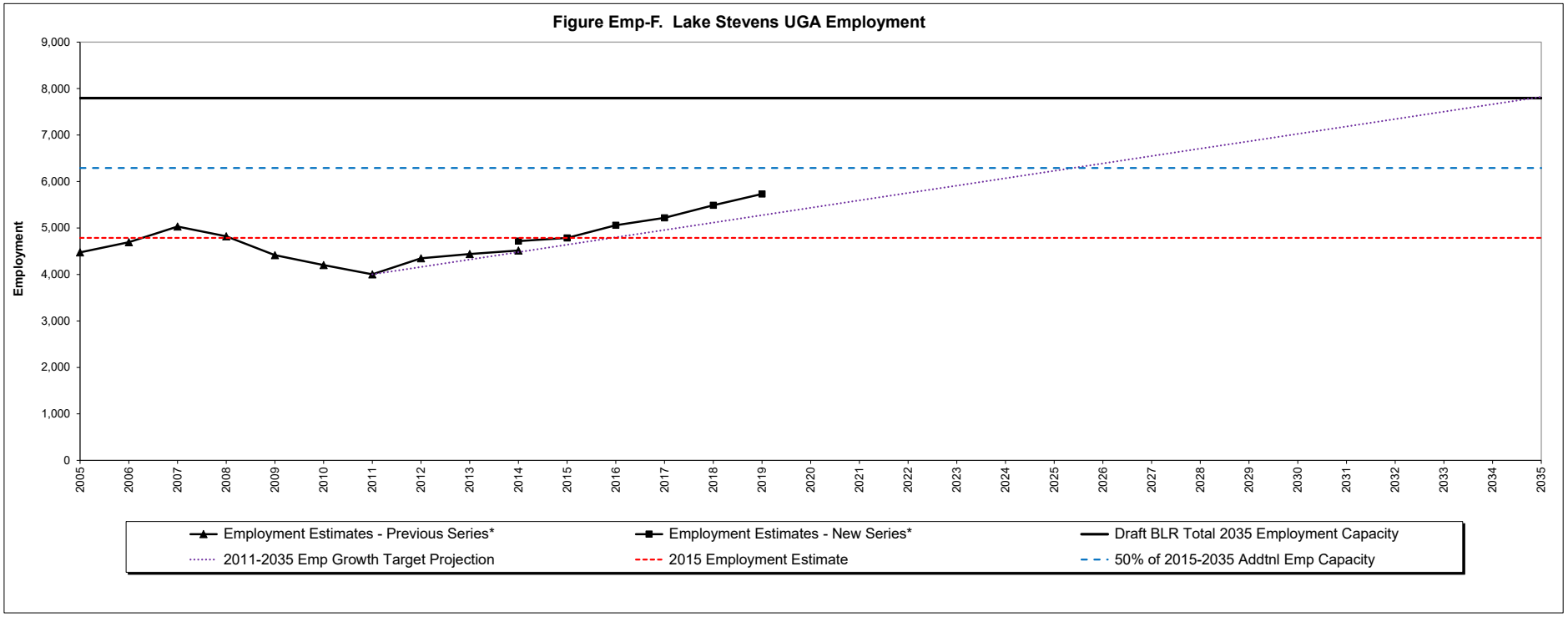


Table Emp-F. Lake Stevens UGA Employment Statistics

	(A)				(B)						(C)	(D)	(E)	(F)		(G)	(H)	
	Employment Estimates																	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
Lake Stevens UGA	4,201	4,003	4,349	4,439	4,517	4,718	4,787	5,059	5,220	5,489	5,732	1,729	7,821	3,818	45.3%	7,795	3,008	31.4%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Lake Stevens UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Lake Stevens UGA	CITY12	(1) PENDING		CBD	0.202	0.0970251	0.104	0	17	0	0	17	17	0	0	17
				CD	38.546	20.67044	17.876	0	288	0	0	288	288	0	0	288
				LB	4.228	1.250189	2.978	0	14	109	0	123	14	109	0	123
			Sum		42.976	22.01765	20.958	0	320	109	0	429	320	109	0	429
		Sum			42.976	22.01765	20.958	0	320	109	0	429	320	109	0	429
		(2) VACANT		CD	34.336	14.24616	20.09	0	296	0	0	296	239	0	0	239
				GI	15.958	5.767937	10.19	0	2	66	0	68	2	53	0	55
				LB	4.345	0.8081688	3.537	0	27	0	2	29	22	0	1	23
				LI	0.987	0.2539485	0.733	0	3	8	0	11	3	7	0	9
				MUN	0.324	0	0.324	0	1	0	0	1	1	0	0	1
				PBD	0.722	0	0.722	0	10	0	1	11	8	0	1	9
			Sum		56.671	21.07621	35.595	0	339	74	3	416	274	60	2	336
Lake Stevens UGA	CITY12	(2) VACANT	MARKET-READY	PBD	21.494	21.43224	0.062	0	1	0	0	1	1	0	0	1
			Sum		21.494	21.43224	0.062	0	1	0	0	1	1	0	0	1
		Sum			78.165	42.50845	35.657	0	340	74	3	417	275	60	3	337

		(3) PARTUSE		CD	3.7	0.1054943	3.595	1.056	26	0	0	26	17	0	0	17
				GI	5.403	0.1236557	5.28	2.934	13	27	0	40	13	22	0	35
				LI	0.886	0	0.886	0.071	0	1	0	1	0	1	0	1
			Sum		9.99	0.2291499	9.76	4.061	39	28	0	67	30	23	0	53
		Sum			9.99	0.2291499	9.76	4.061	39	28	0	67	30	23	0	53
		(4) REDEV		CBD	6.888	1.212964	5.675	0	71	0	10	82	47	0	7	54
				CD	97.121	23.45063	73.67	0	968	0	0	968	644	0	0	644
				GI	32.688	7.928337	24.76	0	5	160	0	165	3	107	0	110
				LB	4.507	0.7903216	3.717	0	26	0	2	28	18	0	1	19
				LI	6.413	2.143825	4.269	0	18	44	0	62	12	29	0	41
				MU	10.428	4.429123	5.999	0	82	0	11	93	54	0	8	62
				MUN	23.476	1.725632	21.75	0	65	0	0	65	43	0	0	43
				PBD	5.87	4.669595	1.2	0	16	0	2	19	11	0	2	12
			Sum		187.39	46.35043	141.04	0	1252	204	26	1482	833	136	17	986
			MARKET-READY	CD	3.095	2.902609	0.193	0	3	0	0	3	3	0	0	3
			Sum		3.095	2.902609	0.193	0	3	0	0	3	3	0	0	3
		Sum			190.486	49.25304	141.233	0	1255	204	26	1485	835	136	17	988
	Sum				321.616	114.0083	207.608	4.061	1953	415	29	2397	1460	328	20	1807
Sum					321.616	114.0083	207.608	4.061	1953	415	29	2397	1460	328	20	1807

Lake Stevens UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Lake Stevens UGA	CITY21	(2) VACANT		GI	11.64	6.701312	4.938	0	1	32	0	33	1	26	0	27
			Sum		11.64	6.701312	4.938	0	1	32	0	33	1	26	0	27
		Sum			11.64	6.701312	4.938	0	1	32	0	33	1	26	0	27
		(3) PARTUSE		GI	2.579	0.0460249	2.533	2.237	0	20	0	21	0	14	0	14

			Sum		2.579	0.0460249	2.533	2.237	0	20	0	21	0	14	0	14
		Sum			2.579	0.0460249	2.533	2.237	0	20	0	21	0	14	0	14
		(4) REDEV		GI	40.139	0.7836545	39.355	0	8	255	0	262	5	169	0	175
			Sum		40.139	0.7836545	39.355	0	8	255	0	262	5	169	0	175
		Sum			40.139	0.7836545	39.355	0	8	255	0	262	5	169	0	175
	Sum				54.357	7.530992	46.826	2.237	9	307	0	316	6	209	0	215
Sum					54.357	7.530992	46.826	2.237	9	307	0	316	6	209	0	215

Lake Stevens UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Lake Stevens UGA	UNINC	(2) VACANT		UI	0.823	0	0.823	0	0	5	0	5	0	4	0	4
			Sum		0.823	0	0.823	0	0	5	0	5	0	4	0	4
		Sum			0.823	0	0.823	0	0	5	0	5	0	4	0	4
Lake Stevens UGA	UNINC	(4) REDEV		UI	11.007	2.699879	8.307	0	2	54	0	55	1	36	0	37
			Sum		11.007	2.699879	8.307	0	2	54	0	55	1	36	0	37
		Sum			11.007	2.699879	8.307	0	2	54	0	55	1	36	0	37
	Sum				11.83	2.699879	9.13	0	2	59	0	61	1	40	0	41
Sum					11.83	2.699879	9.13	0	2	59	0	61	1	40	0	41

Lake Stevens UGA

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
R4 (formerly SR) & WR											
	Single Family	170.46	100%	679	3.97	3.99 (1)	-	-	-	-	-
	Multi-Family	0.70	0.41%	4	0.02	-					
	Total	**171.16**	**100%**	**683**	**3.99**	**3.99 (1)**	**-**	**-**	**-**	**-**	**-**
(1) The densities assumed in Suburban and Waterfront Residential simplify the historic development by including the one multi-family project, a four-unit condominium consisting of two duplex buildings, with the single-family densities.											
R6 (formerly UR)											
	Single Family	53.10	98%	258	4.86	4.86	-	-	-	-	-
	Multi-Family	1.18	2%	10	0.18	0.18	-	-	-	-	-
	Total	**54.28**	**100%**	**268**	**4.94**	**4.94**	**-**	**-**	**-**	**-**	**-**
R8-12 (formerly HUR)											
	Single Family	68.58	93%	485	7.07	5.00 (2)	-	-	-	-	-
	Townhouse	No Development				3.00 (2)					
	Senior Apartments	5.22	7%	54	0.73	1.00 (2)	-	-	-	-	-
	Total	**73.80**	**100%**	**539**	**7.30**	**9.00 (2)**	**-**	**-**	**-**	**-**	**-**
(2) City staff anticipate some townhouse development alongside single family within the R8-12 zone.											
MFR											
	Single Family	1.33	24%	19	3.40	3.40	-	-	-	-	-
	Multi-Family	2.01	36%	45	8.05	8.05	-	-	-	-	-
	Senior Apartments	2.25	40%	72	12.87	12.87	-	-	-	-	-
	Total	**5.59**	**100%**	**136**	**24.32**	**24.32**	**-**	**-**	**-**	**-**	**-**

Lake Stevens UGA

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
PBD (3)											
	Non-Residential	15.28	100%	-	-	-	94,200	0.14	237	15.51	15.51
(3) There has been no development yet in PBD. An expired project called "Centennial Center" is being used to estimate likely future densities.											
MU											
	Mixed Use	0.32	100%	1	3.12	3.12	7,818	0.56	22	69.57	15.51(4)
LB											
	Mixed-Use	0.96	46%	16	7.65	7.65	5,613	0.06	14	6.69	6.96
	Non-Residential	1.13	54%	-	-	-	933	0.01	3	1.43	1.43
	Total	**2.09**	**100%**	**16**	**7.65**	**7.65**	**6,546**	**0.07**	**17**	**8.13**	**8.13**
CBD											
	Non-Residential	0.10	100%	-	-	-	1,064	0.24	2	14.73	15.51(4)
(4) The sample size of development in the Mixed Use and Central Business District zones is too small to be reliable. As a substitute, the employment density from the Planned Business District (PBD) zone within the City is being used. This approach is similar to the 2007 and 2012 Buildable Lands Report.											
LI											
	Non-Residential	2.28	100%	-	-	-	27,058	0.27	36	15.67	15.67
GI (New Projects)											
	Non-Residential	13.39	100%	-	-	-	119,168	0.18	89	6.68	6.68
GI (Infill Projects)											
	Non-Residential	9.60	100%	-	-	-	82,042	0.20	89	9.30	9.30

Lake Stevens UGA

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Employment	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
BD											
	Non-Residential				No Development; New Zone						35.00 (5)
(5) The new Business District zone is expected to develop in an business park format of 1-3 story office and industrial buildings with some other supporting uses. The employment by job sector is assumed to be: 18 Services, 7 Manufacturing, 5 FIRE, 3 Food Services, and 2 Retail.											
CD (New Projects) (6)											
	Non-Residential	6.77	100%	-	-	-	47,841	0.16	100	14.73	14.73
(6) Mainstreet Business and Neighborhood Business were merged into Commercial District											
CD (Infill Projects)											
	Non-Residential	18.65	100%	-	-	-	199,145	0.25	451	24.18	24.18
MUN											
	Mixed-Use	No Development; New Zone				15.00	No Development; New Zone				3.00 (7)
(7) The employment by job sector in MUN zoning for new projects is assumed to be 3 Servcies.											
NB											
	Non-Residential	2.62	100%	-	-	-	18,145	0.16	36	13.66	13.66
Development Within County Plan Designations											
ULDR											
	Single Family	220.60	100%	1,115	5.05	5.05	-	-	-	-	-

Lake Stevens UGA

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
UMDR (2000 to 2010 Sample)											
	Single Family	23.61	62%	237	6.18	6.18	-	-	-	-	-
	Multi-Family	14.76	38%	168	4.38	4.38	-	-	-	-	-
	Total	**38.37**	**100%**	**405**	**10.56**	**10.56**	**-**	**-**	**-**	**-**	**-**
UI		Insufficient Data -- Assumed to be comparable to General Industrial in the City of Lake Stevens									6.68

Maltby UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T

There are no cases available for REPORT to process.

Maltby UGA - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Maltby UGA - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Maltby UGA	UNINC	(1) PENDING		UCOM	16.952	.0000000	16.952	.000	0	0	360	0	360	0	0	360	0	360	0	0	662	0	662
			Sum		16.952	.0000000	16.952	.000	0	0	360	0	360	0	0	360	0	360	0	0	662	0	662
		Sum			16.952	.0000000	16.952	.000	0	0	360	0	360	0	0	360	0	360	0	0	662	0	662

	(2) VACANT		UCOM	19.034	.0000000	19.034	.000	0	0	92	12	104	0	0	74	10	84	0	0	137	11	148
		Sum		19.034	.0000000	19.034	.000	0	0	92	12	104	0	0	74	10	84	0	0	137	11	148
	Sum			19.034	.0000000	19.034	.000	0	0	92	12	104	0	0	74	10	84	0	0	137	11	148
	(4) REDEV		UCOM	6.300	.0000000	6.300	.000	0	0	30	3	33	0	0	20	2	22	0	0	37	2	39
UGA																						
		Sum		6.300	.0000000	6.300	.000	0	0	30	3	33	0	0	20	2	22	0	0	37	2	39
	Sum			6.300	.0000000	6.300	.000	0	0	30	3	33	0	0	20	2	22	0	0	37	2	39
Sum				42.287	.0000000	42.287	.000	0	0	482	15	497	0	0	454	12	466	0	0	836	14	850
Sum				42.287	.0000000	42.287	.000	0	0	482	15	497	0	0	454	12	466	0	0	836	14	850

Figure Emp-G. Maltby UGA Employment

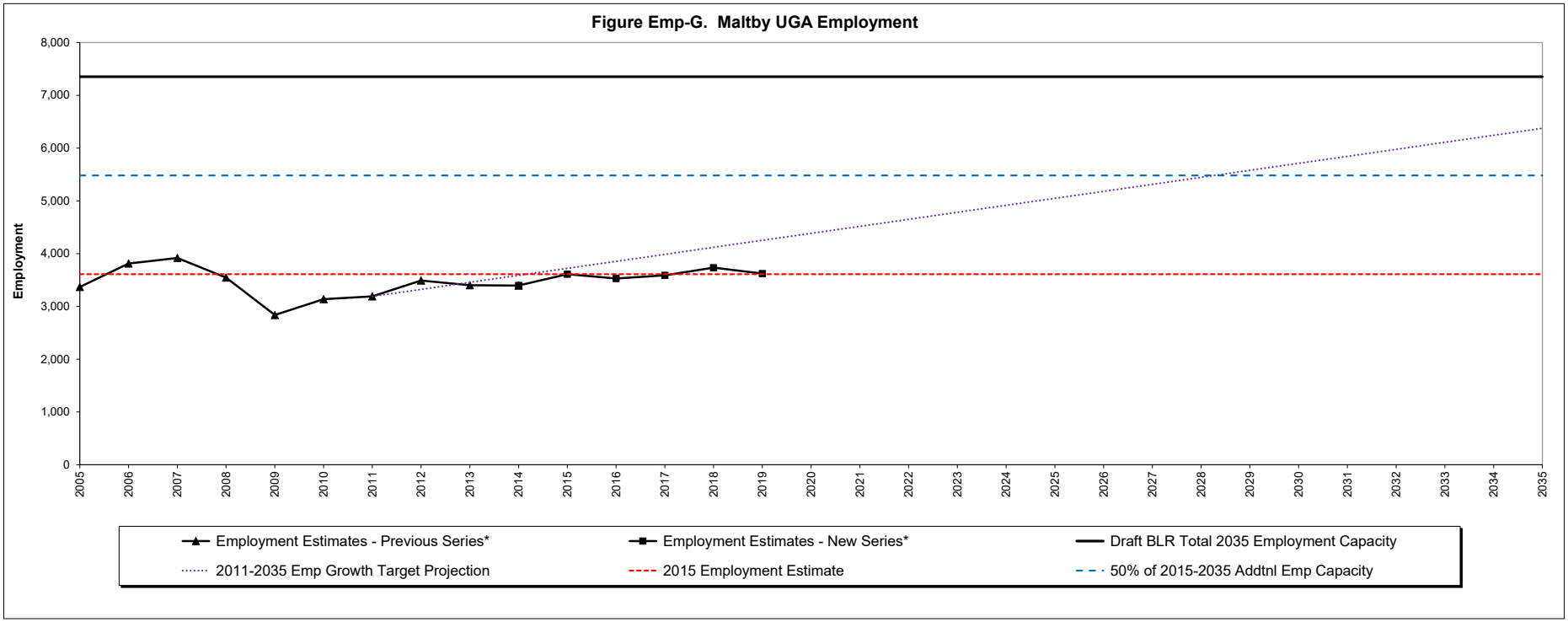


Table Emp-G. Maltby UGA Employment Statistics

	(A) Employment Estimates				(B) Employment Estimates						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth)	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	= (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	Addtnl Emp Cap = (C-B)/(H)*100
Maltby UGA	3,136	3,190	3,489	3,401	3,393	3,396	3,610	3,528	3,588	3,734	3,623	433	6,374	3,184	13.6%	7,352	3,742	0.3%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Maltby UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

N/A

Woodway UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Woodway UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Maltby UGA	UNINC	(1) PENDING		UI	18.989	.0000000	18.989	.000	21	146	0	167	21	146	0	167
			Sum		18.989	.0000000	18.989	.000	21	146	0	167	21	146	0	167
		Sum			18.989	.0000000	18.989	.000	21	146	0	167	21	146	0	167
		(2) VACANT		UCOM	18.347	.0000000	18.347	.000	245	13	7	265	198	10	6	214
				UI	42.687	.0000000	42.687	.000	228	703	5	936	184	567	4	756
			Sum		61.034	.0000000	61.034	.000	473	715	12	1200	382	578	9	969
		Sum			61.034	.0000000	61.034	.000	473	715	12	1200	382	578	9	969
		(3) PARTUSE		UCOM	2.210	.0000000	2.210	1.284	12	0	0	12	8	0	0	8

		UI	10.172	.0000000	10.172	4.183	11	36	1	48	7	24	0	32
	Sum		12.382	.0000000	12.382	5.467	23	36	1	60	15	24	0	40
Sum			12.382	.0000000	12.382	5.467	23	36	1	60	15	24	0	40
	(4) REDEV	UI	186.744	.0000000	186.744	.000	998	2791	21	3810	675	1864	14	2553
	Sum		186.744	.0000000	186.744	.000	998	2791	21	3810	675	1864	14	2553
Sum			186.744	.0000000	186.744	.000	998	2791	21	3810	675	1864	14	2553
Sum			279.150	.0000000	279.150	5.467	1515	3689	33	5237	1094	2612	24	3729
Sum			279.150	.0000000	279.150	5.467	1515	3689	33	5237	1094	2612	24	3729

Maltby UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development In Unincorporated Designations											
UI (New Projects)											
	Non-Residential	138.48	100%	-	-	-	1,830,539	0.29	3,035	21.92	21.92
UI (Infill Projects)											
	Non-Residential	153.34	100%	-	-	-	1,113,261	0.17	1,749	11.41	11.41
UCOM (New Projects)											
	Multi-Family	No Data				5.58 (1)	No Data				-
	Non-Residential					-					14.48 (1)
(1) In the absence of new development in Urban Commercial in the Maltby UGA, the Urban Commercial densities of the Southwest UGA are being used.											
UCOM (Infill Projects)											
	Non-Residential	1.72	0%	-	-	-	8,588	0.11	16	9.37	9.37

Figure Pop-G. Marysville UGA Population

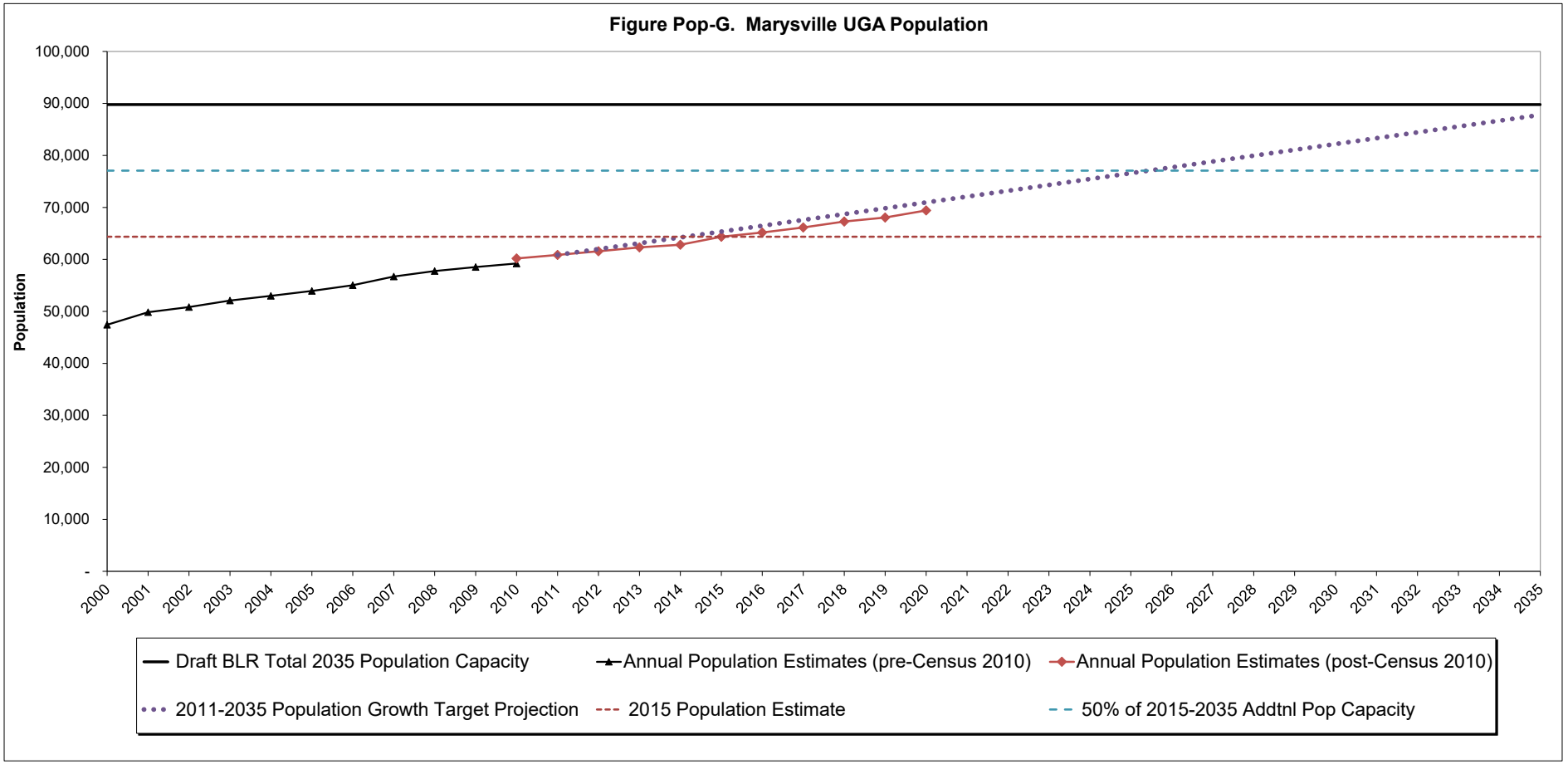


Table Pop-G. Marysville UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng	(G)	(H)	2015-20 Pop Chng as % of 2015-35
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop	2011-35 Numeric Change	(38% expected if linear growth)	Total 2035	2015-35 Addtnl	Addtnl Pop Cap
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)	Target	= (E) - (A)	= (D)/(F)*100	Pop Cap	= (G) - (B	= (C-B)/(H)*100
47,424	59,218	60,183	965	1.6%	60,869	61,574	62,314	62,816	64,361	65,164	66,132	67,275	68,058	69,417	8,549	87,798	26,929	31.7%	89,788	25,427	19.9%

Population

Marysville UGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

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AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
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AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Marysville UGA	CITY12	(1) PENDING		LI	0.972	0	0.972	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				MU	8.07	0.0484674	8.021	0	15	6	144	0	165	15	6	144	0	165	43	15	265	0	323
				R12 MFL	2.962	0.1912352	2.771	0	0	23	0	0	23	0	23	0	0	23	0	59	0	0	59
				R18 MFM	19.381	5.996187	13.385	0	65	0	128	0	193	65	0	128	0	193	187	0	236	0	423
				R4.5 SFM	65.777	27.24375	38.534	0	189	0	0	0	189	189	0	0	0	189	544	0	0	0	544
				R6.5 SFH	95.927	11.41968	84.507	0	457	0	0	1	458	457	0	0	1	458	1316	0	0	1	1317
				R8 SFH-SL	17.721	0	17.721	0	107	0	0	0	107	107	0	0	0	107	308	0	0	0	308
				WR-6-18	14.176	1.061098	13.115	0	104	0	0	0	104	104	0	0	0	104	300	0	0	0	300
				WR-R-4-8	11.758	0.5080711	11.25	0	60	0	0	0	60	60	0	0	0	60	173	0	0	0	173
			Sum		236.743	46.46849	190.275	0	998	29	272	1	1300	998	29	272	1	1300	2874	74	500	1	3450
		Sum			236.743	46.46849	190.275	0	998	29	272	1	1300	998	29	272	1	1300	2874	74	500	1	3450
Marysville UGA	CITY12	(2) VACANT		DC	10.348	0	10.348	0	3	0	4	0	7	2	0	3	0	6	7	0	6	0	13
				MU	25.112	3.139233	21.973	0	0	0	242	51	293	0	0	195	41	237	0	0	360	48	408
				R12 MFL	47.722	13.99707	33.725	0	172	0	154	0	326	141	0	126	0	266	405	0	232	0	636
				R18 MFM	35.307	9.613009	25.694	0	55	0	372	0	427	44	0	300	0	345	128	0	553	0	681
				R28 MFH	0.965	0	0.965	0	0	0	8	10	18	0	0	6	8	15	0	0	12	9	21

		R4.5 SFM	159.815	70.13604	89.679	0	386	0	0	0	386	323	0	0	0	323	929	0	0	0	929
		R6.5 SFH	149.318	69.3817	79.937	0	374	0	0	0	374	313	0	0	0	313	900	0	0	0	900
		R8 SFH-SL	6.808	1.132873	5.675	0	44	0	0	0	44	37	0	0	0	37	106	0	0	0	106
		WR-6-18	11.794	0.0144759	11.779	0	73	0	68	0	141	60	0	56	0	115	172	0	102	0	274
		WR-R-4-8	7.276	0.0000103	7.276	0	49	0	0	0	49	41	0	0	0	41	118	0	0	0	118
	Sum		454.467	167.4144	287.052	0	1156	0	848	61	2065	960	0	687	49	1696	2765	0	1264	58	4087
	MARKET-READY	MU	4.638	1.084749	3.553	0	0	0	39	9	48	0	0	37	9	46	0	0	68	10	78
		R12 MFL	77.01	23.55037	55.063	0	285	0	255	0	540	271	0	242	0	513	780	0	446	0	1226
		R6.5 SFH	6.902	0.0654807	6.836	0	32	0	0	0	32	30	0	0	0	30	88	0	0	0	88
	Sum		88.55	24.7006	65.452	0	317	0	294	9	620	301	0	279	9	589	867	0	514	10	1391
Sum			543.017	192.115	352.505	0	1473	0	1142	70	2685	1261	0	966	58	2285	3632	0	1778	68	5478
(3) PARTUSE		MU	13.332	0.0088009	13.323	6.541	0	0	68	13	81	0	0	45	9	54	0	0	83	10	93
		R12 MFL	1.417	0	1.417	0.515	2	0	2	0	4	1	0	1	0	3	4	0	3	0	7
		R18 MFM	2.127	0	2.127	0.789	0	0	10	0	10	0	0	7	0	7	0	0	12	0	12
		R4.5 SFM	278.314	53.54777	224.766	140.309	550	0	0	0	550	439	0	0	0	439	1264	0	0	0	1264
		R6.5 SFH	336.295	40.67451	295.62	213.486	959	0	0	0	959	765	0	0	0	765	2204	0	0	0	2204
		R8 SFH-SL	7.021	0	7.021	5.838	43	0	0	0	43	34	0	0	0	34	99	0	0	0	99
		WR-6-18	70.523	3.147937	67.375	44.931	267	0	252	0	519	195	0	184	0	380	562	0	339	0	902
		WR-R-4-8	53.361	0.0016693	53.36	41.418	284	0	0	0	284	227	0	0	0	227	653	0	0	0	653
	Sum		762.389	97.38069	665.009	453.828	2105	0	332	13	2450	1662	0	238	9	1908	4786	0	437	10	5234
	MARKET-READY	MU	19.787	0	19.787	19.334	0	0	216	50	266	0	0	205	48	253	0	0	378	56	433
		R4.5 SFM	3.935	0.7597889	3.175	2.059	8	0	0	0	8	8	0	0	0	8	22	0	0	0	22
	Sum		23.722	0.7597889	22.962	21.393	8	0	216	50	274	8	0	205	48	260	22	0	378	56	455
Sum			786.111	98.14048	687.971	475.221	2113	0	548	63	2724	1670	0	443	56	2169	4808	0	815	66	5689
(4) REDEV		88 - MU	23.23	11.45444	11.776	0	-2	0	131	29	158	-1	0	87	19	105	-4	0	160	23	179
		DC	5.272	0	5.272	0	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
		MU	88.781	0.6575174	88.124	0	-104	0	945	177	1018	-69	0	628	118	677	-199	0	1156	138	1096
		R12 MFL	27.673	0.340029	27.333	0	95	0	116	0	211	69	0	85	0	154	200	0	156	0	356
		R18 MFM	65.515	5.301074	60.214	0	-38	0	842	0	804	-25	0	560	0	535	-73	0	1030	0	957
		R28 MFH	18.046	0.1527082	17.894	0	-7	0	134	175	302	-5	0	89	116	201	-13	0	164	137	287
		R4.5 SFM	151.652	30.44471	121.207	0	404	0	0	0	404	322	0	0	0	322	928	0	0	0	928
		R6.5 SFH	210.969	33.8118	177.157	0	667	0	0	0	667	532	0	0	0	532	1533	0	0	0	1533
		R8 SFH-SL	8.213	0	8.213	0	32	0	0	0	32	26	0	0	0	26	74	0	0	0	74
		WR-6-18	36.087	0.060894	36.026	0	204	0	208	0	412	149	0	152	0	301	430	0	280	0	710
		WR-R-4-8	55.721	0	55.721	0	369	0	0	0	369	294	0	0	0	294	848	0	0	0	848
	Sum		691.16	82.22317	608.937	0	1620	0	2379	381	4380	1293	0	1604	253	3150	3724	0	2951	298	6972
	MARKET-READY	MU	5.334	0.4691463	4.865	0	-7	0	54	11	58	-7	0	51	10	55	-19	0	94	12	88
		R12 MFL	0.323	0	0.323	0	0	0	1	0	1	0	0	1	0	1	0	0	2	0	2
		R18 MFM	1.758	0	1.758	0	3	0	25	0	28	3	0	24	0	27	8	0	44	0	52
	Sum		7.416	0.4691463	6.946	0	-4	0	80	11	87	-4	0	76	10	83	-11	0	140	12	141
Sum			698.576	82.69231	615.884	0	1616	0	2459	392	4467	1289	0	1680	264	3233	3713	0	3090	310	7113
Sum			2264.447	419.4163	1846.634	475.221	6200	29	4421	526	11176	5218	29	3361	379	8986	15028	74	6184	445	21730
Sum			2264.447	419.4163	1846.634	475.221	6200	29	4421	526	11176	5218	29	3361	379	8986	15028	74	6184	445	21730

Marysville UGA - Additional Population Capacity DRAFT (Jun-23-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Marysville UGA - Additional Population Capacity DRAFT (Jun-23-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

There are no cases available for REPORT to process.

Figure Emp-H. Marysville UGA Employment

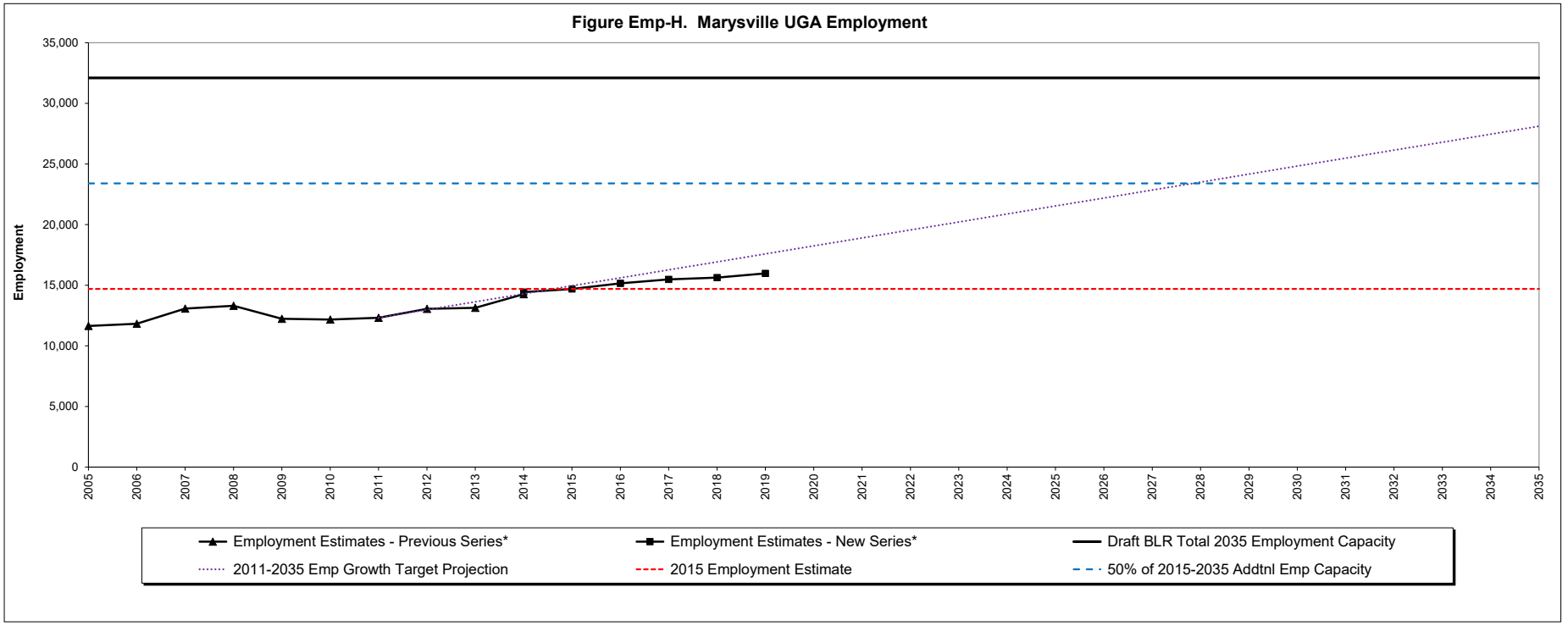

Table Emp-H. Marysville UGA Employment Statistics

	(A) Employment Estimates					(B) Employment Estimates						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019		2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	
Marysville UGA	12,167	12,316	13,056	13,138	14,260	14,428	14,695	15,153	15,475	15,630	15,974		3,658	28,113	15,797	23.2%	32,098	17,403	7.3%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Marysville UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2 Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Marysville UGA	CITY12	(1) PENDING		CB	3.516	0	3.516	0	166	0	0	166	166	0	0	166
				GC	60.47	5.968386	54.501	0	386	120	0	505	386	120	0	505
Marysville UGA	CITY12	(1) PENDING		LI	297.187	59.2788	237.908	0	0	3887	0	3887	0	3887	0	3887
				MU	2.776	0	2.776	0	9	0	0	9	9	0	0	9
				R8 SFH-SL	3.103	0	3.103	0	18	0	0	18	18	0	0	18
			Sum		367.052	65.24719	301.805	0	579	4007	0	4585	579	4007	0	4585
			MARKET-READY	LI	23.325	0.8193537	22.506	0	0	571	0	571	0	571	0	571
			Sum		23.325	0.8193537	22.506	0	0	571	0	571	0	571	0	571
		Sum			390.377	66.06654	324.311	0	579	4578	0	5157	579	4578	0	5157
		(2) VACANT		CB	49.898	7.411979	42.486	0	694	0	0	694	560	0	0	560
				DC	10.348	0	10.348	0	353	0	1	354	285	0	1	286

				GC	108.163	3.546208	104.617	0	1651	207	0	1858	1333	167	0	1500
				LI	358.008	48.73783	309.27	0	594	2044	0	2638	479	1651	0	2130
				MU	25.112	3.139233	21.973	0	179	0	1	180	144	0	1	145
				NB	2.755	0.6000665	2.155	0	35	0	0	35	28	0	0	28
			Sum		554.285	63.43532	490.85	0	3505	2251	2	5759	2831	1818	2	4650
			MARKET-READY	GC	15.027	0	15.027	0	237	149	0	386	226	148	0	374
				LI	45.27	0.1123025	45.158	0	87	298	0	385	82	284	0	366
				MU	4.638	1.084749	3.553	0	29	0	0	29	27	0	0	28
			Sum		64.936	1.197052	63.739	0	353	448	0	801	336	431	0	768
		Sum			619.221	64.63237	554.589	0	3858	2699	2	6559	3167	2249	2	5418
		(3) PARTUSE		CB	9.739	0.000149	9.739	6.284	146	6	0	153	97	4	0	102
				GC	10.845	2.212741	8.632	1.268	20	0	0	21	14	0	0	14
				LI	176.126	7.391691	168.734	89.678	263	665	1	928	175	442	1	617
				MU	14.292	0.0088009	14.283	6.559	27	0	0	27	18	0	0	18
			Sum		211.002	9.613381	201.389	103.79	456	671	1	1128	304	446	1	750
Marysville UGA	CITY12	(3) PARTUSE	MARKET-READY	MU	19.787	0	19.787	19.334	79	0	0	79	75	0	0	75
			Sum		19.787	0	19.787	19.334	79	0	0	79	75	0	0	75
		Sum			230.789	9.613381	221.176	123.124	536	671	1	1208	379	446	1	826
		(4) REDEV		88 - MU	23.23	11.45444	11.776	0	96	0	0	96	64	0	0	64
				CB	166.443	13.22794	153.215	0	2392	0	0	2392	1591	0	0	1591
				DC	21.126	0.562289	20.563	0	657	0	2	659	437	0	2	438
				GC	85.036	5.714528	79.321	0	1059	151	0	1210	704	100	0	805
				LI	166.552	13.61982	152.932	0	268	957	0	1225	178	637	0	815
				MU												

				98.635	0.6575174	97.977	0	782	0	3	785	520	0	2	522
			NB	0.982	0	0.982	0	16	0	0	16	11	0	0	11
		Sum		562.003	45.23654	516.767	0	5270	1108	6	6384	3504	737	4	4245
		MARKET-READY	CB	19.462	1.885131	17.577	0	287	0	0	287	273	0	0	273
			GC	9.409	0.4859007	8.923	0	134	18	0	152	127	17	0	144
			LI	2.973	0	2.973	0	6	20	0	25	5	19	0	24
			MU	5.334	0.4691463	4.865	0	40	0	0	40	38	0	0	38
		Sum		37.179	2.840178	34.339	0	466	37	0	504	443	35	0	479
	Sum			599.182	48.07672	551.105	0	5736	1146	6	6888	3947	772	4	4724
Sum				1839.57	188.389	1651.181	123.124	10709	9094	9	19811	8072	8046	6	16124
Sum				1839.57	188.389	1651.181	123.124	10709	9094	9	19811	8072	8046	6	16124

Marysville UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

N/A

Marysville UGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

N/A

Marysville UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Employment	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
Development Within City Zones											
R-4.5											
	Single Family	213.34	100%	930	4.36	4.36	-	-	-	-	-
R-6.5											
	Single Family	142.44	100%	681	4.78	4.78	-	-	-	-	-
WR-R 4-8											
	Single Family	No Development; New Zone				7.00 (1)	-	-	-	-	-
(1) Post-2018 proposed projects indicate a higher assumed density than what was previously used.											
R-8											
	Single Family	0.41	100%	4	9.74	8.00 (2)	-	-	-	-	-
(2) The sample of development in R-8 is limited to two duplex condos on existing lots. The assumed density matches the zoning because some development with be single-family detached, not just duplexes.											
R-12											
	Single Family	24.98	69%	186	5.16	5.16	-	-	-	-	-
	Multi-Family	11.04	31%	167	4.64	4.64	-	-	-	-	-
	Total	**36.02**	**100%**	**353**	**9.80**	**9.80**	**-**	**-**	**-**	**-**	**-**
WR-R-6-18											
	Single Family	13.78	100%	87	6.31	6.31	-	-	-	-	-
	Multi-Family		No Data			6.00					
	Total	**13.78**	**100%**	**87**	**6.31**	**12.31**	**-**	**-**	**-**	**-**	**-**

Marysville UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
R-18 (3)											
	Single Family	10.05	25%	94	2.33	2.33	-	-	-	-	-
	Multi-Family	30.37	75%	596	14.74	14.74	-	-	-	-	-
	Total	**40.42**	**100%**	**690**	**17.07**	**17.07**	**-**	**-**	**-**	**-**	**-**
(3) The sample used for R-18 excludes two large single-family condominiums because such projects are not likely on the remaining developable R-18 land.											
R-28											
	Single Family	0.66	11%	6	1.00	1.00	-	-	-	-	-
	Multi Family	3.24	54%	55	9.19	9.19	-	-	-	-	-
	Senior Apartments	2.08	35%	70	11.70	11.70	-	-	-	-	-
	Total	**5.98**	**100%**	**131**	**21.89**	**21.89**	**-**	**-**	**-**	**-**	**-**
CB and NB (New Projects)											
	Non-Residential	89.91	100%	-	-	-	776,606	0.20	1,470	16.35	16.35
CB and NB (Infill Projects)											
	Non-Residential	14.76	100%	2	0.14	0.00 (4)	178,311	0.28	359	24.30	24.30
(4) One of the infill projects in CB was on a site that included both existing commercial and a duplex, all of which remain. This report assumes that all additional infill space will be commercial.											
DC (New Projects)											
	Mixed-Use	1.35	7%	11	0.55	0.59	26,041	0.03	30	1.51	1.51
	Non-Residential	18.58	93%	-	-	-	261,076	0.30	652	32.72	32.72
	Total	**19.93**	**100%**	**11**	**0.55**	**0.59**	**287,117**	**0.33**	**682**	**34.23**	**34.23**
DC (Infill Projects)											
	Non-Residential	6.08	100%	-	-	-	85,651	0.32	132	21.72	21.72
GC (New Projects)											
	Non-Residential	106.00	100%	-	-	-	1,212,390	0.26	1,882	17.76	17.76

Marysville UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Employment	Estimated Employment Per Acre	Employment Density Assumed
GC (Infill Projects)											
	Non-Residential	14.36	100%	-	-	-	202,381	0.32	235	16.37	16.37
MU and 88th MU (New Projects) (5)											
	Non-Residential	22.72	30%	-	-	-	250,079	0.08	614	8.17	8.17
	Multi-Family	47.11	63%	844	11.22	11.22	-	-	-	-	-
	Senior Apartments	5.42	7%	197	2.62	2.62	-	-	-	-	-
	Total	**75.25**	**100%**	**1,041**	**13.84**	**13.84**	**250,079**	**0.08**	**614**	**8.17**	**8.17**
(5) The Lodge is a horizontal mixed use project that has been seperated into Multi-Family and Non-Residential											
MU and 88th MU (Infill Projects)											
	Non-Residential	3.57	100%	-	-	-	14,667	0.09	15	4.09	4.09
LI and GI (New Projects)											
	Non-Residential	116.04	100%	-	-	-	743,491	0.15	990	8.53	8.53 (6)
(6) Light Industrial densities are applied to the GI zone due to a small sample size within the GI zone											
LI and GI (Infill Projects)											
	Non-Residential	69.88	100%	-	-	-	382,454	0.13	723	10.35	10.35

Figure Pop-H. Monroe UGA Population

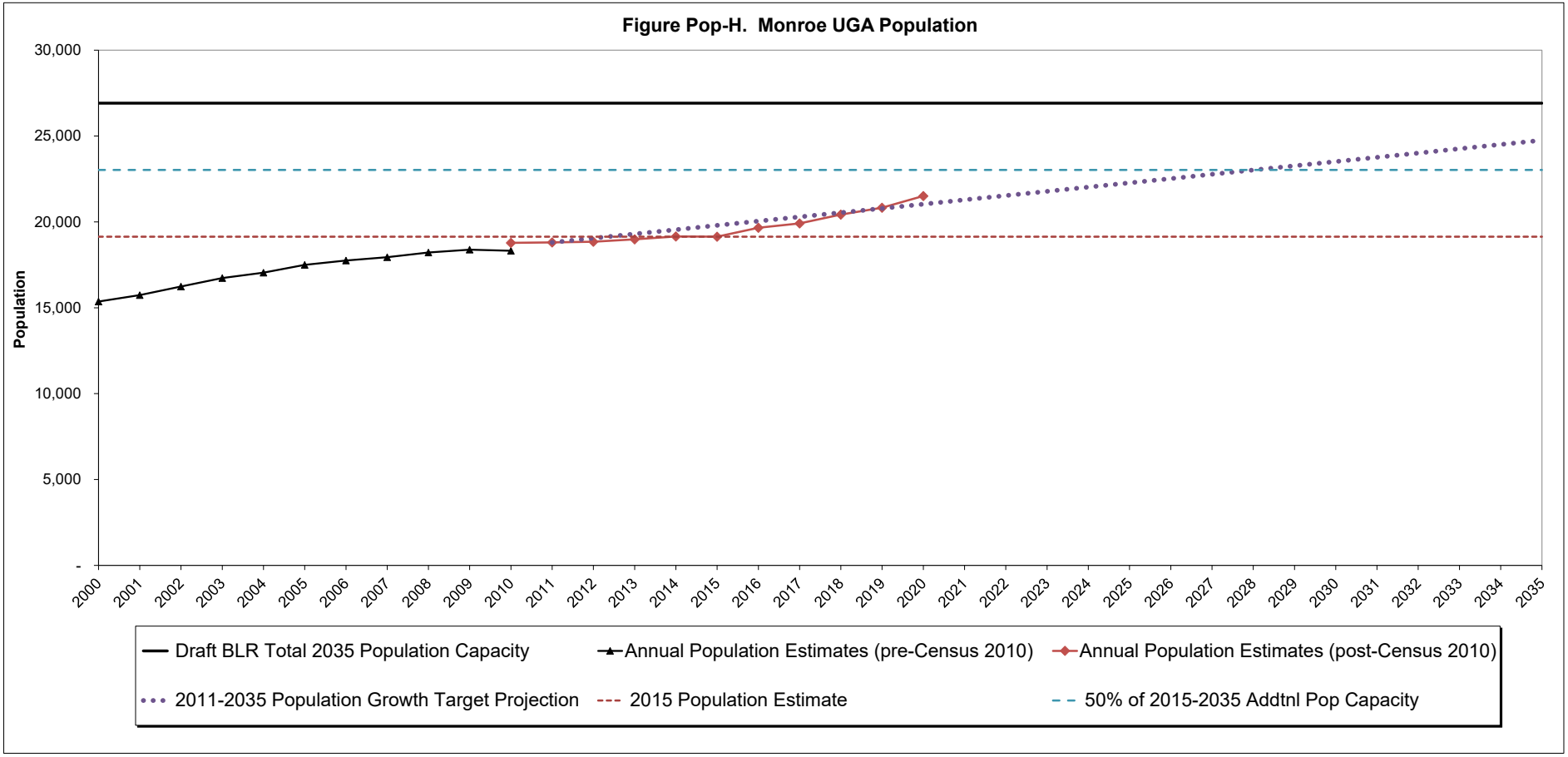

Table Pop-H. Monroe UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B	= (C-B)/(H)*100
15,364	18,318	18,781	463	2.5%	18,806	18,846	18,987	19,153	19,139	19,661	19,913	20,430	20,826	21,510	2,705	24,754	5,948	45.5%	26,914	7,775	30.5%

Population

Monroe UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Monroe UGA	CITY12	(1) PENDING		DC	7.377	5.192155	2.185	.000	0	0	170	0	170	0	0	170	0	170	0	0	313	0	313
				MG	5.102	.4739188	4.628	.000	43	64	10	0	117	43	64	10	0	117	124	163	18	0	305
				R15	2.067	.0000000	2.067	.000	17	0	0	0	17	17	0	0	0	17	49	0	0	0	49
				R25	13.487	7.695405	5.791	.000	29	0	112	0	141	29	0	112	0	141	84	0	206	0	290
				R4	86.803	10.65016	76.153	.000	432	0	0	0	432	432	0	0	0	432	1244	0	0	0	1244
				R7	4.190	3.780091	.410	.000	30	0	0	0	30	30	0	0	0	30	86	0	0	0	86
			Sum		119.027	27.79173	91.235	.000	551	64	292	0	907	551	64	292	0	907	1587	163	537	0	2287
		Sum			119.027	27.79173	91.235	.000	551	64	292	0	907	551	64	292	0	907	1587	163	537	0	2287
		(2) VACANT		DC	.535	.0000000	.535	.000	3	0	1	0	4	2	0	1	0	3	7	0	1	0	8
				MG	.545	.0000000	.545	.000	0	0	7	0	7	0	0	6	0	6	0	0	10	0	10
				MN	.124	.0000000	.124	.000	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				R15	1.577	.0287615	1.548	.000	3	0	10	1	14	2	0	8	1	11	7	0	15	1	23
				R25	1.601	.6875880	.914	.000	0	0	16	0	16	0	0	13	0	13	0	0	24	0	24
				R4	41.528	21.63373	19.894	.000	81	0	0	0	81	68	0	0	0	68	195	0	0	0	195
				R7	2.940	2.939973	.000	.000	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
			Sum		48.850	25.29005	23.560	.000	89	0	34	1	124	74	0	28	1	103	214	0	51	1	265
		Sum			48.850	25.29005	23.560	.000	89	0	34	1	124	74	0	28	1	103	214	0	51	1	265
		(3) PARTUSE		DC	.557	.0000000	.557	.557	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
				MG	.646	.0000000	.646	.646	0	0	9	0	9	0	0	6	0	6	0	0	11	0	11
				R15	14.233	.0000000	14.233	9.719	7	0	65	7	79	5	0	48	5	58	15	0	87	6	108
				R25	.295	.0000000	.295	.295	0	0	5	0	5	0	0	3	0	3	0	0	6	0	6
				R4	80.722	10.19372	70.529	63.213	242	0	0	0	242	193	0	0	0	193	556	0	0	0	556
				R7	46.671	18.61953	28.052	25.892	149	0	21	0	170	119	0	17	0	136	342	0	31	0	373
				TC	3.499	1.586620	1.912	1.128	0	0	0	5	5	0	0	0	3	3	0	0	0	4	4
			Sum		146.623	30.39987	116.223	101.450	398	0	103	12	513	317	0	76	8	401	913	0	139	10	1062
		Sum			146.623	30.39987	116.223	101.450	398	0	103	12	513	317	0	76	8	401	913	0	139	10	1062

		(4) REDEV		DC	1.810	.0000000	1.810	.000	0	0	11	0	11	0	0	7	0	7	0	0	13	0	13
				MG	18.131	1.542703	16.589	.000	-30	0	202	0	172	-20	0	134	0	114	-57	0	247	0	190
				MN	6.927	.0104105	6.917	.000	-14	12	36	0	34	-9	8	24	0	23	-27	20	44	0	38
				R15	14.974	.1089227	14.865	.000	-2	0	100	8	106	-1	0	73	6	78	-4	0	135	7	137
				R25	14.881	.3115409	14.569	.000	-55	0	190	0	135	-37	0	126	0	90	-105	0	232	0	127
				R4	30.760	5.817044	24.943	.000	77	0	0	0	77	61	0	0	0	61	177	0	0	0	177
				R7	21.484	11.52365	9.961	.000	49	0	7	0	56	39	0	6	0	45	113	0	10	0	123
				TC	3.122	1.456328	1.666	.000	-1	0	0	7	6	-1	0	0	5	4	-2	0	0	5	4
			Sum		112.091	20.77060	91.320	.000	24	12	546	15	597	33	8	371	11	422	94	20	682	12	809
		Sum			112.091	20.77060	91.320	.000	24	12	546	15	597	33	8	371	11	422	94	20	682	12	809
	Sum				426.590	104.2522	322.338	101.450	1062	76	975	28	2141	975	72	766	20	1833	2808	183	1409	23	4423
Sum					426.590	104.2522	322.338	101.450	1062	76	975	28	2141	975	72	766	20	1833	2808	183	1409	23	4423

Monroe UGA - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Monroe UGA - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Monroe UGA	UNINC	(1) PENDING		LDSFR	60.175	31.62833	28.546	.000	103	0	0	0	103	103	0	0	0	103	297	0	0	0	297
				MDSFR	79.390	36.48959	42.900	.000	200	0	0	0	200	200	0	0	0	200	576	0	0	0	576
			Sum		139.564	68.11792	71.446	.000	303	0	0	0	303	303	0	0	0	303	873	0	0	0	873
		Sum			139.564	68.11792	71.446	.000	303	0	0	0	303	303	0	0	0	303	873	0	0	0	873
		(2) VACANT		LDSFR	6.082	4.712833	1.369	.000	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
				LDSFR UE	1.852	.3660998	1.485	.000	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
			Sum		7.933	5.078933	2.854	.000	10	0	0	0	10	8	0	0	0	8	24	0	0	0	24
		Sum			7.933	5.078933	2.854	.000	10	0	0	0	10	8	0	0	0	8	24	0	0	0	24
		(3) PARTUSE		LDSFR	21.459	13.17360	8.285	6.864	23	0	0	0	23	18	0	0	0	18	53	0	0	0	53
				LDSFR UE	1.288	.7072411	.581	.581	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				MDSFR	24.442	1.778779	22.663	21.482	124	0	17	0	141	99	0	14	0	113	285	0	25	0	310
				MU	3.121	.6864124	2.435	2.027	0	0	28	0	28	0	0	19	0	19	0	0	34	0	34
			Sum		50.310	16.34603	33.964	30.954	148	0	45	0	193	118	0	32	0	150	340	0	59	0	399
		Sum			50.310	16.34603	33.964	30.954	148	0	45	0	193	118	0	32	0	150	340	0	59	0	399
		(4) REDEV		LDSFR	36.594	26.75592	9.838	.000	26	0	0	0	26	21	0	0	0	21	60	0	0	0	60
				MDSFR	25.167	3.400019	21.767	.000	121	0	19	0	140	97	0	15	0	112	278	0	28	0	306
				MU	1.062	.6123967	.450	.000	-1	0	4	0	3	-1	0	3	0	2	-2	0	5	0	3
			Sum		62.823	30.76833	32.054	.000	146	0	23	0	169	117	0	18	0	134	336	0	33	0	369
		Sum			62.823	30.76833	32.054	.000	146	0	23	0	169	117	0	18	0	134	336	0	33	0	369
	Sum				260.630	120.3112	140.319	30.954	607	0	68	0	675	546	0	50	0	596	1573	0	92	0	1665
Sum					260.630	120.3112	140.319	30.954	607	0	68	0	675	546	0	50	0	596	1573	0	92	0	1665

Figure Emp-I. Monroe UGA Employment

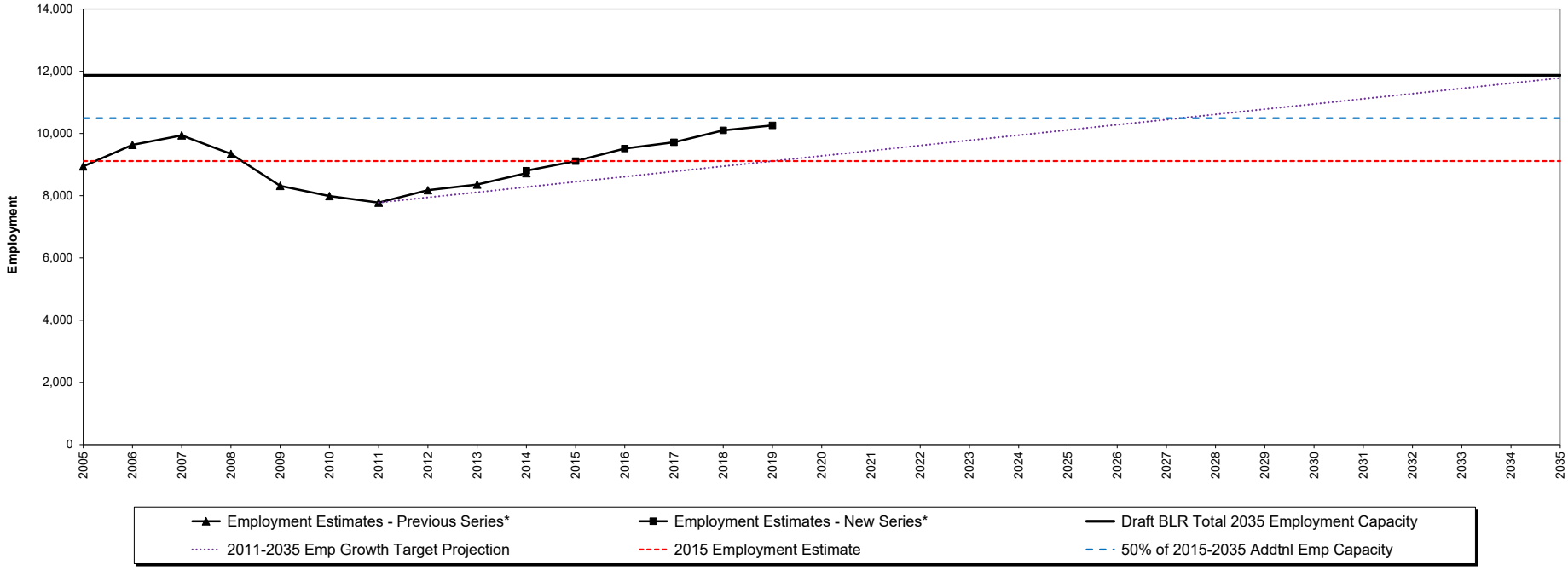

Table Emp-I. Monroe UGA Employment Statistics

	(A)				(B)						(C)	(D)	(E)	(F)		(G)	(H)	
	Employment Estimates																	
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
Monroe UGA	7,987	7,779	8,180	8,360	8,724	8,805	9,114	9,516	9,720	10,103	10,260	2,481	11,781	4,002	62.0%	11,870	2,756	41.6%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Monroe UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Monroe UGA	CITY12	(1) PENDING		DC	.209	.0000000	.209	.000	15	0	0	15	15	0	0	15
				R25	10.317	7.695405	2.621	.000	2	0	0	2	2	0	0	2
			Sum		10.526	7.695405	2.830	.000	17	0	0	17	17	0	0	17
		Sum			10.526	7.695405	2.830	.000	17	0	0	17	17	0	0	17
		(2) VACANT		DC	.535	.0000000	.535	.000	20	0	1	21	16	0	1	17
				GC	6.245	2.933777	3.311	.000	53	0	0	53	42	0	0	42
				IT	.392	.1952845	.196	.000	2	1	0	3	1	1	0	3
				MG	.545	.0000000	.545	.000	8	0	0	8	7	0	0	7
				MN	.124	.0000000	.124	.000	2	0	0	2	1	0	0	1
			Sum		7.840	3.129061	4.711	.000	84	1	1	86	68	1	1	69
		Sum			7.840	3.129061	4.711	.000	84	1	1	86	68	1	1	69
		(3) PARTUSE		DC	.557	.0000000	.557	.557	20	0	0	20	13	0	0	13
				GC	42.699	13.88979	28.809	28.809	455	1	0	456	303	1	0	303
				MG	.646	.0000000	.646	.646	10	0	0	10	6	0	0	6
				MM												

					.407	.0000000	.407	.137	8	0	0	8	5	0	0	5
				TC												
					3.499	1.586620	1.912	1.128	17	0	0	17	11	0	0	11
			Sum		47.808	15.47641	32.331	31.277	509	1	0	510	339	1	0	339
		Sum			47.808	15.47641	32.331	31.277	509	1	0	510	339	1	0	339
		(4) REDEV		DC												
					14.361	1.895043	12.466	.000	451	0	16	467	300	0	11	311
				GC												
					38.378	8.500391	29.877	.000	411	0	0	411	273	0	0	273
				IT												
					6.001	2.936431	3.065	.000	9	21	0	30	6	14	0	20
				LI												
					17.806	7.461008	10.345	.000	36	224	0	260	24	149	0	173
				MG												
					21.509	1.542703	19.966	.000	297	0	0	297	198	0	0	198
				MM												
					.998	.0000000	.998	.000	51	0	0	51	34	0	0	34
				MN												
					9.434	.0104105	9.424	.000	113	0	2	115	75	0	1	76
				SI												
					7.508	2.731921	4.776	.000	17	103	0	120	11	69	0	80
				TC												
					4.410	2.525808	1.884	.000	28	0	0	28	19	0	0	19
			Sum		120.405	27.60372	92.801	.000	1413	349	18	1780	940	232	12	1183
		Sum			120.405	27.60372	92.801	.000	1413	349	18	1780	940	232	12	1183
	Sum				186.578	53.90459	132.673	31.277	2023	351	19	2393	1363	234	12	1609
Sum					186.578	53.90459	132.673	31.277	2023	351	19	2393	1363	234	12	1609

Monroe UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Monroe UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Monroe UGA	UNINC	(4) REDEV		MU	.374	.2510013	.122	.000	2	0	0	2	1	0	0	1
			Sum		.374	.2510013	.122	.000	2	0	0	2	1	0	0	1
		Sum			.374	.2510013	.122	.000	2	0	0	2	1	0	0	1

Sum	.374	.2510013	.122	.000	2	0	0	2	1	0	0	1
Sum	.374	.2510013	.122	.000	2	0	0	2	1	0	0	1

City of Monroe

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
Limited Open Space											
	Single Family		No Data Available			0.20	-	-	-	-	-
R-4											
	Single Family	225.06	100%	926	4.11	4.11	-	-	-	-	-
R-7											
	Single Family	25.39	97%	140	5.32	6.00 (1)	-	-	-	-	-
	Multi-Family	0.91	3%	8	0.30	1.00 (1)					
	Total	**26.30**	**100%**	**148**	**5.63**	**7.00 (1)**					
(1) This report assumes higher densities in R-7 than what was previously observed in the former but comparable UR-6000 due to zoning changes.											
R-15											
	Single Family					2.06 (2)	-	-	-	-	-
	Multi-Family		No Data Available			7.83 (2)					
	Senior Apartment					2.09 (2)					
	Total					**11.98 (2)**					
(2) The residential densities are based off of what was previously achieved in the MR-6000 zone											
R-25											
	Multi-Family		No Data Available			18.00 (3)	-	-	-	-	-
(3) R-25 is a new zone that has a minimum density requirement of 12 dwelling units per acre and a maximum of 25 dwelling units per acre											

City of Monroe

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
TC											
	Senior Apartments		No Data Available			5.00 (4)					
	Non-Residential		No Data Available					No Data Available			10.00 (4)
	Total					**5.00 (4)**					**10.00 (4)**
(4) The assumed job sector breakdown is: 5 Retail, 5 Services, and 5 Food Services.											
DC (New Projects)											
	Multi-Family	0.63	52%	6	4.99	4.99	-	-	-	-	-
	Mixed-Use	0.12	10%	2	1.66	1.66	2,775	0.05	7	6.16	6.16
	Non-Residential	0.46	38%	-	-	-	17,427	0.33	39	32.36	32.36
	Total	**1.20**	**100%**	**8**	**6.65**	**6.65**	**20,202**	**0.39**	**46**	**38.51**	**38.52**
DC (Infill Projects)											
	Non-Residential	1.17	100%	-	-	-	23,104	0.45	42	36.21	36.21
GC and GI (New Projects)											
	Non-Residential	94.84	100%	-	-	-	836,934	0.20	1,506	15.88	15.88
GC and GI (Infill Projects)											
	Non-Residential	27.49	100%	-	-	-	295,736	0.25	435	15.82	15.82
IT											
	Non-Residential		No Data Available					No Data Available			16.00 (5)
(5) The Industrial transition allows a mix of industrial and commercial uses. The employment density was based on an average of Light Industrial and General Commercial. The job sector breakdown is 7 Retail, 7 Manufacturing, 1 Food Services, and 1 Services.											
LI and SI (New Projects)											
	Non-Residential	104.10	100%	-	-	-	1,618,541	0.36	2,616	25.13	25.13

City of Monroe

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
LI and SI (Infill Projects)											
	Non-Residential	13.59	100%	-	-	-	225,879	0.38	233	17.12	17.12
MU - G											
	Multi-Family					10.00 (6)					-
	Mixed-Use		No Data Available			5.00 (6)		No Data Available			4.00 (7)
	Non-Residential					-					11.00 (7)
	Total					**15.00 (6)**					**15.00 (7)**
(6) The minimum allowed density is 12 units per acre and the maximum allowed density is 25 units per acre. The report anticipates future development to be similar to though less dense than Monroe Family Village which achieved 19.35 units per acre in the former Mixed Use Commercial zone.											
(7) The assumed job sector breakdown is: 5 Retail, 5 Services, and 5 FIRE.											
MU - M (8)											
	Non-Residential		No Data Available					No Data Available			55.04 (9)
(8) No residential density forecasted because only temporary caretaker housing allowed											
(9) Based off the 'Medical Services' zone in the City of Arlington that achieved an employment density of 55.04.											
MU - N											
	Townhouse					2.81 (10)					
	Multi-Family		No Data Available			3.45 (10)		No Data Available			
	Mixed-Use					2.38 (10)					4.00 (11)
	Non-Residential					-					8.00 (11)
	Total					**8.64 (10)**					**12.00 (11)**
(10) Residential density is based on what was achieved in the former Mixed Use Neighborhood Center zone.											
(11) Employment density is based on but lower than the achevied employment densities from the former Mixed Use Neighborhood Center zone. The assumed job sector breakdown is: 8 FIRE and 4 Services.											

Figure Pop-I. Snohomish UGA Population

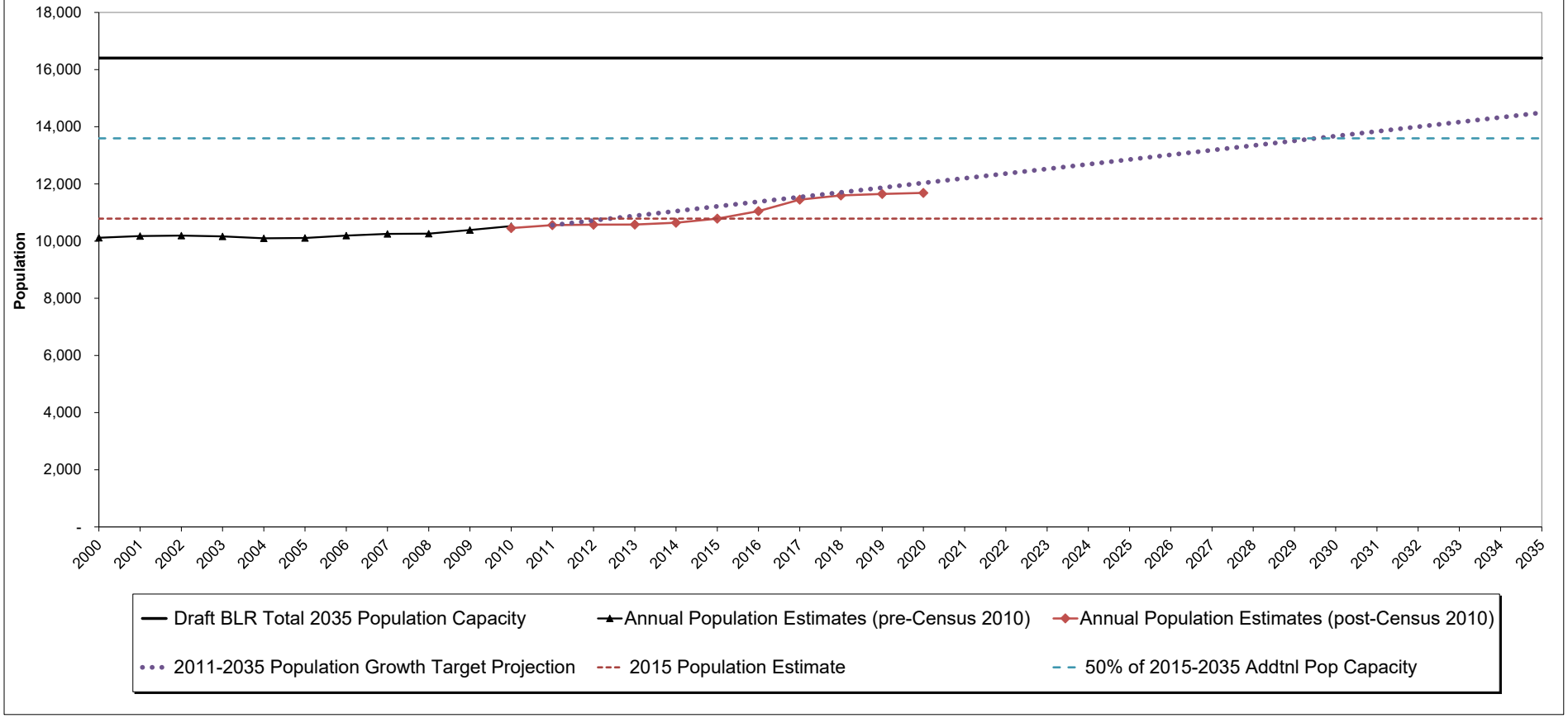

Table Pop-I. Snohomish UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B	= (C-B)/(H)*100
10,118	10,525	10,456	-69	-0.7%	10,559	10,576	10,579	10,643	10,786	11,049	11,449	11,598	11,650	11,687	1,128	14,494	3,935	28.7%	16,404	5,618	16.0%

Population

Snohomish UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Snohomish UGA	CITY12	(1) PENDING		HDR	3.234	1.617221	1.617	.000	0	30	0	0	30	0	30	0	0	30	0	76	0	0	76
				MDR	21.144	7.065093	14.079	.000	113	0	6	0	119	113	0	6	0	119	325	0	11	0	336
				MU	1.442	.6541719	.788	.000	3	0	6	0	9	3	0	6	0	9	9	0	11	0	20
				SFR	26.720	12.33353	14.387	.000	86	0	0	0	86	86	0	0	0	86	248	0	0	0	248
			Sum		52.541	21.67002	30.871	.000	202	30	12	0	244	202	30	12	0	244	582	76	22	0	680
		Sum			52.541	21.67002	30.871	.000	202	30	12	0	244	202	30	12	0	244	582	76	22	0	680
		(2) VACANT		BP	32.801	20.49554	12.306	.000	7	0	16	0	23	6	0	13	0	19	16	0	24	0	40
				COM	20.409	11.06737	9.342	.000	7	0	76	0	83	6	0	61	0	67	16	0	113	0	129
				HDR	.623	.2438114	.379	.000	0	0	7	0	7	0	0	6	0	6	0	0	10	0	10
				LDR	.123	.0000000	.123	.000	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				MDR	.087	.0000000	.087	.000	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				MU	.481	.0000000	.481	.000	0	0	6	0	6	0	0	5	0	5	0	0	9	0	9
				PIL	.500	.0000000	.500	.000	0	0	6	0	6	0	0	5	0	5	0	0	9	0	9
				SFR	30.081	10.41353	19.667	.000	98	0	0	0	98	82	0	0	0	82	236	0	0	0	236
			Sum		85.105	42.22025	42.884	.000	114	0	111	0	225	95	0	90	0	185	273	0	165	0	438
		Sum			85.105	42.22025	42.884	.000	114	0	111	0	225	95	0	90	0	185	273	0	165	0	438
		(3) PARTUSE		BP	67.875	14.19802	53.677	53.677	0	0	82	0	82	0	0	55	0	55	0	0	100	0	100
				COM	4.732	.0000000	4.732	4.732	1	0	38	0	39	1	0	25	0	26	2	0	46	0	48
				MDR	4.170	.3365856	3.833	3.260	11	0	11	0	22	8	0	8	0	16	23	0	15	0	38
				PIL	.969	.0000000	.969	.969	0	0	14	0	14	0	0	9	0	9	0	0	17	0	17
				SFR	107.231	38.82162	68.409	53.854	247	0	0	0	247	197	0	0	0	197	568	0	0	0	568
			Sum		184.977	53.35622	131.621	116.493	259	0	145	0	404	206	0	97	0	303	593	0	179	0	772
		Sum			184.977	53.35622	131.621	116.493	259	0	145	0	404	206	0	97	0	303	593	0	179	0	772
		(4) REDEV		BP	32.605	9.791895	22.813	.000	-9	0	23	0	14	-6	0	15	0	9	-17	0	28	0	11
				COM	15.573	6.003333	9.569	.000	0	0	72	0	72	0	0	48	0	48	0	0	88	0	88

				HBD	4.254	.4012824	3.853	.000	-3	0	41	0	38	-2	0	27	0	25	-6	0	50	0	44
				HDR	4.346	.3089918	4.037	.000	-23	0	47	0	24	-15	0	31	0	16	-44	0	58	0	13
				LDR	7.997	3.680521	4.317	.000	29	0	0	0	29	23	0	0	0	23	67	0	0	0	67
				MDR	6.762	3.090755	3.671	.000	5	0	11	0	16	4	0	8	0	12	11	0	15	0	25
				MU	1.906	.5258916	1.380	.000	-4	0	14	0	10	-3	0	9	0	7	-8	0	17	0	9
				PIL	18.728	3.194626	15.533	.000	-31	0	189	0	158	-21	0	126	0	105	-59	0	231	0	172
				SFR	78.522	25.19603	53.326	.000	209	0	0	0	209	167	0	0	0	167	480	0	0	0	480
			Sum		170.693	52.19333	118.500	.000	173	0	397	0	570	147	0	265	0	412	423	0	487	0	911
		Sum			170.693	52.19333	118.500	.000	173	0	397	0	570	147	0	265	0	412	423	0	487	0	911
	Sum				493.316	169.4398	323.876	116.493	748	30	665	0	1443	650	30	464	0	1143	1871	76	853	0	2800
Sum					493.316	169.4398	323.876	116.493	748	30	665	0	1443	650	30	464	0	1143	1871	76	853	0	2800

Snohomish UGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Snohomish UGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Snohomish UGA	UNINC	(2) VACANT		ULDR	4.239	.6549853	3.584	.000	17	0	0	0	17	14	0	0	0	14	41	0	0	0	41
			Sum		4.239	.6549853	3.584	.000	17	0	0	0	17	14	0	0	0	14	41	0	0	0	41
		Sum			4.239	.6549853	3.584	.000	17	0	0	0	17	14	0	0	0	14	41	0	0	0	41
		(3) PARTUSE		UCOM	5.717	.0842465	5.633	5.009	0	0	6	0	6	0	0	4	0	4	0	0	7	0	7
				ULDR	205.840	71.45328	134.387	117.900	564	0	0	0	564	450	0	0	0	450	1296	0	0	0	1296
				UMDR	27.398	6.102777	21.295	18.542	90	0	0	0	90	72	0	0	0	72	207	0	0	0	207
			Sum		238.955	77.64030	161.315	141.451	654	0	6	0	660	522	0	4	0	526	1503	0	7	0	1510
		Sum			238.955	77.64030	161.315	141.451	654	0	6	0	660	522	0	4	0	526	1503	0	7	0	1510
		(4) REDEV		ULDR	61.094	22.45824	38.636	.000	148	0	0	0	148	118	0	0	0	118	340	0	0	0	340
				UMDR	9.684	3.146176	6.538	.000	27	0	0	0	27	22	0	0	0	22	62	0	0	0	62
			Sum		70.778	25.60442	45.174	.000	175	0	0	0	175	140	0	0	0	140	402	0	0	0	402
		Sum			70.778	25.60442	45.174	.000	175	0	0	0	175	140	0	0	0	140	402	0	0	0	402
	Sum				313.972	103.8997	210.072	141.451	846	0	6	0	852	676	0	4	0	680	1946	0	7	0	1954
Sum					313.972	103.8997	210.072	141.451	846	0	6	0	852	676	0	4	0	680	1946	0	7	0	1954

Figure Emp-J. Snohomish UGA Employment

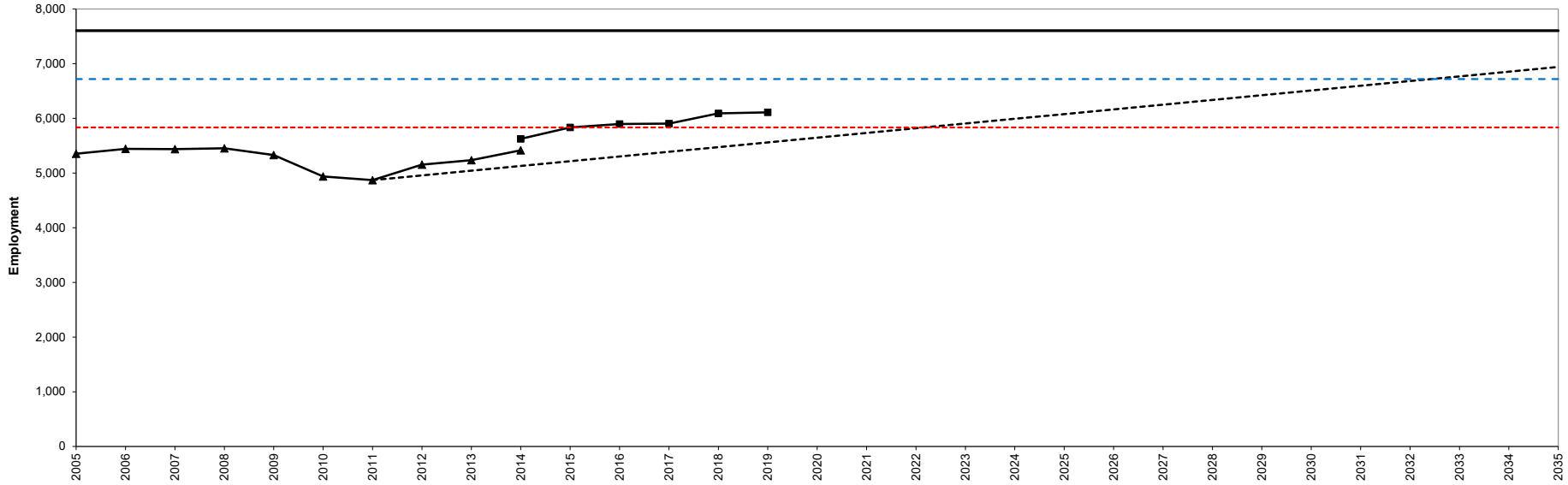

Table Emp-J. Snohomish UGA Employment Statistics

	(A)				(B) Employment Estimates						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth)	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)	= (D)/(F)*100	Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	= (C-B)/(H)*100
Snohomish UGA	4,938	4,871	5,154	5,235	5,417	5,626	5,834	5,896	5,905	6,091	6,110	1,239	6,941	2,070	59.9%	7,604	1,770	15.6%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Snohomish UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Snohomish UGA	CITY12	(2) VACANT		BP	26.724	14.41850	12.306	.000	146	50	0	196	118	40	0	158
				COM	20.409	11.06737	9.342	.000	111	17	1	129	89	14	0	104
				IND	16.617	16.52179	.095	.000	0	2	0	2	0	2	0	2
				MU	.481	.0000000	.481	.000	5	1	0	5	4	1	0	4
				PIL	.537	.0000000	.537	.000	8	1	0	8	6	0	0	7
			Sum		64.768	42.00766	22.761	.000	269	70	1	340	217	57	1	275
		Sum			64.768	42.00766	22.761	.000	269	70	1	340	217	57	1	275
		(3) PARTUSE		BP	69.609	14.41091	55.198	54.923	568	0	0	568	378	0	0	378
				COM	4.732	.0000000	4.732	4.732	102	0	0	102	68	0	0	68
				PIL	1.133	.0000000	1.133	.982	22	0	0	22	14	0	0	14
			Sum		75.474	14.41091	61.063	60.637	691	0	0	691	460	0	0	460
		Sum			75.474	14.41091	61.063	60.637	691	0	0	691	460	0	0	460
		(4) REDEV		BP	50.143	21.90128	28.241	.000	307	114	1	422	204	76	0	280
				COM	19.540	7.560605	11.979	.000	125	22	1	148	83	15	0	98
				HBD												

					7.697	.9241179	6.773	.000	123	0	4	127	82	0	2	84
				IND												
					3.331	3.078229	.253	.000	1	6	0	6	0	4	0	4
				MU												
					6.406	2.315531	4.091	.000	38	6	0	44	25	4	0	29
				PIL												
					28.401	5.394805	23.006	.000	276	23	0	299	184	15	0	199
			Sum		115.518	41.17457	74.343	.000	870	171	5	1046	578	114	3	695
		Sum			115.518	41.17457	74.343	.000	870	171	5	1046	578	114	3	695
	Sum				255.760	97.59313	158.167	60.637	1830	242	6	2077	1255	171	4	1430
Sum					255.760	97.59313	158.167	60.637	1830	242	6	2077	1255	171	4	1430

Snohomish UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Snohomish UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Snohomis	UNINC	(1) PENDING		UCOM												
h UGA					1.564	.0000000	1.564	.000	6	2	0	8	6	2	0	8
			Sum		1.564	.0000000	1.564	.000	6	2	0	8	6	2	0	8
		Sum			1.564	.0000000	1.564	.000	6	2	0	8	6	2	0	8
		(3) PARTUSE		UCOM												
					6.271	.0842465	6.187	5.564	58	0	0	58	38	0	0	38
			Sum		6.271	.0842465	6.187	5.564	58	0	0	58	38	0	0	38
		Sum			6.271	.0842465	6.187	5.564	58	0	0	58	38	0	0	38
		(4) REDEV		UCOM												
					4.168	2.635526	1.532	.000	20	7	0	26	13	4	0	18
			Sum		4.168	2.635526	1.532	.000	20	7	0	26	13	4	0	18
		Sum			4.168	2.635526	1.532	.000	20	7	0	26	13	4	0	18
	Sum				12.003	2.719772	9.283	5.564	83	9	0	92	58	6	0	64
Sum					12.003	2.719772	9.283	5.564	83	9	0	92	58	6	0	64

Snohomish UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Within City Zones											
Single Family											
	Single Family	82.70	100%	429	5.19	5.19	-	-	-	-	-
LDR											
	Single Family	1.26	100%	9	7.12	7.12	-	-	-	-	-
MDR											
	Single Family	16.67	77%	97	4.47	4.47	-	-	-	-	-
	Multi-Family	4.79	22%	83	3.83	3.83	-	-	-	-	-
	Senior Apartment	0.22	1%	8	0.37	0.37	-	-	-	-	-
	Total	**21.69**	**100%**	**188**	**8.67**	**8.67**	**-**	**-**	**-**	**-**	**-**
HDR											
	Multi-Family	1.15	100%	22	19.07	19.07	-	-	-	-	-
BP (New Projects)											
	Multi-Family	5.75	8%	96	1.30	1.30	-	-	-	-	-
	Mixed-Use	7.36	10%	22	0.30	0.30	116,143	0.04	15	0.20	0.20
	Non-Residential	61.01	82%	-	-	-	699,177	0.22	1,164	15.71	15.71
	Total	**74.12**	**100%**	**118**	**1.60**	**1.60**	**815,320**	**0.25**	**1,179**	**15.91**	**15.91**
BP (Infill Projects)											
	Non-Residential	70.27	100%	-	-	-	597,673	0.20	727	10.35	10.35

Snohomish UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
COM (New Projects)											
	Single Family	0.83	8%	10	0.94	0.94	-	-	-	-	-
	Multi-Family	1.77	17%	50	4.68	4.68	-	-	-	-	-
	Mixed-Use	2.67	25%	43	4.03	4.03	32,734	0.07	65	6.13	6.13
	Non-Residential	5.41	51%	-	-	-	37,950	0.08	82	7.68	7.68
	Total	**10.68**	**100%**	**103**	**9.65**	**9.65**	**70,684**	**0.15**	**147**	**13.81**	**13.81**
COM (Infill Projects)											
	Non-Residential	5.96	100%	-	-	-	64,966	0.25	128	21.52	21.52
HB											
	Multi-Family	1.28	34%	24	6.35	6.35	-	-	-	-	-
	Mixed-Use	1.58	42%	25	6.62	6.62	18,529	0.11	46	12.18	12.18
	Non-Residential	0.92	24%	-	-	-	11,640	0.07	31	8.20	8.20
	Total	**3.78**	**100%**	**49**	**12.97**	**12.97**	**30,169**	**0.18**	**77**	**20.38**	**20.38**
MU											
	Multi-Family	2.00	44%	38	8.43	8.43	-	-	-	-	-
	Mixed-Use	1.39	31%	26	5.77	5.77	7,890	0.04	4	0.89	0.89
	Non-Residential	1.12	25%	-	-	.	18,567	0.09	46	10.20	10.20
	Total	**4.51**	**100%**	**64**	**14.20**	**14.20**	**26,457**	**0.13**	**50**	**11.09**	**11.09**
PCD (New Projects)											
	Mixed Use	No Data (New Zone)				15.00	No Data (New Zone)				15.00 (1)
(1) This report assumes a job sector distribution of 8 Service, 3 Retail, 2 Food Service, 1 FIRE, and 1 WTU.											
PCD (Infill Projects)											
	Non-Residential	3.15	100%	-	-	-	43,605	0.32	69	22.05	22.05

Snohomish UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
IND (New Projects)											
	Non-Residential	1.21	100%	-	-	-	26,508	0.50	30	24.75	24.75
IND (Infill Projects)											
	Non-Residential	9.78	100%	-	-	-	50,239	0.12	70	7.17	7.17

Figure Pop-J. Stanwood UGA Population

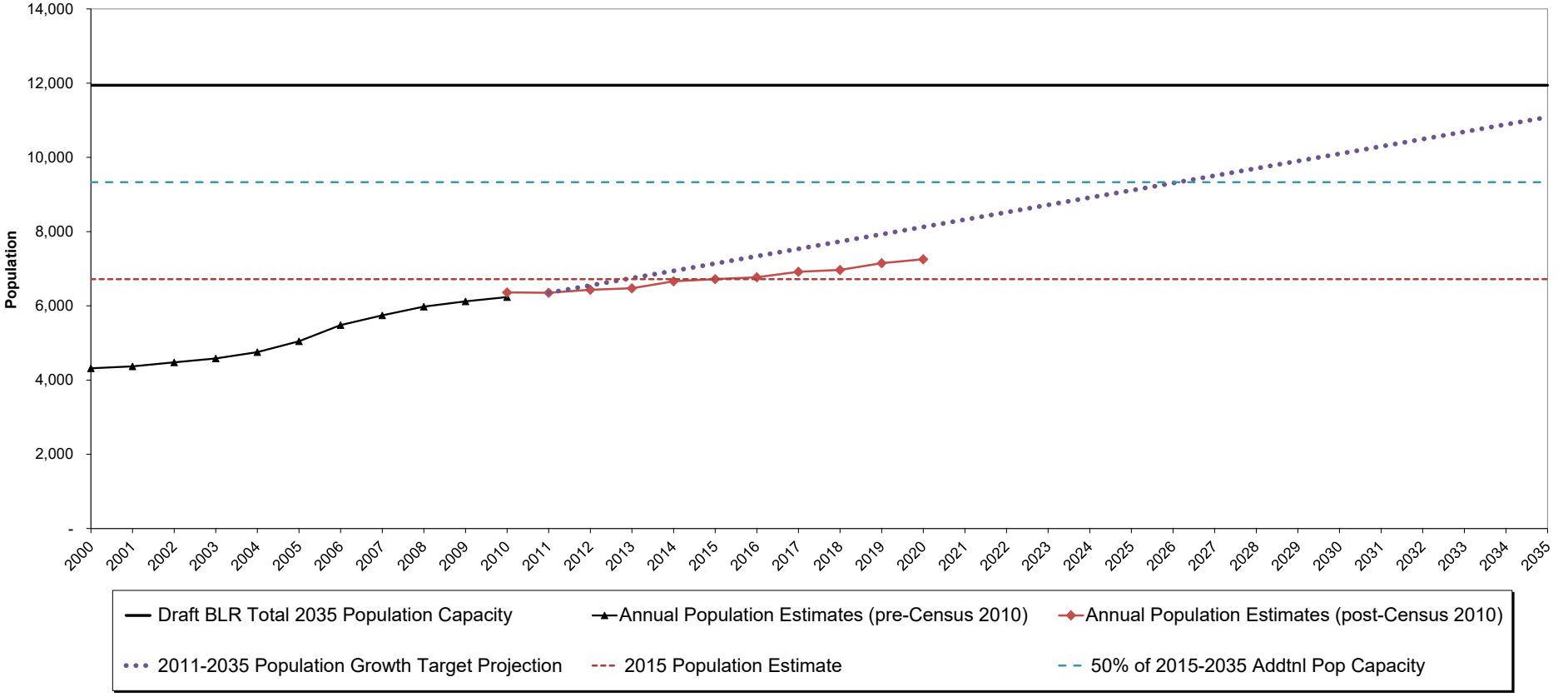

Table Pop-J. Stanwood UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B) Post-Census Pop Estimates									(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
2000	2010	Pop	Diff. (Census-Est) No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		2011-20 Numeric Change = (C) - (A)	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap = (G) - (B	= (C-B)/(H)*100
4,318	6,237	6,364	127	2.0%	6,353	6,433	6,473	6,663	6,720	6,771	6,919	6,969	7,149	7,257		904	11,085	4,732	19.1%	11,944	5,224	10.3%

Stanwood UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Stanwood UGA	CITY12	(1) PENDING		GC	9.580	1.013930	8.566	.000	0	0	295	0	295	0	0	295	0	295	0	0	543	0	543
				MR	1.884	.7864430	1.097	.000	2	0	0	0	2	2	0	0	0	2	6	0	0	0	6
				SR 7.0	4.327	.0000000	4.327	.000	17	0	0	0	17	17	0	0	0	17	49	0	0	0	49
				SR 9.6	41.666	14.80847	26.857	.000	163	0	0	0	163	163	0	0	0	163	469	0	0	0	469
				TN	19.041	10.17831	8.863	.000	80	0	1	0	81	80	0	1	0	81	230	0	2	0	232
			Sum		76.497	26.78715	49.710	.000	262	0	296	0	558	262	0	296	0	558	755	0	545	0	1299
		Sum			76.497	26.78715	49.710	.000	262	0	296	0	558	262	0	296	0	558	755	0	545	0	1299
		(2) VACANT		GC	.661	.0010619	.660	.000	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
				MR	5.955	2.635548	3.320	.000	2	0	36	6	44	2	0	29	5	36	5	0	53	6	64
				SR 12.4	.270	.0563445	.214	.000	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				SR 5.0	14.850	10.93952	3.911	.000	2	0	36	0	38	2	0	29	0	31	5	0	54	0	59
				SR 7.0	3.723	.2139224	3.509	.000	15	0	0	0	15	13	0	0	0	13	36	0	0	0	36
				SR 9.6	11.694	1.615937	10.078	.000	38	0	0	0	38	32	0	0	0	32	91	0	0	0	91
				TN	23.417	10.24847	13.168	.000	78	0	52	0	130	64	0	42	0	106	184	0	78	0	262
			Sum		60.571	25.71080	34.860	.000	136	0	127	6	269	112	0	103	5	220	323	0	190	6	519
		Sum			60.571	25.71080	34.860	.000	136	0	127	6	269	112	0	103	5	220	323	0	190	6	519
		(3) PARTUSE		GC	2.085	.0327480	2.052	.479	0	0	2	0	2	0	0	1	0	1	0	0	2	0	2
				MR	1.635	.0853791	1.549	.513	0	0	4	0	4	0	0	3	0	3	0	0	5	0	5
				SR 5.0	1.020	.0000000	1.020	.236	0	0	2	0	2	0	0	1	0	1	0	0	3	0	3
				SR 7.0	3.152	.0067655	3.145	1.409	5	0	0	0	5	4	0	0	0	4	11	0	0	0	11
				SR 9.6	59.928	6.730629	53.197	34.931	108	0	0	0	108	86	0	0	0	86	248	0	0	0	248
			Sum		67.819	6.855521	60.964	37.567	113	0	8	0	121	90	0	5	0	96	260	0	10	0	270
		Sum			67.819	6.855521	60.964	37.567	113	0	8	0	121	90	0	5	0	96	260	0	10	0	270
		(4) REDEV		GC	.960	.0000000	.960	.000	-1	0	4	0	3	-1	0	3	0	2	-2	0	5	0	3
				MR	24.116	7.386792	16.729	.000	2	0	179	23	204	1	0	119	15	136	4	0	219	18	241

				SR 5.0	.596	.2408525	.356	.000	-1	0	2	0	1	-1	0	1	0	1	-2	0	3	0	1
				SR 7.0	3.025	.0000000	3.025	.000	8	0	0	0	8	6	0	0	0	6	18	0	0	0	18
				SR 9.6	17.549	1.859901	15.689	.000	35	0	0	0	35	28	0	0	0	28	80	0	0	0	80
				TN	77.637	10.88511	66.752	.000	393	0	266	0	659	287	0	195	0	482	828	0	358	0	1186
			Sum		123.883	20.37266	103.511	.000	436	0	451	23	910	322	0	318	15	655	927	0	585	18	1529
			MARKET-READY	GC	.605	.3217536	.283	.000	0	0	1	0	1	0	0	1	0	1	0	0	2	0	2
			Sum		.605	.3217536	.283	.000	0	0	1	0	1	0	0	1	0	1	0	0	2	0	2
		Sum			124.489	20.69441	103.794	.000	436	0	452	23	911	322	0	319	15	656	927	0	586	18	1531
	Sum				329.376	80.04789	249.328	37.567	947	0	883	29	1859	786	0	724	20	1530	2264	0	1331	24	3619
Sum					329.376	80.04789	249.328	37.567	947	0	883	29	1859	786	0	724	20	1530	2264	0	1331	24	3619

Stanwood UGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Stanwood UGA	CITY21	(1) PENDING		TN	36.457	18.08072	18.376	.000	125	0	0	0	125	125	0	0	0	125	360	0	0	0	360
			Sum		36.457	18.08072	18.376	.000	125	0	0	0	125	125	0	0	0	125	360	0	0	0	360
		Sum			36.457	18.08072	18.376	.000	125	0	0	0	125	125	0	0	0	125	360	0	0	0	360
		(4) REDEV		TN	16.677	11.70028	4.977	.000	28	0	19	0	47	20	0	14	0	34	59	0	26	0	85
			Sum		16.677	11.70028	4.977	.000	28	0	19	0	47	20	0	14	0	34	59	0	26	0	85
		Sum			16.677	11.70028	4.977	.000	28	0	19	0	47	20	0	14	0	34	59	0	26	0	85
	Sum				53.134	29.78100	23.353	.000	153	0	19	0	172	145	0	14	0	159	419	0	26	0	445
Sum					53.134	29.78100	23.353	.000	153	0	19	0	172	145	0	14	0	159	419	0	26	0	445

Stanwood UGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Stanwood UGA	UNINC	(1) PENDING			10.459	.0000000	10.459	.000	0	0	60	0	60	0	0	60	0	60	0	0	110	0	110
			Sum		10.459	.0000000	10.459	.000	0	0	60	0	60	0	0	60	0	60	0	0	110	0	110
		Sum			10.459	.0000000	10.459	.000	0	0	60	0	60	0	0	60	0	60	0	0	110	0	110
		(2) VACANT		ULDR	11.213	1.782838	9.431	.000	29	0	0	0	29	24	0	0	0	24	70	0	0	0	70
				UMDR	2.300	.0000000	2.300	.000	7	0	0	0	7	6	0	0	0	6	17	0	0	0	17
			Sum		13.513	1.782838	11.731	.000	36	0	0	0	36	30	0	0	0	30	87	0	0	0	87
		Sum			13.513	1.782838	11.731	.000	36	0	0	0	36	30	0	0	0	30	87	0	0	0	87
		(3) PARTUSE		ULDR	40.470	13.07884	27.391	21.277	67	0	0	0	67	53	0	0	0	53	154	0	0	0	154
				UMDR	19.107	5.771147	13.336	11.461	52	0	0	0	52	41	0	0	0	41	120	0	0	0	120
			Sum		59.577	18.84999	40.727	32.738	119	0	0	0	119	95	0	0	0	95	273	0	0	0	273
		Sum			59.577	18.84999	40.727	32.738	119	0	0	0	119	95	0	0	0	95	273	0	0	0	273
		(4) REDEV		UI	34.022	23.08821	10.934	.000	63	0	43	0	106	42	0	29	0	70	121	0	53	0	173
				ULDR	24.480	12.24355	12.237	.000	34	0	0	0	34	27	0	0	0	27	78	0	0	0	78
				UMDR	1.699	.0000000	1.699	.000	4	0	0	0	4	3	0	0	0	3	9	0	0	0	9
			Sum		60.202	35.33176	24.870	.000	101	0	43	0	144	72	0	29	0	101	208	0	53	0	261
		Sum			60.202	35.33176	24.870	.000	101	0	43	0	144	72	0	29	0	101	208	0	53	0	261
	Sum				143.751	55.96459	87.787	32.738	256	0	103	0	359	197	0	89	0	286	568	0	163	0	731
Sum					143.751	55.96459	87.787	32.738	256	0	103	0	359	197	0	89	0	286	568	0	163	0	731

Figure Emp-K. Stanwood UGA Employment

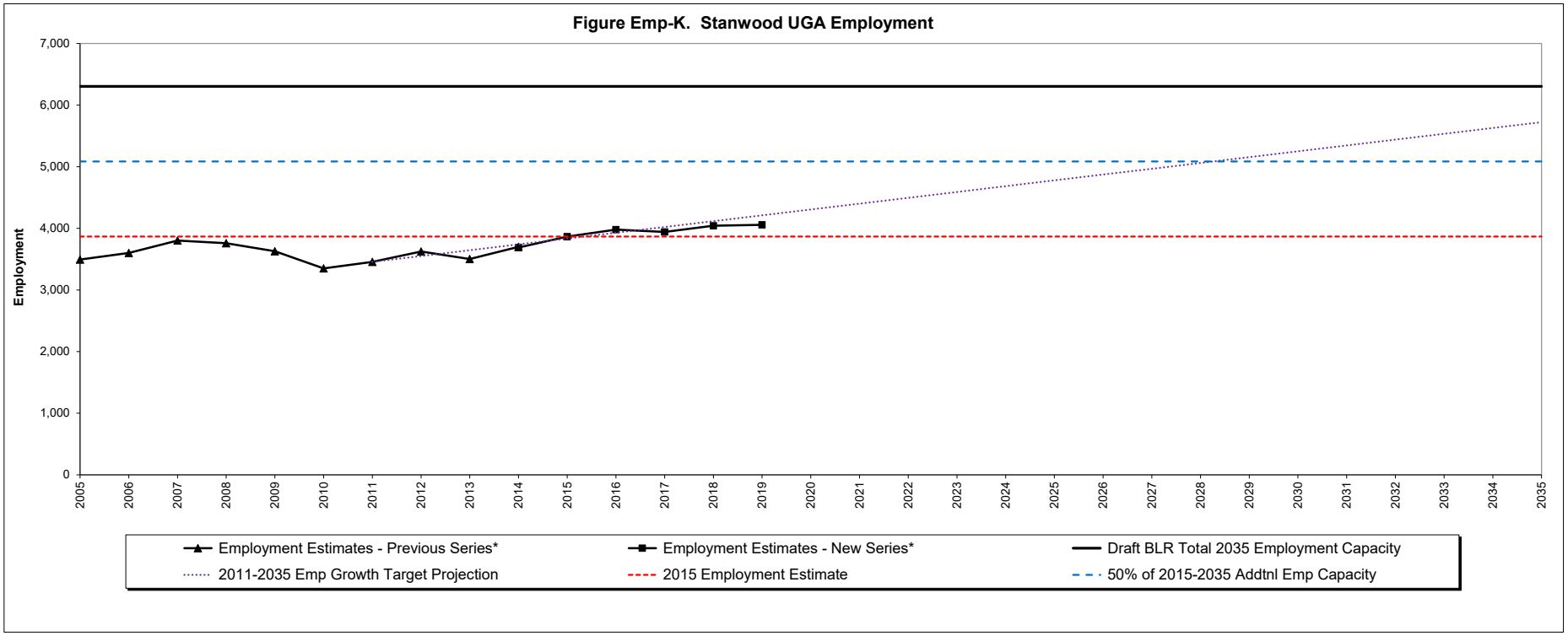

Table Emp-K. Stanwood UGA Employment Statistics

	(A)				(B) Employment Estimates						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	
Stanwood UGA	3,350	3,456	3,624	3,502	3,699	3,689	3,867	3,979	3,942	4,042	4,057	601	5,723	2,267	26.5%	6,304	2,437	7.8%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Stanwood UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Stanwood UGA	CITY12	(1) PENDING		GC	1.453	.0000000	1.453	.000	17	0	0	17	17	0	0	17
			Sum		1.453	.0000000	1.453	.000	17	0	0	17	17	0	0	17
		Sum			1.453	.0000000	1.453	.000	17	0	0	17	17	0	0	17
		(2) VACANT		GC	.661	.0010619	.660	.000	10	1	0	11	8	1	0	9
				GI	5.964	4.900174	1.064	.000	3	18	0	21	2	15	0	17
				LI	16.998	3.185772	13.812	.000	38	239	0	278	31	193	0	224
				MB1	1.617	.0000000	1.617	.000	33	0	0	33	27	0	0	27
				MB2	3.618	.0000000	3.618	.000	79	0	1	80	64	0	1	65
			Sum		28.858	8.087008	20.771	.000	163	258	1	423	132	209	1	342
			MARKET-READY	GI	3.329	2.105587	1.224	.000	3	21	0	25	3	20	0	23
				MB2	.976	.2807531	.695	.000	15	0	0	15	14	0	0	15
			Sum		4.305	2.386341	1.919	.000	19	21	0	40	18	20	0	38
		Sum			33.163	10.47335	22.690	.000	182	280	1	463	150	229	1	380
		(3) PARTUSE		GC	2.085	.0327480	2.052	.479	9	1	0	10	6	1	0	7

			GI	27.691	8.830897	18.860	10.499	29	182	0	211	19	121	0	140
			LI	2.791	.0000000	2.791	1.734	5	30	0	35	3	20	0	23
			MB1	1.008	.0000000	1.008	.188	4	0	0	4	3	0	0	3
		Sum		33.576	8.863645	24.712	12.900	47	213	0	260	31	141	0	173
	Sum			33.576	8.863645	24.712	12.900	47	213	0	260	31	141	0	173
	(4) REDEV		GC	2.356	.7956025	1.560	.000	23	2	0	25	15	1	0	16
			GI	2.123	.7260570	1.397	.000	4	24	0	28	3	16	0	19
			LI	11.196	7.975307	3.221	.000	7	56	0	62	4	37	0	42
			MB1	7.282	.0462105	7.236	.000	141	0	0	141	94	0	0	94
			MB2	16.556	.2136269	16.342	.000	293	0	5	297	195	0	3	198
			NB	.842	.0000000	.842	.000	24	0	0	24	16	0	0	16
		Sum		40.355	9.756804	30.598	.000	491	82	5	577	326	54	3	384
		MARKET-READY	GC	.605	.3217536	.283	.000	4	0	0	4	4	0	0	4
		Sum		.605	.3217536	.283	.000	4	0	0	4	4	0	0	4
	Sum			40.960	10.07856	30.882	.000	495	82	5	582	330	55	3	388
Sum				109.152	29.41555	79.737	12.900	741	574	6	1321	528	425	4	957
Sum				109.152	29.41555	79.737	12.900	741	574	6	1321	528	425	4	957

Stanwood UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Stanwood UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Stanwood UGA	UNINC	(1) PENDING		UI	8.760	6.616686	2.143	.000	13	0	0	13	13	0	0	13
			Sum		8.760	6.616686	2.143	.000	13	0	0	13	13	0	0	13

Sum			8.760	6.616686	2.143	.000	13	0	0	13	13	0	0	13
(2) VACANT		UI	14.820	11.09438	3.726	.000	10	65	0	75	8	52	0	60
		ULDR	26.306	12.15619	14.150	.000	39	245	0	284	32	198	0	230
	Sum		41.126	23.25057	17.875	.000	50	310	0	359	40	250	0	290
Sum			41.126	23.25057	17.875	.000	50	310	0	359	40	250	0	290
(3) PARTUSE		UI	25.875	8.003586	17.872	15.893	44	275	0	319	29	183	0	212
		ULDR	26.552	9.975885	16.576	14.995	42	260	0	301	28	173	0	200
		UMDR	3.134	1.386997	1.747	.457	1	8	0	9	1	5	0	6
	Sum		55.560	19.36647	36.194	31.346	87	543	0	630	58	361	0	419
Sum			55.560	19.36647	36.194	31.346	87	543	0	630	58	361	0	419
(4) REDEV		UCOM	.964	.0000000	.964	.000	15	1	0	16	10	1	0	10
		UI	48.461	28.59880	19.862	.000	55	344	0	399	37	229	0	265
		ULDR	14.467	9.724860	4.742	.000	10	82	0	92	7	55	0	61
	Sum		63.892	38.32366	25.568	.000	80	427	0	507	53	284	0	337
	MARKET-READY	UMDR	23.753	11.66151	12.092	.000	34	209	0	243	32	199	0	231
	Sum		23.753	11.66151	12.092	.000	34	209	0	243	32	199	0	231
Sum			87.645	49.98517	37.660	.000	114	637	0	750	85	483	0	568
Sum			193.091	99.21889	93.872	31.346	263	1489	0	1752	196	1094	0	1290
Sum			193.091	99.21889	93.872	31.346	263	1489	0	1752	196	1094	0	1290

Stanwood UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Within City Zones											
SR-12400											
	Single Family	61.88	100%	167	2.70	2.70	-	-	-	-	-
SR-9600											
	Single Family	136.51	100%	468	3.43	3.43	-	-	-	-	-
SR-7000											
	Single Family	14.50	100%	66	4.55	4.55	-	-	-	-	-
SR-5000											
	Multi-Family	7.01	100%	69	9.84	9.84	-	-	-	-	-
MR											
	Single Family	2.08	10%	21	1.04	1.04					
	Multi-family	15.72	78%	233	11.58	11.58	-	-	-	-	-
	Senior Apartments	2.32	12%	44	2.19	2.19					
	Total	**20.12**	**100%**	**298**	**14.81**	**14.81**					
TN											
	Single Family	13.02	100%	76	5.84	6.00 (1)	-	-	-	-	-
	Multi-Family	No Development Yet			5.00	4.00 (1)	-	-	-	-	-
	Total				**10.84**	**10.00 (1)**					

(1) Previously assumed an equal share of single family to multi-family development. Now assume more single family development relative to multi-family development within the TN zone.

Stanwood UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
GC (New Projects)											
	Mixed-Use	No Development Yet			-	6.56 (2)					2.54 (2)
	Non-Residential	54.55	100%	-	-	-	44,316	0.02	891	16.33	13.79 (2)
	Total				-	**6.56 (2)**					**16.33 (2)**
(2) Post-2018 actual and proposed projects are averaged with the development history to determine an assumed residential and employment density.											
GC (Infill Projects)											
	Non-Residential	36.31	100%	-	-	-	11,085	0.01	750	20.65	20.65
Light Industrial *(and Urban Industrial)*											
	Non-Residential	No New Development in LI -- Assumed Employment Density Adjusts City of Monroe LI Zone by 20% for Roads									20.10
General Industrial -- (Excluding Twin City Foods Reconstruction)											
	Non-Residential	3.35	100%	-	-	-	37,570	0.26	28	8.25	20.10 (3)
(3) The sample of projects in GI is too small to be reliable. For modeling purposes, GI will use the same assumptions as LI.											
MB-I (Mainstreet Business I)											
	Non-Residential	0.73	100%	-	-	-	6,002	0.19	15	20.34	20.34
MB-2											
	Non-Residential	18.04	100%	-	-	-	198,317	0.25	400	22.18	22.18
NB (Neighborhood Business) *(and Urban Commercial)*											
	Non-Residential	1.01	100%	-	-	-	11,515	0.26	29	28.59	28.59

Figure Pop-K. Sultan UGA Population

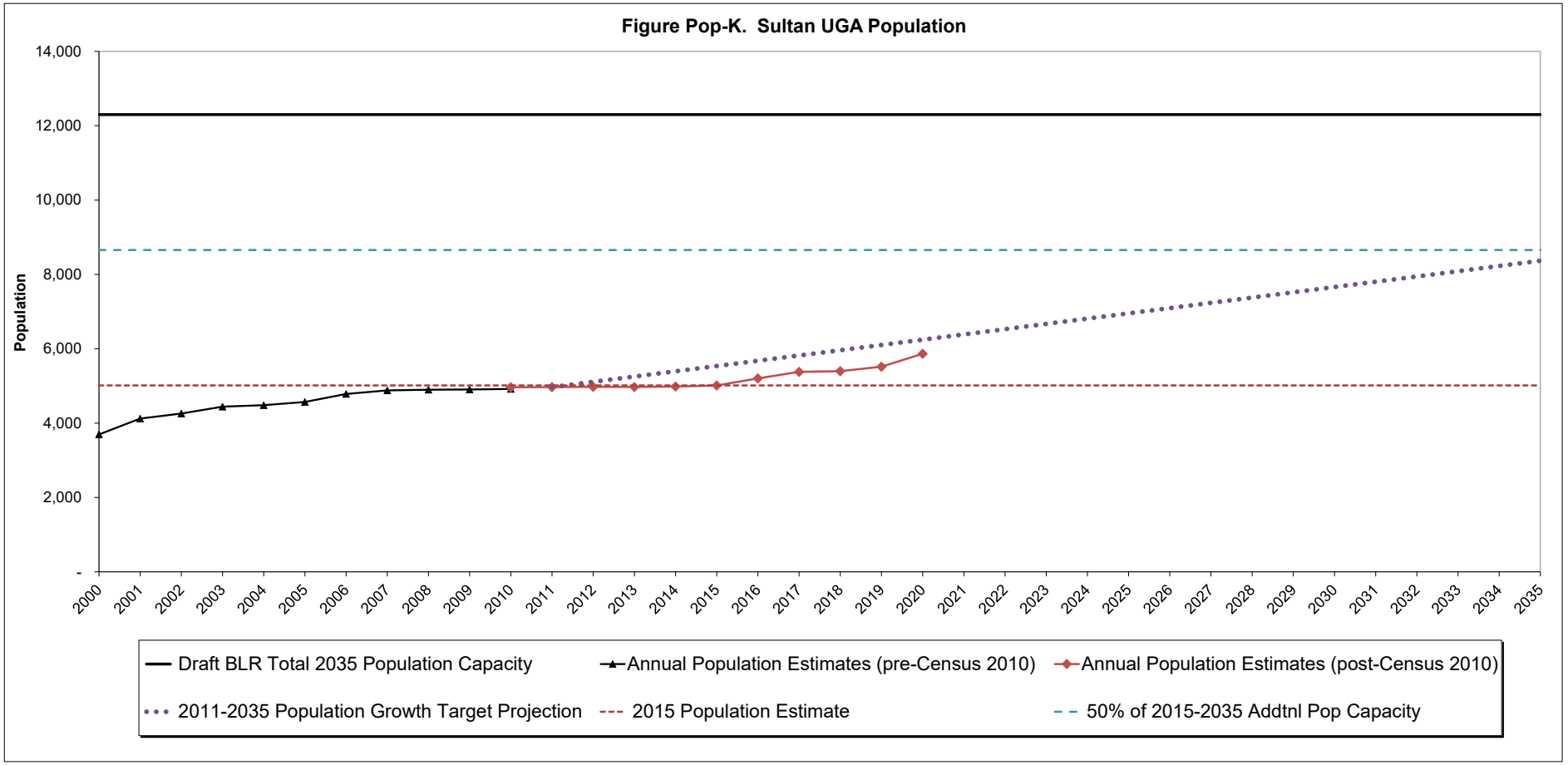

Table Pop-K. Sultan UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng	(G)	(H)	2015-20 Pop Chng as % of 2015-35
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop	2011-35 Numeric Change	(38% expected if linear growth)	Total 2035	2015-35 Addtnl	Addtnl Pop Cap
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)	Target	= (E) - (A)	= (D)/(F)*100	Pop Cap	Pop Cap = (G) - (B	= (C-B)/(H)*100
3,695	4,920	4,966	46	0.9%	4,969	4,975	4,974	4,986	5,014	5,204	5,379	5,399	5,519	5,866	896	8,369	3,399	26.4%	12,300	7,286	11.7%

Population

Sultan UGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Sultan UGA	CITY12	(1) PENDING		High Density Residential	3.220	.0000000	3.220	.000	9	0	15	0	24	9	0	15	0	24	26	0	28	0	54
				Low Density Residential	22.989	19.30951	3.679	.000	80	0	0	0	80	80	0	0	0	80	230	0	0	0	230
				Moderate Density Residential	60.324	28.61711	31.707	.000	352	0	0	0	352	352	0	0	0	352	1014	0	0	0	1014
			Sum		86.533	47.92662	38.606	.000	441	0	15	0	456	441	0	15	0	456	1270	0	28	0	1298
		Sum			86.533	47.92662	38.606	.000	441	0	15	0	456	441	0	15	0	456	1270	0	28	0	1298
		(2) VACANT		High Density Residential	13.603	3.020994	10.582	.000	69	0	2	0	71	56	0	2	0	58	162	0	3	0	165
				Low Density Residential	72.747	48.40259	24.344	.000	141	0	0	0	141	118	0	0	0	118	339	0	0	0	339
				Moderate Density Residential	49.522	32.84565	16.677	.000	96	0	0	0	96	80	0	0	0	80	231	0	0	0	231
				Neighborhood Commercial Overlay	3.650	.0000000	3.650	.000	22	0	0	0	22	18	0	0	0	18	53	0	0	0	53
			Sum		139.522	84.26923	55.253	.000	328	0	2	0	330	273	0	2	0	275	786	0	3	0	789
			MARKET-READY	Low Density Residential	4.912	4.766499	.145	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				Moderate Density Residential	8.115	6.632337	1.483	.000	9	0	0	0	9	9	0	0	0	9	25	0	0	0	25
			Sum		13.027	11.39884	1.628	.000	10	0	0	0	10	10	0	0	0	10	27	0	0	0	27
		Sum			152.549	95.66807	56.881	.000	338	0	2	0	340	282	0	2	0	284	813	0	3	0	816

	(3) PARTUSE		High Density Residential	52.039	9.047806	42.991	33.608	222	0	13	0	235	162	0	10	0	172	468	0	17	0	485
			Low Density Residential	37.440	27.50905	9.931	6.849	38	0	0	0	38	30	0	0	0	30	87	0	0	0	87
			Moderate Density Residential	100.972	44.18328	56.788	41.500	244	0	0	0	244	195	0	0	0	195	561	0	0	0	561
			Neighborhood Commercial Overlay	1.966	.6541167	1.312	.605	3	0	0	0	3	2	0	0	0	2	7	0	0	0	7
		Sum		192.416	81.39426	111.022	82.562	507	0	13	0	520	390	0	10	0	399	1123	0	17	0	1140
		MARKET-READY	Moderate Density Residential	2.145	.5521122	1.593	1.237	7	0	0	0	7	7	0	0	0	7	19	0	0	0	19
		Sum		2.145	.5521122	1.593	1.237	7	0	0	0	7	7	0	0	0	7	19	0	0	0	19
	Sum			194.561	81.94637	112.615	83.800	514	0	13	0	527	396	0	10	0	406	1142	0	17	0	1159
	(4) REDEV		High Density Residential	23.712	7.737524	15.974	.000	68	0	1	0	69	50	0	1	0	50	143	0	1	0	145
			Low Density Residential	94.570	35.40342	59.166	.000	340	0	0	0	340	271	0	0	0	271	781	0	0	0	781
			Moderate Density Residential	29.877	16.51113	13.366	.000	67	0	0	0	67	53	0	0	0	53	154	0	0	0	154
			Neighborhood Commercial Overlay	3.056	1.133409	1.923	.000	9	0	0	0	9	7	0	0	0	7	21	0	0	0	21
		Sum		151.215	60.78549	90.429	.000	484	0	1	0	485	382	0	1	0	382	1099	0	1	0	1101
	Sum			151.215	60.78549	90.429	.000	484	0	1	0	485	382	0	1	0	382	1099	0	1	0	1101
Sum				584.858	286.3265	298.531	83.800	1777	0	31	0	1808	1502	0	27	0	1528	4325	0	49	0	4374
Sum				584.858	286.3265	298.531	83.800	1777	0	31	0	1808	1502	0	27	0	1528	4325	0	49	0	4374

Sultan UGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Sultan UGA	CITY21	(1) PENDING			28.257	2.681319	25.576	.000	201	0	0	0	201	201	0	0	0	201	579	0	0	0	579
				Moderate Density Residential	63.938	10.47488	53.463	.000	379	0	0	0	379	379	0	0	0	379	1092	0	0	0	1092
			Sum		92.195	13.15620	79.039	.000	580	0	0	0	580	580	0	0	0	580	1670	0	0	0	1670
		Sum			92.195	13.15620	79.039	.000	580	0	0	0	580	580	0	0	0	580	1670	0	0	0	1670
		(2) VACANT		Moderate Density Residential	3.192	1.927052	1.265	.000	6	0	0	0	6	5	0	0	0	5	14	0	0	0	14
			Sum		3.192	1.927052	1.265	.000	6	0	0	0	6	5	0	0	0	5	14	0	0	0	14
		Sum			3.192	1.927052	1.265	.000	6	0	0	0	6	5	0	0	0	5	14	0	0	0	14
		(3) PARTUSE		Moderate Density Residential	1.385	.0000000	1.385	.835	5	0	0	0	5	4	0	0	0	4	11	0	0	0	11
			Sum		1.385	.0000000	1.385	.835	5	0	0	0	5	4	0	0	0	4	11	0	0	0	11
		Sum			1.385	.0000000	1.385	.835	5	0	0	0	5	4	0	0	0	4	11	0	0	0	11

	Sum				96.772	15.08325	81.689	.835	591	0	0	0	591	589	0	0	0	589	1696	0	0	0	1696
Sum					96.772	15.08325	81.689	.835	591	0	0	0	591	589	0	0	0	589	1696	0	0	0	1696

Sultan UGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Sultan UGA	UNINC	(2) VACANT		ULDR	1.429	.0157533	1.413	.000	8	0	0	0	8	7	0	0	0	7	19	0	0	0	19
			Sum		1.429	.0157533	1.413	.000	8	0	0	0	8	7	0	0	0	7	19	0	0	0	19
		Sum			1.429	.0157533	1.413	.000	8	0	0	0	8	7	0	0	0	7	19	0	0	0	19
		(3) PARTUSE		ULDR	47.761	16.64374	31.118	25.743	149	0	0	0	149	119	0	0	0	119	342	0	0	0	342
				UMDR	4.878	1.318346	3.559	2.987	17	0	0	0	17	14	0	0	0	14	39	0	0	0	39
			Sum		52.639	17.96208	34.677	28.730	166	0	0	0	166	132	0	0	0	132	382	0	0	0	382
		Sum			52.639	17.96208	34.677	28.730	166	0	0	0	166	132	0	0	0	132	382	0	0	0	382
		(4) REDEV		ULDR	59.830	38.56298	21.267	.000	115	0	0	0	115	92	0	0	0	92	264	0	0	0	264
				UMDR	9.970	6.331910	3.638	.000	20	0	0	0	20	16	0	0	0	16	46	0	0	0	46
			Sum		69.801	44.89489	24.906	.000	135	0	0	0	135	108	0	0	0	108	310	0	0	0	310
		Sum			69.801	44.89489	24.906	.000	135	0	0	0	135	108	0	0	0	108	310	0	0	0	310
	Sum				123.869	62.87272	60.996	28.730	309	0	0	0	309	247	0	0	0	247	711	0	0	0	711
Sum					123.869	62.87272	60.996	28.730	309	0	0	0	309	247	0	0	0	247	711	0	0	0	711

Figure Emp-L. Sultan UGA Employment

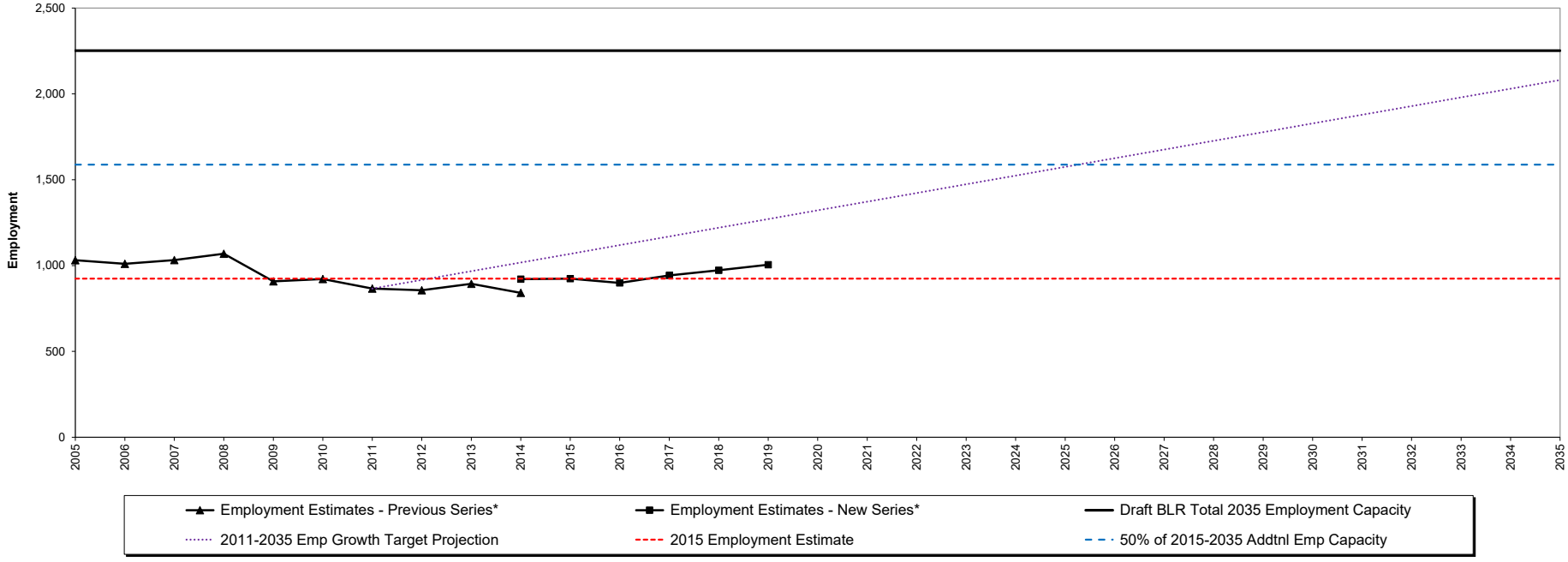

Table Emp-L. Sultan UGA Employment Statistics

	(A) Employment Estimates				(B) Employment Estimates						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	
Sultan UGA	922	866	856	894	841	921	924	899	943	973	1,005	139	2,081	1,215	11.4%	2,252	1,328	6.1%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Sultan UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Sultan UGA	CITY12	(2) VACANT		Highway Oriented Commercial	58.763	20.97099	37.792	.000	491	0	0	491	397	0	0	397
				Manufacturing	16.164	8.646543	7.517	.000	3	104	0	108	3	84	0	87
				Neighborhood Commercial Overlay	3.650	.0000000	3.650	.000	18	0	0	18	15	0	0	15
				Urban Center	.314	.0000000	.314	.000	6	0	0	6	5	0	0	5
			Sum		78.891	29.61753	49.273	.000	519	104	0	624	419	84	0	504
			MARKET-READY	Highway Oriented Commercial	4.695	2.216631	2.478	.000	32	0	0	32	31	0	0	31
			Sum		4.695	2.216631	2.478	.000	32	0	0	32	31	0	0	31
		Sum			83.585	31.83416	51.751	.000	551	104	0	656	450	84	0	534
		(3) PARTUSE		Highway Oriented Commercial	49.086	19.67628	29.410	20.053	261	0	0	261	173	0	0	173
				Manufacturing	8.656	5.081825	3.574	1.605	1	22	0	23	0	15	0	15
				Neighborhood Commercial Overlay	2.307	.6635073	1.644	.657	3	0	0	3	2	0	0	2
				Urban Center	1.656	.0000000	1.656	.564	11	0	0	11	7	0	0	7

	Sum		61.706	25.42161	36.284	22.879	276	22	0	298	183	15	0	198
Sum			61.706	25.42161	36.284	22.879	276	22	0	298	183	15	0	198
	(4) REDEV	Highway Oriented Commercial	34.433	10.31567	24.118	.000	302	0	0	302	201	0	0	201
		Manufacturing	50.573	17.19890	33.374	.000	15	417	0	432	10	278	0	287
		Neighborhood Commercial Overlay	6.771	4.844761	1.926	.000	10	0	0	10	6	0	0	6
		Urban Center	1.569	.0000000	1.569	.000	29	0	0	29	19	0	0	19
	Sum		93.345	32.35933	60.986	.000	356	417	0	773	237	278	0	514
Sum			93.345	32.35933	60.986	.000	356	417	0	773	237	278	0	514
Sum			238.637	89.61510	149.022	22.879	1183	544	0	1727	870	377	0	1247
Sum			238.637	89.61510	149.022	22.879	1183	544	0	1727	870	377	0	1247

Sultan UGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Sultan UGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

N/A

Sultan UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
Development Within City Zones *(and County Plan Designations required to build to City standards)*											
LMD *(ULDR and UMDR)*											
	Single Family	45.69	100%	147	3.22	5.85 (1)	-	-	-	-	-
MD											
	Single Family	77.09	100%	361	4.68	6.16 (1)	-	-	-	-	-
(1)Post-2018 actual and proposed projects show a higher achieved density when averaged with the development history.											
HD											
	Single Family	31.51	96%	223	6.79	6.79	-	-	-	-	-
	Multi-Family	1.33	4%	15	0.46	0.46	-	-	-	-	-
	Total	**32.84**	**100%**	**238**	**7.25**	**7.25**	**-**	**-**	**-**	**-**	**-**
NC											
	Single Family	No Development; New Zone				6.16 (2)	No Development; New Zone				-
	Non-Residential					-					5.00 (2)
	Total					**6.16 (2)**					**5.00 (2)**
(2) The Neighborhood Commercial (NC) zone is new and we anticipate similar residential development as has been experienced within the Moderate Density zone. We assume a job sector breakdown of 3 Services, 1 Retail, and 1 FIRE.											
MANU											
	Non-Residential (3)	20.72	100%	3	0.14	0.14	242,931	0.27	297	14.34	14.34
(3) Several single-family caretakers quarters are included in the non-residential category. The Manufacturing zone replaced the Economic Development zone and we have carried forward the same employment densities.											

Sultan UGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
HOD											
	Non-Residential	8.76	100%	-	-	-	43,217	0.11	76	8.67	13.00 (4)
UC											
	Non-Residential	0.45	100%	-	-	-	4,155	0.21	9	19.84	19.84

(4) The sample size for Highway Oriented Develoment (HOD) is small and includes one site (Barmon Lumber) which may not be fully developed and a high proportion of low employment density gas stations (this is important because the market for gas stations appears to now be saturated). Future employment densities are assumed to be 13 employees/buildable acre because future development is expected to use each site more intensively. The assumed employment by sector is as follows: 6 retail, 4 food services, and 3 other services.

Figure Pop-L. Southwest County UGA Population

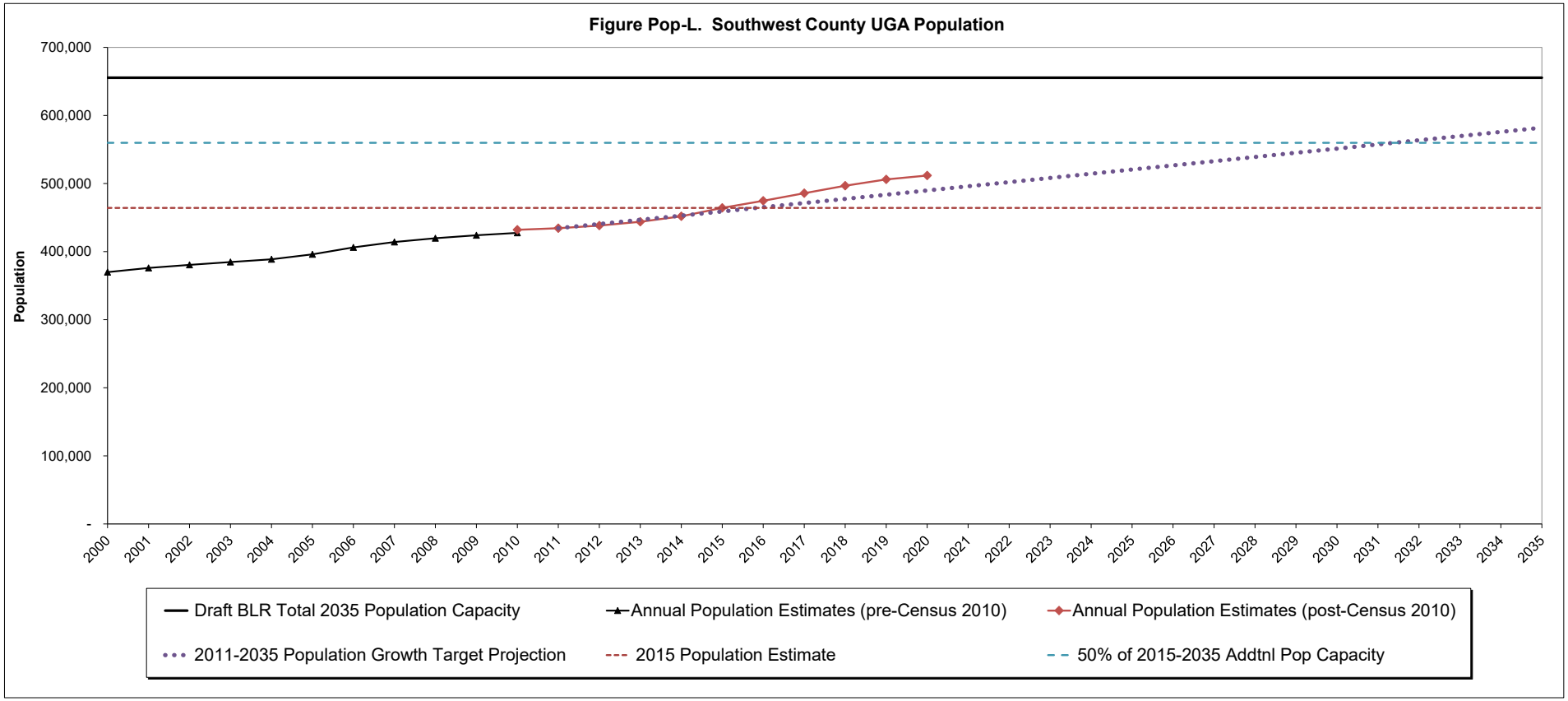

Table Pop-L. Southwest County UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng	(G)	(H)	2015-20 Pop Chng as % of
			Diff. (Census-Est)		Post-2010 Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop	2011-35 Numeric Change	(38% expected if linear growth)	Total 2035	2015-35 Addtnl	2015-35 Addtnl Pop Cap
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)	Target	= (E) - (A)	= (D)/(F)*100	Pop Cap	= (G) - (B	= (C-B)/(H)*100
369,869	427,543	432,020	4,477	1.0%	434,425	438,219	443,878	451,926	464,196	474,702	485,837	496,739	506,018	511,770	77,345	582,035	147,610	52.4%	655,424	191,228	24.9%

Figure Emp-M. Southwest County UGA Employment

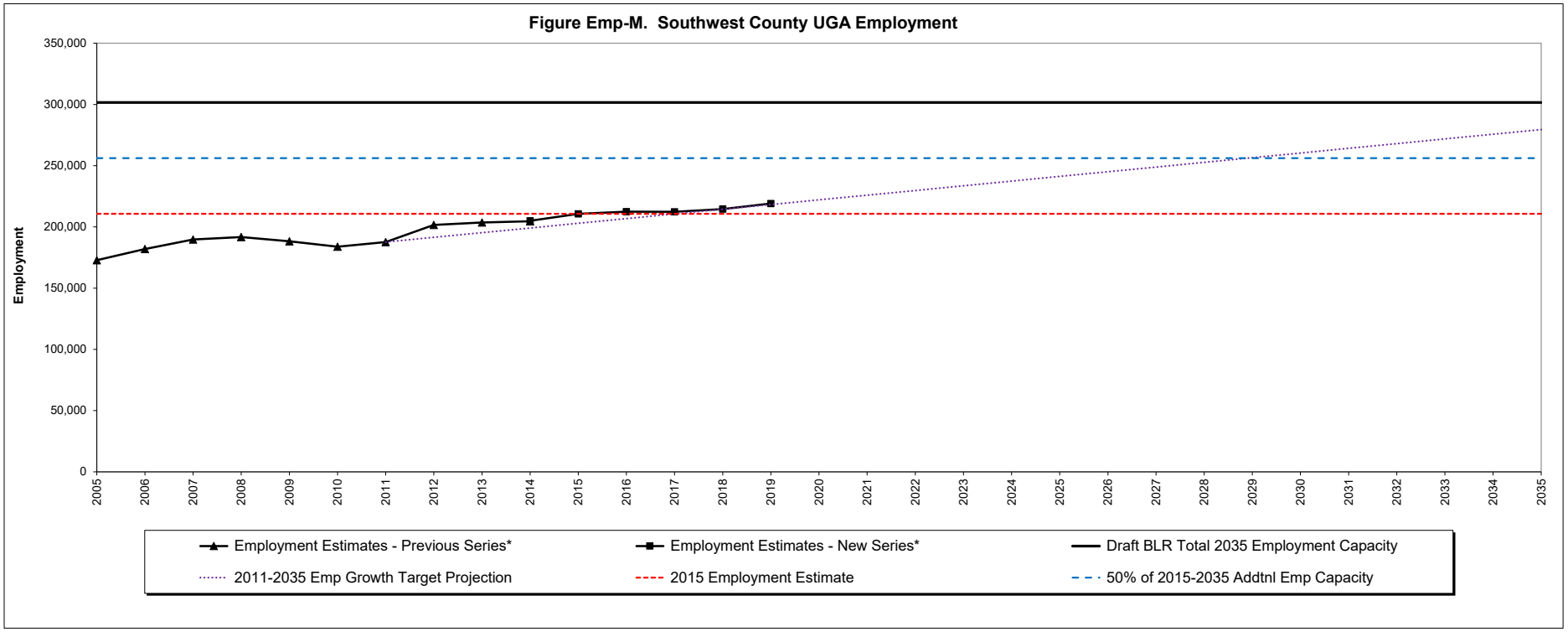

Table Emp-M. Southwest County UGA Employment Statistics

	(A)	(B) Employment Estimates										(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019		2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	
SW County UGA	183,863	187,656	201,601	203,590	204,601	205,010	210,707	212,458	212,348	214,552	219,101		31,445	279,479	91,823	34.2%	301,593	90,886	9.2%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Figure Pop-M. Total UGA Population

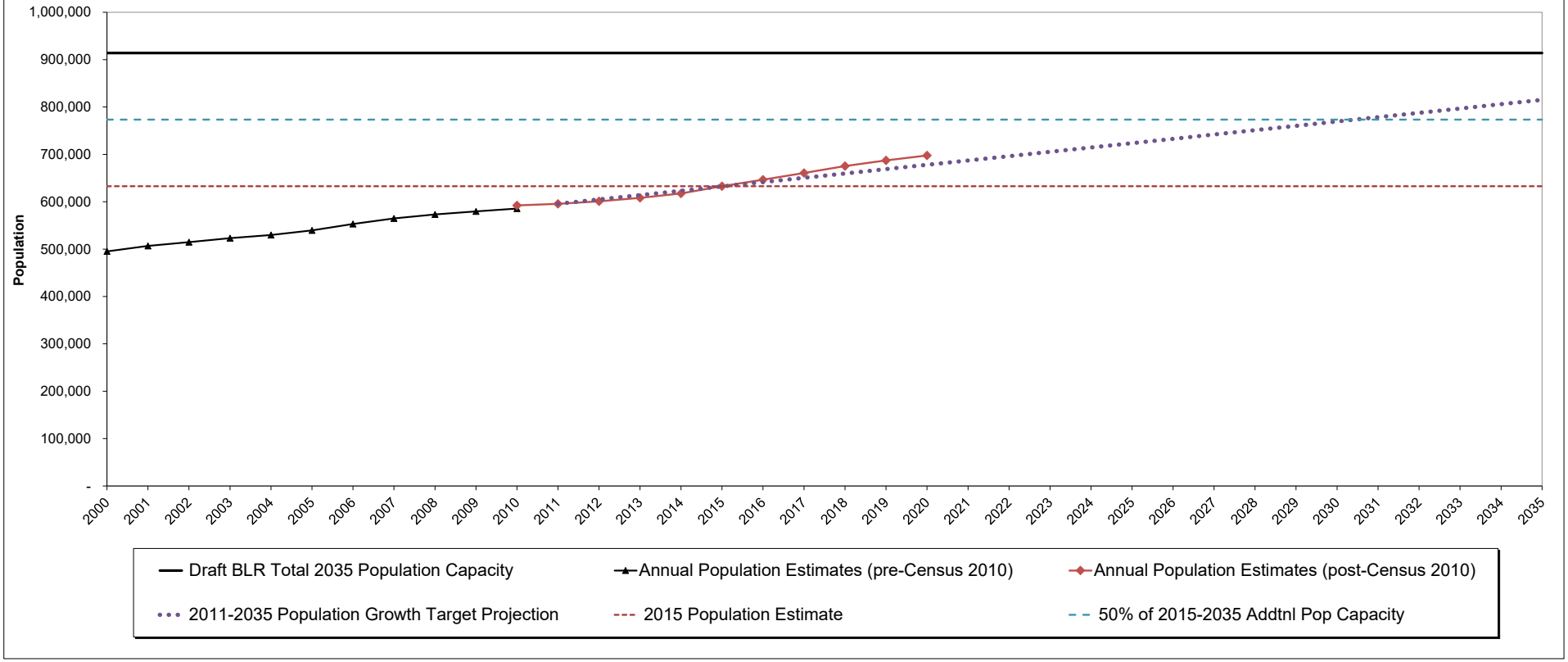

Table Pop-M. Total UGA Population Statistics

Pre-2010 Census Population Estimates		2010 Census			(A)	(B)								(C)	(D)	(E)	(F)	2011-20 Pop Chng as % of 2011-35 Pop Chng (38% expected if linear growth)	(G)	(H)	2015-20 Pop Chng as % of 2015-35 Addtnl Pop Cap
			Diff. (Census-Est)		Post-Census Pop Estimates										2011-20 Numeric Change	Reconciled 2035 CPP Pop Target	2011-35 Numeric Change		Total 2035 Pop Cap	2015-35 Addtnl Pop Cap	
2000	2010	Pop	No.	Pct.	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	= (C) - (A)		= (E) - (A)	= (D)/(F)*100		= (G) - (B)	= (C-B)/(H)*100
495,187	585,653	592,321	6,668	1.1%	595,713	600,852	608,251	617,641	632,801	646,521	660,821	675,294	687,356	697,692	101,978	815,132	219,419	46.5%	914,036	281,235	23.1%

Figure Emp-N. Total UGA Employment

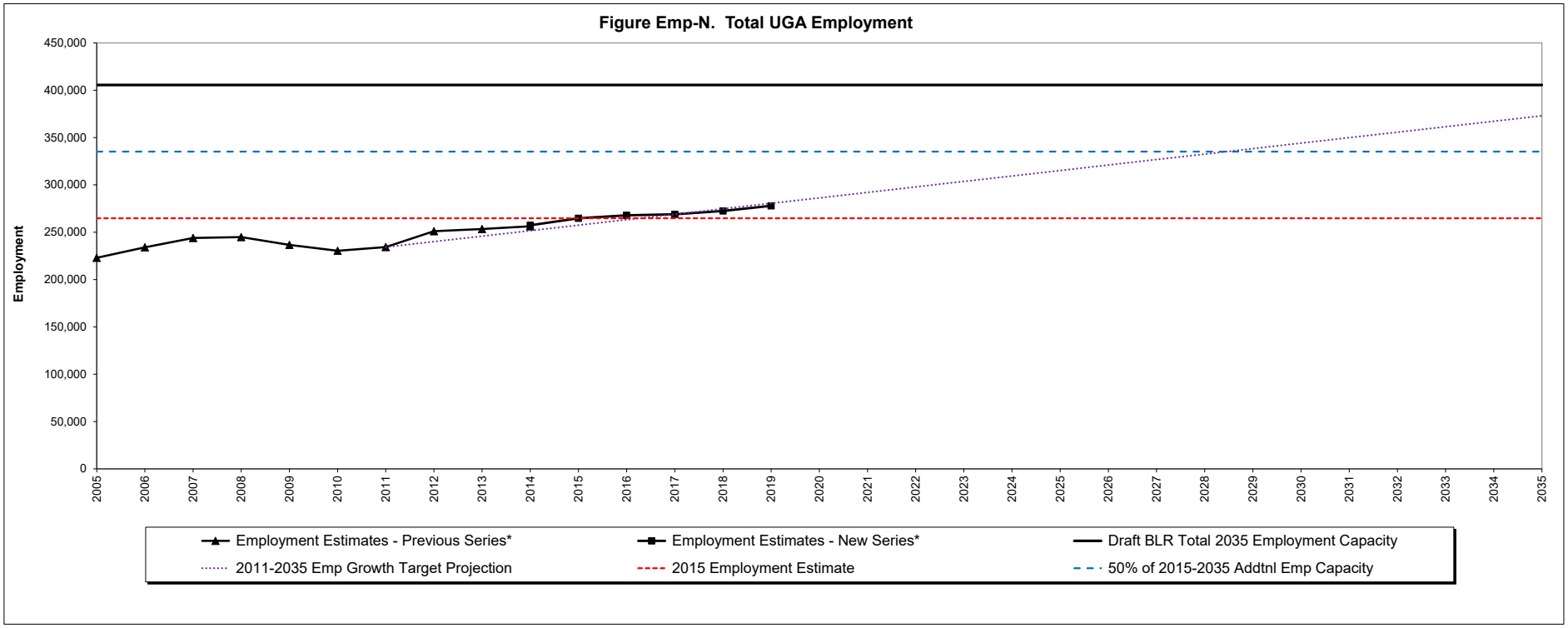

Table Emp-N. Total UGA Employment Statistics

	(A)				(B) Employment Estimates						(C)	(D)	(E)	(F)	2011-19 Emp Chng as % of 2011-35 Emp Chng (33% expected if linear growth) = (D)/(F)*100	(G)	(H)	2015-19 Emp Chng as % of 2015-35 Addtnl Emp Cap = (C-B)/(H)*100
	2010	2011	2012	2013	Previous Series* 2014	New Series* 2014	2015	2016	2017	2018	2019	2011-19 Numeric Change = (C) - (A)	CPP 2035 Employment Target	2011-35 Numeric Change = (E) - (A)		Total 2035 Emp Cap	2015-35 Addtnl Emp Cap = (G) - (B)	
Total UGA	230,374	234,300	251,069	253,447	256,307	257,374	264,804	267,872	268,957	272,443	277,928	43,628	373,050	138,750	31.4%	405,570	140,766	9.3%

* New series incorporates improved methodology by PSRC, the biggest difference being the use of US Census Bureau and business license data to locate employment from home-based occupations.

Results by City and MUGA within SW County UGA

Bothell MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Bothell	CITY12	(1) PENDING		OR-L	6.825	1.407472	5.418	0	0	118	0	0	118	0	118	0	0	118	0	300	0	0	300
				R 2,800, OP	3.96	0.1911965	3.769	0	31	0	0	0	31	31	0	0	0	31	89	0	0	0	89
				R 4,000	3.503	1.205181	2.298	0	13	0	0	0	13	13	0	0	0	13	37	0	0	0	37
				R 40,000, (LID), NCPA	13.863	4.351642	9.511	0	12	0	0	0	12	12	0	0	0	12	35	0	0	0	35
				R 5,400a, OP	6.479	4.042218	2.436	0	7	0	0	0	7	7	0	0	0	7	20	0	0	0	20
				R 5,400d	0.564	0.0247012	0.539	0	4	0	0	0	4	4	0	0	0	4	12	0	0	0	12
				R 7,200	10.78	0.1925047	10.587	0	55	0	0	0	55	55	0	0	0	55	158	0	0	0	158
				R 8,400	2.675	0.0001067	2.675	0	15	0	0	0	15	15	0	0	0	15	43	0	0	0	43
				R 9,600	73.035	8.920096	64.115	0	203	0	0	0	203	203	0	0	0	203	585	0	0	0	585
				R-AC, OP, CB	14.509	2.419247	12.09	0	0	0	212	0	212	0	0	212	0	212	0	0	390	0	390
			Sum		136.192	22.75436	113.438	0	340	118	212	0	670	340	118	212	0	670	979	300	390	0	1669
		Sum			136.192	22.75436	113.438	0	340	118	212	0	670	340	118	212	0	670	979	300	390	0	1669
		(2) VACANT		OR-M	28.355	13.51996	14.835	0	0	0	253	0	253	0	0	204	0	204	0	0	376	0	376
				R 2,800	1.495	0.1855954	1.309	0	4	0	8	0	12	3	0	6	0	10	9	0	12	0	21
				R 2,800, OP	0.901	0.0735098	0.827	0	4	0	6	0	10	3	0	5	0	8	9	0	9	0	18
				R 4,000	0.194	0.0158029	0.178	0	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
				R 4,000, OP, CB	0.501	0.1225152	0.378	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
				R 40,000, (LID), NCPA	15.362	5.673348	9.689	0	8	0	0	0	8	7	0	0	0	7	21	0	0	0	21

				R 5,400a	4.22	1.790003	2.43	0	6	0	12	0	18	5	0	10	0	15	15	0	19	0	33
				R 5,400a, NCPA	0.729	0.6070072	0.122	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				R 5,400d	0.276	0.0335209	0.242	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				R 7,200	7.427	1.970045	5.457	0	32	0	0	0	32	29	0	0	0	29	82	0	0	0	82
				R 8,400	1.039	0.1019723	0.937	0	4	0	0	0	4	4	0	0	0	4	10	0	0	0	10
				R 9,600	55.39	25.08715	30.302	0	91	0	0	0	91	81	0	0	0	81	234	0	0	0	234
				R 9,600, (LID), NCPA	4.889	1.028501	3.861	0	12	0	0	0	12	11	0	0	0	11	31	0	0	0	31
				R-AC, OP, LI	61.861	36.3822	25.479	0	124	0	632	0	756	100	0	510	0	610	288	0	939	0	1227
				RMU-H	1.77	1.575006	0.195	0	0	0	23	0	23	0	0	19	0	19	0	0	34	0	34
			Sum		184.407	88.16614	96.241	0	287	0	938	0	1225	245	0	758	0	1003	705	0	1395	0	2099
			MARKET-READY	R 9,600, NCPA	2.353	1.232822	1.12	0	3	0	0	0	3	3	0	0	0	3	8	0	0	0	8
			Sum		2.353	1.232822	1.12	0	3	0	0	0	3	3	0	0	0	3	8	0	0	0	8
		Sum			186.76	89.39896	97.361	0	290	0	938	0	1228	248	0	758	0	1005	713	0	1395	0	2107
		(3) PARTUSE		OR-H	10.367	1.415811	8.951	2.18	0	0	173	0	173	0	0	115	0	115	0	0	212	0	212
				OR-H, AQB	3.106	0.2759434	2.83	0.4	0	0	31	0	31	0	0	21	0	21	0	0	38	0	38
				OR-M	5.885	2.308056	3.577	0.94	0	0	16	0	16	0	0	11	0	11	0	0	20	0	20
Bothell	CITY12	(3) PARTUSE		R 40,000, (LID), NCPA	18.57	2.963855	15.606	11.964	9	0	0	0	9	8	0	0	0	8	22	0	0	0	22
				R 5,400a, NCPA	1.252	0.0515937	1.201	0.488	1	0	2	0	3	1	0	2	0	2	2	0	3	0	5
				R 5,400d	1.029	0.0023955	1.027	0.513	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
				R 7,200	22.921	2.308164	20.613	13.633	75	0	0	0	75	64	0	0	0	64	185	0	0	0	185
				R 8,400	2.44	0.479139	1.961	1.39	4	0	0	0	4	3	0	0	0	3	10	0	0	0	10
				R 9,600	194.61	29.55103	165.059	114.619	327	0	0	0	327	280	0	0	0	280	805	0	0	0	805
				R 9,600, (LID), NCPA	34.174	13.23226	20.942	14.602	43	0	0	0	43	37	0	0	0	37	106	0	0	0	106
				RMU-H	15.322	0.8205655	14.502	1.23	0	0	146	0	146	0	0	97	0	97	0	0	179	0	179
				RMU-M	4.68	1.003256	3.677	1.717	0	0	88	0	88	0	0	59	0	59	0	0	108	0	108
			Sum		314.358	54.41208	259.945	163.676	461	0	456	0	917	394	0	303	0	697	1135	0	558	0	1693
		Sum			314.358	54.41208	259.945	163.676	461	0	456	0	917	394	0	303	0	697	1135	0	558	0	1693
		(4) REDEV		OR-H	18.15	1.889378	16.261	0	0	0	1296	0	1296	0	0	862	0	862	0	0	1586	0	1586
				OR-H, AQB	4.399	0.7736965	3.625	0	0	0	289	0	289	0	0	192	0	192	0	0	354	0	354
				OR-L	0.797	0.3073892	0.49	0	-1	0	12	0	11	-1	0	8	0	7	-2	0	15	0	13
				OR-M	6.98	4.866457	2.113	0	0	0	36	0	36	0	0	24	0	24	0	0	44	0	44
				R 2,800	3.191	0.8706077	2.32	0	4	0	13	0	17	3	0	9	0	11	8	0	16	0	24
				R 2,800, OP	6.685	1.868765	4.816	0	19	0	38	0	57	13	0	25	0	38	36	0	46	0	83
				R 4,000	1.13	0.0103963	1.12	0	-2	0	18	0	16	-1	0	12	0	11	-4	0	22	0	18
				R 4,000, OP, CB	15.692	4.52767	11.164	0	-2	0	51	0	49	-1	0	34	0	33	-4	0	62	0	59
				R 40,000, (LID), NCPA	16.143	9.752188	6.391	0	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
				R 5,400a	5.789	0.948905	4.84	0	10	0	24	0	34	8	0	18	0	26	22	0	34	0	55
				R 5,400a, NCPA	3.266	1.16806	2.098	0	2	0	11	0	13	2	0	8	0	10	4	0	15	0	20
				R 5,400a, OP	8.524	1.047146	7.477	0	71	0	0	0	71	54	0	0	0	54	155	0	0	0	155
				R 5,400d	0.49	0.006293	0.483	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				R 7,200	16.259	2.022035	14.237	0	53	0	0	0	53	45	0	0	0	45	131	0	0	0	131
				R 9,600	73.112	15.11887	57.993	0	128	0	0	0	128	109	0	0	0	109	315	0	0	0	315
				R 9,600, (LID), NCPA	8.694	5.636474	3.058	0	8	0	0	0	8	7	0	0	0	7	20	0	0	0	20
				R 9,600, MHP	0.981	0.0501492	0.931	0	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
				R 9,600, NCPA	12.803	7.218521	5.584	0	13	0	0	0	13	11	0	0	0	11	32	0	0	0	32
				R-AC, OP, LI	5.759	4.312373	1.447	0	3	0	35	0	38	2	0	23	0	25	6	0	43	0	49

				RMU-H	7.403	0.5445974	6.859	0	0	0	817	0	817	0	0	543	0	543	0	0	1000	0	1000
				RMU-M	1.615	0.1276269	1.487	0	0	0	75	0	75	0	0	50	0	50	0	0	92	0	92
			Sum		217.861	63.0676	154.794	0	314	0	2715	0	3029	257	0	1809	0	2065	739	0	3328	0	4067
			MARKET-READY	OR-H	6.99	4.866457	2.124	0	0	0	169	0	169	0	0	161	0	161	0	0	295	0	295
				OR-M	17.957	6.383739	11.574	0	0	0	197	0	197	0	0	187	0	187	0	0	344	0	344
			Sum		24.948	11.2502	13.697	0	0	0	366	0	366	0	0	348	0	348	0	0	640	0	640
		Sum			242.809	74.3178	168.491	0	314	0	3081	0	3395	257	0	2157	0	2413	739	0	3968	0	4707
	Sum				880.119	240.8832	639.235	163.676	1405	118	4687	0	6210	1238	118	3430	0	4786	3566	300	6311	0	10177
Sum					880.119	240.8832	639.235	163.676	1405	118	4687	0	6210	1238	118	3430	0	4786	3566	300	6311	0	10177

Bothell MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Bothell	CITY21	(1) PENDING		R 9,600	10.468	1.670885	8.797	0	47	0	0	0	47	47	0	0	0	47	135	0	0	0	135
			Sum		10.468	1.670885	8.797	0	47	0	0	0	47	47	0	0	0	47	135	0	0	0	135
		Sum			10.468	1.670885	8.797	0	47	0	0	0	47	47	0	0	0	47	135	0	0	0	135
		(4) REDEV		R 9,600	2.123	0.8516406	1.272	0	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
			Sum		2.123	0.8516406	1.272	0	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
		Sum			2.123	0.8516406	1.272	0	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
	Sum				12.591	2.522526	10.069	0	50	0	0	0	50	50	0	0	0	50	143	0	0	0	143
Sum					12.591	2.522526	10.069	0	50	0	0	0	50	50	0	0	0	50	143	0	0	0	143

Bothell MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Bothell	UNINC	(1) PENDING		UHDR	34.552	22.16026	12.391	0	45	24	506	0	575	45	24	506	0	575	130	61	931	0	1122
				ULDR	87.706	15.67084	72.035	0	511	6	10	0	527	511	6	10	0	527	1472	15	18	0	1505
				UMDR	12.027	1.805754	10.222	0	88	5	0	0	93	88	5	0	0	93	253	13	0	0	266
			Sum		134.285	39.63686	94.648	0	644	35	516	0	1195	644	35	516	0	1195	1855	89	949	0	2893
		Sum			134.285	39.63686	94.648	0	644	35	516	0	1195	644	35	516	0	1195	1855	89	949	0	2893
		(2) VACANT		UHDR	17.602	6.488172	11.114	0	41	48	91	14	194	33	39	73	11	157	95	99	135	13	342
				ULDR	18.403	6.084978	12.318	0	66	0	0	0	66	59	0	0	0	59	170	0	0	0	170
				UMDR	9.955	2.334826	7.621	0	60	0	1	0	61	51	0	1	0	52	146	0	2	0	148
			Sum		45.961	14.90798	31.053	0	167	48	92	14	321	143	39	74	11	267	411	99	137	13	660
		Sum			45.961	14.90798	31.053	0	167	48	92	14	321	143	39	74	11	267	411	99	137	13	660
		(3) PARTUSE		UHDR	0.923	0	0.923	0.287	1	1	2	0	4	1	1	1	0	3	2	2	2	0	6
				ULDR	209.27	48.1257	161.144	86.275	445	0	3	0	448	381	0	3	0	384	1096	0	6	0	1102
				UMDR	24.564	2.970005	21.594	13.461	107	1	1	0	109	81	1	1	0	83	234	2	1	0	238
				UVILL	1.337	0	1.337	1.106	0	2	22	2	26	0	1	15	1	17	0	3	27	2	32

		Sum		236.095	51.0957	184.999	101.128	553	4	28	2	587	463	3	20	1	486	1332	7	36	2	1377
	Sum			236.095	51.0957	184.999	101.128	553	4	28	2	587	463	3	20	1	486	1332	7	36	2	1377
	(4) REDEV		UCENTER	21.261	3.971118	17.29	0	-58	8	770	161	881	-39	5	512	107	586	-111	14	942	126	971
			UHDR	19.269	0.2803298	18.989	0	11	52	130	4	197	7	35	86	3	131	21	88	159	3	271
			ULDR	208.46	57.17676	151.283	0	704	0	0	0	704	602	0	0	0	602	1734	0	0	0	1734
			UMDR	14.787	1.858761	12.928	0	70	0	0	0	70	53	0	0	0	53	153	0	0	0	153
			UVILL	4.688	0	4.688	0	-8	3	92	9	96	-5	2	61	6	64	-15	5	113	7	109
		Sum		268.465	63.28697	205.178	0	719	63	992	174	1948	619	42	660	116	1436	1781	107	1214	136	3238
	Sum			268.465	63.28697	205.178	0	719	63	992	174	1948	619	42	660	116	1436	1781	107	1214	136	3238
Sum				684.806	168.9275	515.878	101.128	2083	150	1628	190	4051	1868	118	1270	128	3384	5380	301	2336	151	8168
Sum				684.806	168.9275	515.878	101.128	2083	150	1628	190	4051	1868	118	1270	128	3384	5380	301	2336	151	8168

Bothell MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Bothell	CITY12	(1) PENDING		R 4,000, OP, CB	1.997	.0246788	1.973	.000	85	0	0	85	85	0	0	85
				R-AC, OP, CB	2.371	1.100017	1.271	.000	0	110	0	110	0	110	0	110
				R-AC, OP, CB, LI	1.063	.0000000	1.063	.000	33	0	0	33	33	0	0	33
			Sum		5.432	1.124696	4.307	.000	117	110	0	227	117	110	0	227
		Sum			5.432	1.124696	4.307	.000	117	110	0	227	117	110	0	227
		(2) VACANT		E-L	12.582	.2838809	12.298	.000	307	209	0	517	248	169	0	417
				OR-M	28.355	13.51996	14.835	.000	771	237	0	1009	623	192	0	815
				R 4,000, OP, CB	.501	.1225152	.378	.000	4	0	0	4	4	0	0	4
				R-AC, OP, CB	4.454	3.788320	.666	.000	25	0	0	25	20	0	0	20
				R-AC, OP, LI	61.861	36.38220	25.479	.000	9	0	0	9	8	0	0	8
				RMU-H	1.770	1.575006	.195	.000	4	0	0	4	3	0	0	3
			Sum		109.523	55.67189	53.851	.000	1121	446	0	1568	905	360	0	1266
		Sum			109.523	55.67189	53.851	.000	1121	446	0	1568	905	360	0	1266
		(3) PARTUSE		E-L	69.846	7.029277	62.816	12.364	309	210	0	519	206	140	0	345
				E-M												

			75.807	19.49953	56.307	23.154	926	602	0	1528	616	400	0	1016
		OR-H	10.367	1.415811	8.951	2.180	131	44	0	174	87	29	0	116
		OR-H, AQB	3.106	.2759434	2.830	.400	24	8	0	32	16	5	0	21
		OR-M	5.885	2.308056	3.577	.940	49	15	0	64	33	10	0	43
		RMU-H	15.322	.8205655	14.502	1.230	25	0	0	25	16	0	0	16
		RMU-M	4.680	1.003256	3.677	1.717	15	0	0	15	10	0	0	10
	Sum		185.013	32.35243	152.661	41.985	1479	879	0	2358	984	584	0	1568
Sum			185.013	32.35243	152.661	41.985	1479	879	0	2358	984	584	0	1568
(4) REDEV		E-L	.563	.0000000	.563	.000	14	10	0	24	9	6	0	16
		NB	2.081	.0040547	2.077	.000	77	0	0	77	51	0	0	51
		OP, CB, GC	4.534	.3828135	4.151	.000	64	0	0	64	42	0	0	42
		OP, GC	11.316	3.964784	7.351	.000	127	0	0	127	85	0	0	85
		OR-H	18.150	1.889378	16.261	.000	774	325	0	1099	514	216	0	731
		OR-H, AQB	4.399	.7736965	3.625	.000	218	73	0	290	145	48	0	193
		OR-L	.797	.3073892	.490	.000	5	2	0	7	3	1	0	5
		OR-M	6.980	4.866457	2.113	.000	110	0	0	110	73	0	0	73
		R 4,000, OP, CB	15.692	4.527670	11.164	.000	131	0	0	131	87	0	0	87
		R-AC, OP, CB	29.354	13.46299	15.891	.000	586	0	0	586	390	0	0	390
		R-AC, OP, CB, LI	19.278	3.668774	15.609	.000	853	0	0	853	567	0	0	567
		R-AC, OP, LI	5.759	4.312373	1.447	.000	1	0	0	1	0	0	0	0
		RMU-H	7.403	.5445974	6.859	.000	104	0	0	104	69	0	0	69
		RMU-M	1.615	.1276269	1.487	.000	13	0	0	13	8	0	0	8
	Sum		127.921	38.83261	89.089	.000	3075	409	0	3484	2045	272	0	2317
	MARKET-READY	E-L	7.097	2.195166	4.902	.000	59	83	0	142	56	79	0	135
		E-M	5.156	.0285444	5.127	.000	103	133	0	236	97	127	0	224
		OR-H	6.990	4.866457	2.124	.000	127	0	0	127	121	0	0	121
		OR-M	17.957	6.383739	11.574	.000	466	128	0	594	443	121	0	564
	Sum		37.200	13.47391	23.726	.000	755	344	0	1099	717	327	0	1044

		Sum			165.121	52.30651	112.815	.000	3830	754	0	4584	2762	599	0	3361
	Sum				465.089	141.4555	323.633	41.985	6547	2189	0	8736	4768	1654	0	6422
Sum					465.089	141.4555	323.633	41.985	6547	2189	0	8736	4768	1654	0	6422

Bothell MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Bothell MUGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Bothell	UNINC	(2) VACANT		CITY	1.507	.2008504	1.306	.000	42	0	0	43	34	0	0	34
			Sum		1.507	.2008504	1.306	.000	42	0	0	43	34	0	0	34
		Sum			1.507	.2008504	1.306	.000	42	0	0	43	34	0	0	34
		(3) PARTUSE		UVILL	2.323	.0000000	2.323	1.108	11	0	0	11	7	0	0	7
			Sum		2.323	.0000000	2.323	1.108	11	0	0	11	7	0	0	7
		Sum			2.323	.0000000	2.323	1.108	11	0	0	11	7	0	0	7
		(4) REDEV		UCENTER	21.261	3.971118	17.290	.000	423	0	17	440	281	0	11	293
				UVILL	4.688	.0000000	4.688	.000	41	0	0	41	27	0	0	27
			Sum		25.949	3.971118	21.978	.000	464	0	17	481	308	0	11	320
		Sum			25.949	3.971118	21.978	.000	464	0	17	481	308	0	11	320
	Sum				29.779	4.171969	25.607	1.108	517	0	18	535	350	0	12	362
Sum					29.779	4.171969	25.607	1.108	517	0	18	535	350	0	12	362

Bothell MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
R-40,000											
	Single Family		No Data Available			1.00		No Data Available			-
R-9,600											
	Single Family	222.23	100%	727	3.26	3.26	-	-	-	-	-
	Senior Apartments	1.00	0%	15	0.07	0.07	-	-	-	-	-
	Total	**223.23**	**100%**	**742**	**3.33**	**3.33**	**-**	**-**	**-**	**-**	**-**
R-8,400											
	Single Family	3.77	100%	15	3.98	3.98	-	-	-	-	-
R-7,200											
	Single Family	18.82	100%	83	4.41	6.04 (1)	-	-	-	-	-
(1) City staff is anticipating residential densities in the Snohomish County portion of the City of Bothell that resemble what is being achievied within the King County portion of the City. An average between the Snohomish County achieved densities and King County achieved denisites is applied here.											
R-5,400 detached											
	Single Family	10.71	100%	50	4.67	4.67	-	-	-	-	-
R-5,400 attached											
	Single Family	20.96	30%	156	2.78	2.78	-	-	-	-	-
	Multi-Family	35.20	70%	301	5.36	5.36	-	-	-	-	-
	Total	**56.15**	**100%**	**457**	**8.14**	**8.14**	**-**	**-**	**-**	**-**	**-**
R-5,400 attached, Office Park											
	Single Family	4.83	100%	47	9.73	9.73	-	-	-	-	-
R-4,000											
	Multi-Family	8.04	100%	153	19.02	19.02	-	-	-	-	-

Bothell MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
R-4,000, OP, CB (New Projects)											
	Multi-Family		No Data Available			5.00 (2)		No Data Available			-
	Non-Residential	17.56	100%	-	-	-	104,541	0.14	209	11.90	11.90
	Total					**5.00 (2)**					**11.90**
(2) Only non-residential projects have so far been completed in the R-400, OP, CB zone. Since the zoning allows both housing and commercial uses, and the remaining developable sites include locations appropriate for both, this report assumes a mix of residential development in addition to the past mix of non-residential uses.											
R-4,000, OP, CB (Infill Projects)											
	Non-Residential	15.24	100%	-	-	-	89,832	0.14	173	11.38	11.38
R-2,800											
	Single Family	0.35	24%	5	3.39	3.39	-	-	-	-	-
	Multi-Family	1.13	76%	10	6.77	6.77	-	-	-	-	-
	Totals	**1.48**	**100%**	**15**	**10.16**	**10.16**	**-**	**-**	**-**	**-**	**-**
R-2,800, OP											
	Single Family	8.78	47%	93	5.02	5.02	-	-	-	-	-
	Multi-Family	9.73	53%	153	8.27	8.27	-	-	-	-	-
	Total	**18.51**	**100%**	**246**	**13.29**	**13.29**	**-**	**-**	**-**	**-**	**-**
R-AC, OP, LI											
	Single Family	10.92	54%	94	4.58	5.00	-	-	-	-	-
	Multi-Family	9.38	46%	200	9.75	25.00	-	-	-	-	-
	Non-Residential	0.22	1%	-	-	-	2,997	0.00	7	0.37	0.37
	Total	**20.52**	**100%**	**294**	**14.33**	**30.00 (3)**	**2,997**	**0.00**	**7**	**0.37**	**0.37**
(3) City staff is anticipating that residential densities in the Snohomish County portion of the City of Bothell will resemble what is being achievied within the King County portion of the City.											

Bothell MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
OR-H											
	Multi-Family		New Zone, No Data Available			79.80 (4)	-	-	-	-	-
	Non-Residential	-		-	-	-		New Zone, No Data Available			80.00 (4)
	Total					**79.80 (4)**					**80.00 (4)**
(4) Residential and Employement densities were derived from tables 9, 11, and 12 of Section D from The Canyon Park Final EIS Vol. 2 Appendicies. This report divides 'Office' roughly equal between Services and FIRE. The job sector breakdown is: 20 Retail, 20 Services, 20 FIRE, and 20 Manufacturing.											
OR-M											
	Multi-Family		New Zone, No Data Available			17.10 (5)	-	-	-	-	-
	Non-Residential							New Zone, No Data Available			68.40 (5)
	Total					**17.10 (5)**	**-**	**-**	**-**	**-**	**68.40 (5)**
(5) City Staff is anticipating greater commercial development compared to residential from what was assumed in the Canyon Park Final EIS Vol. 2 Appendicies. Residential and Employment densities are derived from tables 9, 11, and 12. This report divides 'Office' roughly equal between Services and FIRE. The job sector breakdown is: 18 Retail, 17 Services, 17 FIRE, and 16 Manufacturing.											
OR-L											
	Multi-Family		New Zone, No Data Available			28.00 (6)	-	-	-	-	-
	Non-Residential							New Zone, No Data Available			14.00 (6)
	Total					**28.00 (6)**					**14.00 (6)**
(6) City Staff is anticipating greater commercial development compared to what was assumed in the Canyon Park Final EIS Vol. 2 Appendicies. Residential and Employment densities are based on tables 9, 11, and 12 from the Vol. 2 Appendicies. This report divides 'Office' roughly equal between Services and FIRE. The job sector breakdown is: 4 Retail, 4 Manufacturing, 4 Services, 2 FIRE.											

Bothell MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
RMU-H											
	Multi-Family		New Zone, No Data Available			119.70 (7)	-	-	-	-	-
	Non-Residential	-	0%	-	-	-	New Zone, No Data Available				20.00 (7)
	Total					**119.70 (7)**					**20.00 (7)**
(7) Residential and Employement densities were derived from tables 9, 11, and 12 of Section D from The Canyon Park Final EIS Vol. 2 Appendicies. This report divides 'Office' roughly equal between Services and FIRE. This report divides 'Office' roughly equal between Services and FIRE. The job sector breakdown is: 15 Retail, 3 Services, 2 FIRE.											
RMU-M											
	Multi-Family		New Zone, No Data Available			51.30 (8)	-	-	-	-	-
	Non-Residential	-	0%	-	-	-	New Zone, No Data Available				8.60 (8)
	Total					**51.30 (8)**					**8.60 (8)**
(8) Residential and Employement densities were derived from tables 9, 11, and 12 of Section D from The Canyon Park Final EIS Vol. 2 Appendicies. This report divides 'Office' roughly equal between Services and FIRE. This report divides 'Office' roughly equal between Services and FIRE. The job sector breakdown is: 6 Retail, 2 Services, 1 FIRE											
E-M											
	Non-Residential				New Zone; No Data Available						66.25 (9)
(9) Employment denisty from the R-AC, OP, CB (MVSO) zone is applied here and the job sector breakdown is split based on table 12 from the Canyon Park Final EIS Appendicies. This report divides 'Office' roughly equal between Services and FIRE. The assumed job sector breakdown is: 26 Manufacturing, 20 Services, and 20 FIRE.											
E-L											
	Non-Residential				New Zone; No Data Available						42.46 (10)
(10) Employment denisty from the OP, LI zone is applied here and the job sectore breakdown is split based on table 12 from the Canyon Park Final EIS Appendicies. This report divides 'Office' roughly equal between Services and FIRE. The assumed job sector breakdown is: 17 Manufacturing, 13 Services, and 12 FIRE.											
R-AC, OP, CB (and NB) (11)											
	Non-Residential	14.05	100%	-	-	-	133,385	0.22	401	28.51	36.93 (12)
(12) The assumed job sector breakdown is 16 Services, 15 Food Services, 3 FIRE, and 3 Retail.											

Bothell MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
R-AC, OP, CB (MVSO) (New Projects)											
	Non-Residential	5.46	100%	-	-	-	144,782	0.61	362	66.25	66.25
R-AC, OP, CB (MVSO) (Infill Projects)											
	Non-Residential	12.12	100%	-	-	-	165,501	0.31	366	30.17	30.17
OP, CB (MVSO) (and both CB and OP) (New Projects) (11)											
	Non-Residential	13.10	100%	-	-	-	134,815	0.24	348	26.58	32.67 (13)
(13) The assumed job sector breakdown is 18 Services, 8 Food Services, 4 Retail, 2 FIRE, and 1 Government.											
OP, CB, GC (and OP, GC, and OP) (11)											
	Non-Residential	0.64	100%	-	-	-	5,612	0.20	8	12.59	17.31 (14)
(14) The assumed job sector breakdown is 17 Retail.											
(11) City staff is anticipating densities in the Snohomish County portion of the City of Bothell that resemble what is being achievied within the King County portion of the City. An average floor area ratio (FAR) was determined and the percent difference between the achieved Snohomish County FAR and proposed average FAR was applied to the employment density.											
OP, CB, LI (MVSO) (and R-AC, OP, CB, LI)											
	Non-Residential	3.94	100%	-	-	-	86,148	0.50	215	54.66	54.66
OP, LI											
	Non-Residential	72.05	100%	-	-	-	1,329,077	0.42	3,059	42.46	42.46

Brier MUGA - Additional Population Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Brier	CITY12	(1) PENDING		RS-12500	24.584	5.692483	18.892	.000	49	0	0	0	49	49	0	0	0	49	141	0	0	0	141
			Sum		24.584	5.692483	18.892	.000	49	0	0	0	49	49	0	0	0	49	141	0	0	0	141
			MARKET-READY	RS-12500	2.299	.0000000	2.299	.000	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
			Sum		2.299	.0000000	2.299	.000	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
		Sum			26.883	5.692483	21.191	.000	54	0	0	0	54	54	0	0	0	54	156	0	0	0	156
		(2) VACANT		RS-12500	5.250	.8500113	4.400	.000	15	0	0	0	15	13	0	0	0	13	39	0	0	0	39
			Sum		5.250	.8500113	4.400	.000	15	0	0	0	15	13	0	0	0	13	39	0	0	0	39
		Sum			5.250	.8500113	4.400	.000	15	0	0	0	15	13	0	0	0	13	39	0	0	0	39
		(3) PARTUSE		RS-12500	48.820	11.44784	37.372	23.361	52	0	0	0	52	44	0	0	0	44	128	0	0	0	128
			Sum		48.820	11.44784	37.372	23.361	52	0	0	0	52	44	0	0	0	44	128	0	0	0	128
			MARKET-READY	RS-12500	8.354	1.730729	6.623	4.200	10	0	0	0	10	10	0	0	0	10	27	0	0	0	27
			Sum		8.354	1.730729	6.623	4.200	10	0	0	0	10	10	0	0	0	10	27	0	0	0	27
		Sum			57.173	13.17857	43.995	27.561	62	0	0	0	62	54	0	0	0	54	155	0	0	0	155
		(4) REDEV		RS-12500	38.932	12.98265	25.950	.000	46	0	0	0	46	39	0	0	0	39	113	0	0	0	113
			Sum		38.932	12.98265	25.950	.000	46	0	0	0	46	39	0	0	0	39	113	0	0	0	113
		Sum			38.932	12.98265	25.950	.000	46	0	0	0	46	39	0	0	0	39	113	0	0	0	113
	Sum				128.240	32.70371	95.536	27.561	177	0	0	0	177	161	0	0	0	161	463	0	0	0	463
Sum					128.240	32.70371	95.536	27.561	177	0	0	0	177	161	0	0	0	161	463	0	0	0	463

Brier MUGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Brier	CITY21	(1) PENDING		RS-12500	1.630	1.505814	.125	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
			Sum		1.630	1.505814	.125	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
		Sum			1.630	1.505814	.125	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
		(3) PARTUSE		RS-12500	1.410	.5762621	.834	.572	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
			Sum		1.410	.5762621	.834	.572	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
		Sum			1.410	.5762621	.834	.572	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
	Sum				3.041	2.082076	.959	.572	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
Sum					3.041	2.082076	.959	.572	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5

Brier MUGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Brier	UNINC	(1) PENDING		ULDR	6.622	4.161700	2.460	.000	22	0	2	0	24	22	0	2	0	24	63	0	4	0	67
			Sum		6.622	4.161700	2.460	.000	22	0	2	0	24	22	0	2	0	24	63	0	4	0	67
		Sum			6.622	4.161700	2.460	.000	22	0	2	0	24	22	0	2	0	24	63	0	4	0	67
		(2) VACANT		ULDR	9.313	6.752814	2.560	.000	14	0	0	0	14	13	0	0	0	13	36	0	0	0	36
				UMDR	6.276	6.097598	.178	.000	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
			Sum		15.589	12.85041	2.738	.000	16	0	0	0	16	14	0	0	0	14	41	0	0	0	41
		Sum			15.589	12.85041	2.738	.000	16	0	0	0	16	14	0	0	0	14	41	0	0	0	41
		(3) PARTUSE		ULDR	25.227	6.787062	18.440	10.480	53	0	0	0	53	45	0	0	0	45	131	0	0	0	131
				UMDR	16.756	11.15644	5.600	1.265	10	0	0	0	10	8	0	0	0	8	22	0	0	0	22
			Sum		41.983	17.94350	24.040	11.745	63	0	0	0	63	53	0	0	0	53	152	0	0	0	152
			MARKET-READY	ULDR	1.156	.0803176	1.076	.903	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
			Sum		1.156	.0803176	1.076	.903	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
		Sum			43.140	18.02382	25.116	12.648	68	0	0	0	68	58	0	0	0	58	166	0	0	0	166
		(4) REDEV		ULDR	8.556	4.089706	4.466	.000	16	0	0	0	16	14	0	0	0	14	39	0	0	0	39
			Sum		8.556	4.089706	4.466	.000	16	0	0	0	16	14	0	0	0	14	39	0	0	0	39
		Sum			8.556	4.089706	4.466	.000	16	0	0	0	16	14	0	0	0	14	39	0	0	0	39
	Sum				73.906	39.12564	34.780	12.648	122	0	2	0	124	108	0	2	0	110	310	0	4	0	313
Sum					73.906	39.12564	34.780	12.648	122	0	2	0	124	108	0	2	0	110	310	0	4	0	313

Brier MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Brier	CITY12	(4) REDEV		Commercial	2.580	.0000000	2.580	.000	44	0	0	44	30	0	0	30
			Sum		2.580	.0000000	2.580	.000	44	0	0	44	30	0	0	30
		Sum			2.580	.0000000	2.580	.000	44	0	0	44	30	0	0	30
	Sum				2.580	.0000000	2.580	.000	44	0	0	44	30	0	0	30
Sum					2.580	.0000000	2.580	.000	44	0	0	44	30	0	0	30

Brier MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Brier MUGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

N/A

City of Brier

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
RS-12500											
	Single Family	70.88	100%	189	2.67	2.67	-	-	-	-	-
BN (1)											
	Non-Residential		No Data			-		No Data			20.00

(1) The distribution of jobs by employment sector in Business Neighborhood zoning is expected to be: 12 Services, 3 Food Services, 3 Retail, and 2 FIRE.

Edmonds MUGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Edmonds	CITY12	(1) PENDING		BP	.463	.0000000	.463	.000	3	0	0	0	3	3	0	0	0	3	9	0	0	0	9
				CG	3.241	.0110876	3.230	.000	0	4	433	0	437	0	4	433	0	437	0	10	797	0	807
				RM-1.5	1.579	.0668860	1.512	.000	1	0	37	0	38	1	0	37	0	38	3	0	68	0	71
				RM-2.4	.895	.0000000	.895	.000	0	11	0	0	11	0	11	0	0	11	0	28	0	0	28
				RS-10	.665	.4292546	.235	.000	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				RS-12	1.380	.3751797	1.004	.000	4	0	0	0	4	4	0	0	0	4	12	0	0	0	12
				RS-20	1.892	.4615586	1.431	.000	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
				RS-6	1.056	.1357434	.921	.000	7	0	0	0	7	7	0	0	0	7	20	0	0	0	20
				RS-8	6.841	.1321528	6.708	.000	28	0	0	0	28	28	0	0	0	28	81	0	0	0	81
				WMU	1.287	.4426418	.845	.000	0	0	91	0	91	0	0	91	0	91	0	0	167	0	167
			Sum		19.298	2.054505	17.244	.000	49	15	561	0	625	49	15	561	0	625	141	38	1032	0	1212
		Sum			19.298	2.054505	17.244	.000	49	15	561	0	625	49	15	561	0	625	141	38	1032	0	1212
		(2) VACANT		BC-EW	1.698	.4140119	1.284	.000	0	0	20	15	35	0	0	16	12	28	0	0	30	14	44
				BD2	.135	.0000000	.135	.000	0	0	6	0	6	0	0	5	0	5	0	0	9	0	9
				CG	2.962	.0651400	2.897	.000	0	2	103	14	119	0	2	83	11	96	0	4	153	13	170
				MP2	21.307	12.92686	8.381	.000	0	0	251	0	251	0	0	203	0	203	0	0	373	0	373
				RM-1.5	2.511	.0024588	2.509	.000	0	0	50	0	50	0	0	40	0	40	0	0	74	0	74
				RM-2.4	1.852	.6449138	1.208	.000	5	5	8	0	18	4	4	6	0	15	12	10	12	0	34
				RS-10	.762	.0000000	.762	.000	3	0	0	0	3	3	0	0	0	3	8	0	0	0	8
				RS-12	27.614	16.99560	10.619	.000	49	0	0	0	49	44	0	0	0	44	126	0	0	0	126
				RS-20	22.263	15.99404	6.269	.000	26	0	0	0	26	23	0	0	0	23	67	0	0	0	67
				RS-6	3.167	1.324523	1.842	.000	15	0	0	0	15	13	0	0	0	13	39	0	0	0	39
				RS-8	9.064	3.354571	5.709	.000	31	0	0	0	31	28	0	0	0	28	80	0	0	0	80
				WMU	.231	.0469298	.184	.000	0	0	12	0	12	0	0	10	0	10	0	0	18	0	18
			Sum		93.566	51.76905	41.797	.000	129	7	450	29	615	115	6	363	23	507	331	14	669	28	1041
			MARKET-READY	CG	1.788	.0529700	1.735	.000	0	1	62	8	71	0	1	59	8	67	0	2	108	9	120
			Sum		1.788	.0529700	1.735	.000	0	1	62	8	71	0	1	59	8	67	0	2	108	9	120

	Sum			95.354	51.82202	43.532	.000	129	8	512	37	686	115	7	422	31	575	331	17	777	36	1161
	(3) PARTUSE		RS-10	4.885	.0000000	4.885	2.083	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
			RS-12	15.543	3.940061	11.603	5.514	13	0	0	0	13	11	0	0	0	11	32	0	0	0	32
			RS-20	4.969	2.247176	2.722	1.610	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
			RS-6	.807	.0000000	.807	.238	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
			RS-8	18.684	1.785273	16.899	8.569	33	0	0	0	33	28	0	0	0	28	81	0	0	0	81
			RS-MP	5.858	.3144501	5.544	3.345	16	0	0	0	16	14	0	0	0	14	39	0	0	0	39
		Sum		50.746	8.286960	42.459	21.358	72	0	0	0	72	62	0	0	0	62	177	0	0	0	177
	Sum			50.746	8.286960	42.459	21.358	72	0	0	0	72	62	0	0	0	62	177	0	0	0	177
	(4) REDEV		BC	7.567	1.953837	5.613	.000	0	0	87	66	153	0	0	58	44	102	0	0	106	52	158
			BC-EW	.882	.1872419	.695	.000	-2	0	11	8	17	-1	0	7	5	11	-4	0	13	6	16
			BD1	2.154	.0000000	2.154	.000	0	0	8	0	8	0	0	5	0	5	0	0	10	0	10
			BD2	10.821	.3199118	10.501	.000	-33	0	431	0	398	-22	0	287	0	265	-63	0	527	0	464
			BD3	3.294	.9445006	2.349	.000	-3	0	36	25	58	-2	0	24	17	39	-6	0	44	20	58
			BD4	.568	.0000000	.568	.000	-13	0	21	10	18	-9	0	14	7	12	-25	0	26	8	9
			BD5	2.244	.0000000	2.244	.000	-14	0	43	0	29	-9	0	29	0	19	-27	0	53	0	26
			CG	94.557	4.657048	89.900	.000	-74	52	3193	403	3574	-49	35	2123	268	2377	-142	88	3907	315	4168
			RM-1.5	13.877	.7377731	13.140	.000	-96	0	245	0	149	-64	0	163	0	99	-184	0	300	0	116
			RM-2.4	16.670	.7735018	15.896	.000	-1	42	87	0	128	-1	28	58	0	85	-2	71	106	0	176
			RM-3	1.121	.0000000	1.121	.000	-3	0	7	0	4	-2	0	5	0	3	-6	0	9	0	3
			RS-10	9.687	.0000000	9.687	.000	17	0	0	0	17	15	0	0	0	15	42	0	0	0	42
			RS-12	15.139	1.137357	14.002	.000	22	0	0	0	22	19	0	0	0	19	54	0	0	0	54
			RS-6	4.736	.0000000	4.736	.000	12	0	0	0	12	10	0	0	0	10	30	0	0	0	30
			RS-8	43.448	1.960055	41.488	.000	109	0	0	0	109	93	0	0	0	93	268	0	0	0	268
			RS-MP	1.108	.0000000	1.108	.000	4	0	0	0	4	3	0	0	0	3	10	0	0	0	10
			WMU	20.449	4.664716	15.784	.000	-7	0	1096	0	1089	-5	0	729	0	724	-13	0	1341	0	1328
		Sum		248.321	17.33594	230.985	.000	-82	94	5265	512	5789	-23	63	3501	340	3881	-67	159	6442	400	6934
		MARKET-READY	RM-1.5	.361	.0000000	.361	.000	-1	0	7	0	6	-1	0	7	0	6	-3	0	12	0	10
		Sum		.361	.0000000	.361	.000	-1	0	7	0	6	-1	0	7	0	6	-3	0	12	0	10
	Sum			248.682	17.33594	231.346	.000	-83	94	5272	512	5795	-24	63	3508	340	3887	-70	159	6454	400	6944
	Sum			414.081	79.49943	334.582	21.358	167	117	6345	549	7178	201	84	4491	371	5148	579	214	8264	437	9493
Sum				414.081	79.49943	334.582	21.358	167	117	6345	549	7178	201	84	4491	371	5148	579	214	8264	437	9493

Edmonds MUGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Edmonds MUGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Edmonds	UNINC	(1) PENDING		UHDR	.979	.0000000	.979	.000	0	25	0	0	25	0	25	0	0	25	0	64	0	0	64
				UMDR	5.321	.5478670	4.773	.000	47	12	0	0	59	47	12	0	0	59	135	31	0	0	166
			Sum		6.300	.5478670	5.752	.000	47	37	0	0	84	47	37	0	0	84	135	94	0	0	229
		Sum			6.300	.5478670	5.752	.000	47	37	0	0	84	47	37	0	0	84	135	94	0	0	229
		(2) VACANT		UMDR	.882	.0000000	.882	.000	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
			Sum		.882	.0000000	.882	.000	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15

	Sum		.882	.0000000	.882	.000	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
	(3) PARTUSE	UMDR	6.502	.0000000	6.502	1.975	13	0	0	0	13	10	0	0	0	10	28	0	0	0	28
		Sum	6.502	.0000000	6.502	1.975	13	0	0	0	13	10	0	0	0	10	28	0	0	0	28
	Sum		6.502	.0000000	6.502	1.975	13	0	0	0	13	10	0	0	0	10	28	0	0	0	28
	(4) REDEV	UCOM	8.487	1.270420	7.216	.000	0	0	31	1	32	0	0	21	1	21	0	0	38	1	39
		UHDR	5.018	.0266077	4.991	.000	0	11	31	0	42	0	7	21	0	28	0	19	38	0	57
		UMDR	51.017	.3513865	50.666	.000	221	0	0	0	221	168	0	0	0	168	484	0	0	0	484
		Sum	64.522	1.648414	62.873	.000	221	11	62	1	295	168	7	41	1	217	484	19	76	1	579
	Sum		64.522	1.648414	62.873	.000	221	11	62	1	295	168	7	41	1	217	484	19	76	1	579
Sum			78.207	2.196281	76.010	1.975	287	48	62	1	398	230	44	41	1	316	662	113	76	1	852
Sum			78.207	2.196281	76.010	1.975	287	48	62	1	398	230	44	41	1	316	662	113	76	1	852

Edmonds MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Edmonds	CITY12	(1) PENDING		BD2	.565	.0000000	.565	.000	16	0	0	16	16	0	0	16
				WMU	1.287	.4426418	.845	.000	8	0	0	8	8	0	0	8
			Sum		1.852	.4426418	1.409	.000	24	0	0	24	24	0	0	24
		Sum			1.852	.4426418	1.409	.000	24	0	0	24	24	0	0	24
		(2) VACANT		BC-EW	1.698	.4140119	1.284	.000	6	0	0	6	5	0	0	5
				BD2	.135	.0000000	.135	.000	2	0	1	3	2	0	1	3
				BN	1.482	.5409807	.941	.000	20	0	0	20	16	0	0	17
				CG	2.962	.0651400	2.897	.000	76	6	3	84	61	5	2	68
				MP2	21.307	12.92686	8.381	.000	25	0	0	25	20	0	0	20
				WMU	.231	.0469298	.184	.000	1	0	0	1	1	0	0	1
			Sum		27.815	13.99393	13.821	.000	130	6	4	139	105	5	3	113
			MARKET-READY	CG	1.788	.0529700	1.735	.000	45	3	2	50	43	3	2	48
			Sum		1.788	.0529700	1.735	.000	45	3	2	50	43	3	2	48
		Sum			29.603	14.04690	15.556	.000	175	9	6	190	148	8	5	160

	(3) PARTUSE		MU	3.115	.1580956	2.957	.754	75	0	0	75	50	0	0	50
		Sum		3.115	.1580956	2.957	.754	75	0	0	75	50	0	0	50
	Sum			3.115	.1580956	2.957	.754	75	0	0	75	50	0	0	50
	(4) REDEV		BC	7.623	1.959226	5.664	.000	266	0	46	311	177	0	30	207
			BC-EW	.882	.1872419	.695	.000	3	0	0	3	2	0	0	2
			BD1	5.328	.0000000	5.328	.000	266	0	0	266	177	0	0	177
			BD2	11.674	.3199118	11.354	.000	112	0	103	216	75	0	69	143
			BD3	3.294	.9445006	2.349	.000	121	0	19	140	80	0	13	93
			BD5	3.752	.0000000	3.752	.000	88	0	19	107	59	0	12	71
			BN	11.884	1.165333	10.719	.000	185	0	2	187	123	0	1	124
			BP	6.081	.5827262	5.498	.000	116	0	1	117	77	0	1	78
			CG	95.447	4.754542	90.692	.000	1816	182	83	2081	1208	121	55	1384
			OR	.224	.0004110	.223	.000	0	0	0	0	0	0	0	0
			WMU	8.333	2.990327	5.343	.000	18	0	0	18	12	0	0	12
		Sum		154.521	12.90422	141.617	.000	2992	182	273	3447	1989	121	182	2292
		MARKET-READY	BN	1.119	.0166938	1.102	.000	23	0	0	23	21	0	0	22
		Sum		1.119	.0166938	1.102	.000	23	0	0	23	21	0	0	22
	Sum			155.640	12.92091	142.719	.000	3014	182	274	3469	2011	121	182	2314
Sum				190.210	27.56855	162.642	.754	3288	191	279	3758	2232	129	187	2548
Sum				190.210	27.56855	162.642	.754	3288	191	279	3758	2232	129	187	2548

Edmonds MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Edmonds MUGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2

Edmonds	UNINC	(4) REDEV		UCOM	10.481	1.356536	9.124	.000	98	6	3	108	65	4	2	72
			Sum		10.481	1.356536	9.124	.000	98	6	3	108	65	4	2	72
		Sum			10.481	1.356536	9.124	.000	98	6	3	108	65	4	2	72
	Sum				10.481	1.356536	9.124	.000	98	6	3	108	65	4	2	72
Sum					10.481	1.356536	9.124	.000	98	6	3	108	65	4	2	72

City of Edmonds

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
RS -20000											
	Single Family	7.82	100%	16	2.05	2.05	-	-	-	-	-
RS -12000											
	Single Family	25.58	100%	81	3.17	3.17	-	-	-	-	-
RS -10000											
	Single Family	1.76	100%	6	3.41	3.41	-	-	-	-	-
RS -8000											
	Single Family	48.61	100%	219	4.51	4.51	-	-	-	-	-
RS -6000											
	Single Family	1.39	100%	8	5.74	5.74	-	-	-	-	-
RS-MP											
	Single Family		No Data			5.50	-	-	-	-	-
RM-3000											
	Multi-Family	0.37	100%	4	10.70	10.70	-	-	-	-	-
RM-2400											
	Single Family	1.50	25%	25	4.14	4.14	-	-	-	-	-
	Townhouse	1.98	33%	31	5.13	5.13	-	-	-	-	-
	Multi-Family	2.56	42%	44	7.28	7.28	-	-	-	-	-
	Total	**6.04**	**100%**	**100**	**16.55**	**16.55**	-	-	-	-	-

City of Edmonds

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
RM-1500											
	Townhouse	0.33	2%	8	0.55	0.55	-	-	-	-	-
	Multi-Family	14.34	98%	306	20.86	20.86	-	-	-	-	-
	Total	**14.67**	**100%**	**314**	**21.41**	**21.41**	-	-	-	-	-
RM-EW, BC-EW											
	Mixed-Use	1.83	100%	89	48.55	48.55	6,009	0.08	9	4.68	4.68
BC (New Projects)											
	Senior Apartments	1.38	21%	83	12.39	12.39	-	-	-	-	-
	Mixed-Use	3.95	59%	109	16.27	16.27	80,203	0.27	213	31.84	31.84
	Non-Residential	1.37	20%	-	-	-	75,238	0.26	200	29.87	29.87
	Total	**6.70**	**100%**	**192**	**28.66**	**28.66**	**155,441**	**0.53**	**413**	**61.71**	**61.71**
BC (Infill Projects)											
	Non-Residential	4.10	100%	-	-	-	22,755	0.13	62	15.13	15.13
BD-1											
	Mixed-Use	No Data				5.00	No Data				60.00 (1)
(1) The distribution of employment by job sector in BD-1 is assumed to be: 35 Services, 10 FIRE, 10 Retail, and 5 Food Services.											
BD-2											
	Multi-Family	0.17	10%	13	8.01	8.01	-	-	-	-	-
	Mixed-Use	0.99	61%	63	38.82	38.82	4,432	0.10	15	9.10	9.10
	Non-Residential	0.47	29%	-	-	-	8,884	0.44	23	14.30	14.30
	Total	**1.62**	**100%**	**76**	**46.83**	**46.83**	**13,316**	**0.19**	**38**	**23.40**	**23.40**
BD-3											
	Mixed-Use	No Data				28.67	No Data				61.71

City of Edmonds

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
BD-4											
	Mixed-Use	No Data				40.00	No Data				-
	Senior Apartments	No Data				20.00	No Data				-
	Total	No Data				**60.00**	No Data				**0.00 (2)**
(2) While some non-residential uses are allowed in BD-4, city staff indicate that they expect the redevelopable sites to develop as residential-only projects.											
BD-5											
	Mixed-Use	No Data				30.00	No Data				30.00 (3)
(3) The distribution of employment by job sector in BD-5 is assumed to be: 15 Services, 5 FIRE, 5 Government, and 5 Retail.											
BN											
	Non-Residential	7.36	100%	-	-	-	61,886	0.19	160	21.72	21.72
CG (New Projects)											
	Townhouse	0.50	2%	12	0.40	1.00 (4)	-	-	-	-	-
	Multi-Family	-	0%	-	-	36.00 (4)	-	-	-	-	-
	Senior Apartments	-	0%	-	-	5.00 (4)	-	-	-	-	-
	Non-Residential	29.27	98%	-	-	-	504,943	0.39	980	32.92	29.00 (4)
	Total	**29.77**	**100%**	**12**	**0.40**	**42.00 (4)**	**504,943**	**0.39**	**980**	**32.92**	**29.00 (4)**
(4) Post-2018 actual and proposed projects within the CG zone serve as the basis for establishing the assumed residential densities. The assumed job sector breakdown is 19 Services, Retail 5, Food Services, 2, Manufacturing 2, Government 1											
CG (Infill Projects)											
	Non-Residential	64.99	100%	-	-	-	893,674	0.32	1,848	28.43	-

City of Edmonds

Development History (1995-2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
CW											
	Non-Residential	No Data				-	No Data				30.00 (5)
(5) The distribution of employment by job sector is assumed to be: 10 Retail, 10 Services, 10 Food Services.											
MP-1											
	Mixed-Use	New Zone: No Data				15.00	New Zone: No Data				3.00 (6)
MP-2											
	Mixed-Use	New Zone: No Data				30.00	New Zone: No Data				3.00 (6)
(6) The future employment in MP-1 and MP-2, if any, is expected to be entirely within the Services sector.											
MU (Medical Use)											
	Non-Residential	2.00	100%	-	-	-	79,744	0.91	199	99.50	99.50
WMU											
	Mixed-Use	1.29	100%	91	70.70	70.70	3,100	0.06	4	3.44	3.44
Office/Residential											
	Mixed-Use	0.28	100%	6	21.20	21.20	211	0.02	1	1.94	1.94

Everett MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Everett	CITY12	(1) PENDING		AG	2.9	2.712533	0.188	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				MU	101.705	31.43418	70.271	0	52	0	3001	0	3053	52	0	3001	0	3053	150	0	5522	0	5672
				R-1	9.731	1.842274	7.889	0	35	0	67	0	102	35	0	67	0	102	101	0	123	0	224
				R-2	19.069	4.647845	14.421	0	41	0	90	1	132	41	0	90	1	132	118	0	166	1	285
				R-S	1.285	0.0671686	1.218	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
				UR3	7.63	0.7244722	6.905	0	5	13	207	0	225	5	13	207	0	225	14	33	381	0	428
Everett	CITY12	(1) PENDING		UR4	3.543	0.3870471	3.156	0	0	10	151	0	161	0	10	151	0	161	0	25	278	0	303
			Sum		145.863	41.81552	104.047	0	139	23	3516	1	3679	139	23	3516	1	3679	400	59	6469	1	6929
		Sum			145.863	41.81552	104.047	0	139	23	3516	1	3679	139	23	3516	1	3679	400	59	6469	1	6929
		(2) VACANT		B	13.887	6.156151	7.731	0	0	0	45	45	90	0	0	36	36	73	0	0	67	43	110
				MU	21.479	4.584753	16.895	0	3	0	1223	0	1226	2	0	988	0	990	7	0	1817	0	1824
				NB	3.543	2.56393	0.979	0	0	0	57	0	57	0	0	46	0	46	0	0	85	0	85
				R-1	37.891	22.26757	15.623	0	104	0	11	0	115	88	0	9	0	97	253	0	17	0	270
				R-2	30.701	25.03479	5.667	0	46	0	5	0	51	39	0	4	0	43	112	0	8	0	120
				R-2A	4.203	2.377917	1.825	0	15	0	2	0	17	13	0	2	0	14	37	0	3	0	40
				R-S	35.058	28.96545	6.093	0	35	0	0	0	35	31	0	0	0	31	90	0	0	0	90
				UR3	7.322	6.273991	1.048	0	7	3	14	0	24	6	3	12	0	20	17	6	22	0	45
				UR4	8.209	3.107039	5.102	0	3	0	461	0	464	2	0	372	0	375	7	0	685	0	692
			Sum		162.295	101.3316	60.963	0	213	3	1818	45	2079	182	3	1469	36	1690	523	6	2703	43	3275
			MARKET-READ	UR3	7.243	5.912924	1.33	0	0	8	19	0	27	0	8	18	0	26	0	19	33	0	53
				UR4	2.213	0	2.213	0	0	3	205	0	208	0	3	195	0	198	0	7	358	0	366
			Sum		9.456	5.912924	3.543	0	0	11	224	0	235	0	10	213	0	223	0	27	392	0	418
		Sum			171.751	107.2445	64.507	0	213	14	2042	45	2314	182	13	1682	36	1913	523	33	3095	43	3694

		(3) PARTUSE		MU	13.48	0.8792751	12.601	4.852	0	0	355	0	355	0	0	236	0	236	0	0	434	0	434
				R-1	43.61	17.40315	26.207	13.704	61	0	6	0	67	46	0	5	0	51	134	0	8	0	142
				R-2	11.239	1.712263	9.527	4.93	18	0	8	0	26	14	0	6	0	20	39	0	11	0	51
				R-2A	2.393	0.2195242	2.173	1.214	10	0	1	0	11	8	0	1	0	8	22	0	1	0	23
				R-S	17.587	8.678797	8.908	4.2	14	0	0	0	14	12	0	0	0	12	34	0	0	0	34
				UR4	0.137	0.0504664	0.087	0.087	0	0	8	0	8	0	0	5	0	5	0	0	10	0	10
			Sum		88.446	28.94347	59.502	28.987	103	0	378	0	481	80	0	253	0	332	229	0	465	0	694
			MARKET-READ	MU	0.676	0	0.676	0.043	0	0	3	0	3	0	0	3	0	3	0	0	5	0	5
			Sum		0.676	0	0.676	0.043	0	0	3	0	3	0	0	3	0	3	0	0	5	0	5
		Sum			89.122	28.94347	60.179	29.03	103	0	381	0	484	80	0	256	0	335	229	0	470	0	700
		(4) REDEV		B	111.826	25.37496	86.451	0	-24	0	515	515	1006	-16	0	342	342	669	-46	0	630	403	987
				MU	230.459	17.51964	212.94	0	-292	0	15247	0	14955	-194	0	10139	0	9945	-559	0	18656	0	18097
				NB	10.091	1.544298	8.546	0	-35	0	460	0	425	-23	0	306	0	283	-67	0	563	0	496
				R-1	86.023	14.53455	71.488	0	220	0	45	0	265	167	0	34	0	201	482	0	63	0	544
				R-2	45.615	6.152664	39.463	0	61	0	81	0	142	46	0	62	0	108	134	0	113	0	247
				R-2A	0.275	0	0.275	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				R-S	14.394	2.301146	12.093	0	33	0	0	0	33	28	0	0	0	28	81	0	0	0	81
				UR3	103.114	19.50443	83.61	0	-688	437	1194	0	943	-523	332	907	0	717	-1506	845	1670	0	1009
				UR4	65.745	4.98047	60.765	0	-726	5	5419	0	4698	-483	3	3604	0	3124	-1390	8	6631	0	5249
			Sum		667.543	91.91216	575.631	0	-1450	442	22961	515	22468	-997	335	15394	342	15076	-2870	853	28326	403	26712
			MARKET-READ	B	8.299	2.389465	5.909	0	0	0	37	37	74	0	0	35	35	70	0	0	65	41	106
				MU	7.009	0.4302165	6.579	0	-7	0	474	0	467	-7	0	450	0	444	-19	0	829	0	809
				R-2A	6.773	0.9656098	5.807	0	42	0	10	0	52	40	0	10	0	49	115	0	17	0	132
				UR4	1.334	0.0727462	1.261	0	-6	0	116	0	110	-6	0	110	0	105	-16	0	203	0	186
			Sum		23.414	3.858038	19.556	0	29	0	637	37	703	28	0	605	35	668	79	0	1113	41	1234
		Sum			690.957	95.7702	595.187	0	-1421	442	23598	552	23171	-969	335	16000	378	15744	-2791	853	29439	444	27946
	Sum				1097.693	273.7737	823.919	29.03	-966	479	29537	598	29648	-569	371	21453	415	21671	-1638	945	39474	488	39269
Sum					1097.693	273.7737	823.919	29.03	-966	479	29537	598	29648	-569	371	21453	415	21671	-1638	945	39474	488	39269

Everett MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Everett	CITY21	(1) PENDING		MU	0.429	0	0.429	0	0	12	0	0	12	0	12	0	0	12	0	31	0	0	31
			Sum		0.429	0	0.429	0	0	12	0	0	12	0	12	0	0	12	0	31	0	0	31
		Sum			0.429	0	0.429	0	0	12	0	0	12	0	12	0	0	12	0	31	0	0	31
		(4) REDEV		MU	0.22	0	0.22	0	-1	0	15	0	14	-1	0	10	0	9	-2	0	18	0	16
			Sum		0.22	0	0.22	0	-1	0	15	0	14	-1	0	10	0	9	-2	0	18	0	16
		Sum			0.22	0	0.22	0	-1	0	15	0	14	-1	0	10	0	9	-2	0	18	0	16
	Sum				0.649	0	0.649	0	-1	12	15	0	26	-1	12	10	0	21	-2	31	18	0	47
Sum					0.649	0	0.649	0	-1	12	15	0	26	-1	12	10	0	21	-2	31	18	0	47

Everett MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Everett	UNINC	(1) PENDING		UCENTER	9.574	0.6998269	8.874	0	0	0	192	222	414	0	0	192	222	414	0	0	353	261	614

		UHDR	6.651	1.902346	4.749	0	42	0	22	0	64	42	0	22	0	64	121	0	40	0	161
		ULDR	83.401	34.78629	48.615	0	251	0	6	0	257	251	0	6	0	257	723	0	11	0	734
		UMDR	8.785	0.7210954	8.064	0	60	20	4	0	84	60	20	4	0	84	173	51	7	0	231
		UVILL	5.836	0	5.836	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
	Sum		114.247	38.10956	76.137	0	358	20	224	222	824	358	20	224	222	824	1031	51	412	261	1755
	Sum		114.247	38.10956	76.137	0	358	20	224	222	824	358	20	224	222	824	1031	51	412	261	1755
	(2) VACANT	MF-HD	1.342	0.859605	0.483	0	0	1	13	0	14	0	1	10	0	11	0	2	19	0	21
		UCENTER	2.8	2.093517	0.707	0	0	0	31	6	37	0	0	25	5	30	0	0	46	6	52
		UHDR	9.117	4.584111	4.533	0	17	13	30	1	61	14	10	24	1	49	40	27	45	1	112
		ULDR	38.369	24.57077	13.798	0	77	0	0	0	77	69	0	0	0	69	198	0	0	0	198
		UMDR	5.472	1.615437	3.857	0	26	0	0	0	26	22	0	0	0	22	63	0	0	0	63
		UVILL	0.585	0.1178544	0.467	0	0	0	8	0	8	0	0	6	0	6	0	0	12	0	12
	Sum		57.685	33.84129	23.844	0	120	14	82	7	223	104	11	66	6	188	301	29	122	7	458
	Sum		57.685	33.84129	23.844	0	120	14	82	7	223	104	11	66	6	188	301	29	122	7	458
	(3) PARTUSE	UCENTER	28.971	6.277651	22.693	10.004	0	6	446	93	545	0	4	297	62	362	0	10	546	73	629
		UHDR	3.131	0.2897414	2.842	1.613	3	4	12	1	20	2	3	8	1	13	6	7	15	1	28
		ULDR	210.061	94.55422	115.507	63.306	333	0	0	0	333	285	0	0	0	285	820	0	0	0	820
		UMDR	18.692	2.469698	16.223	7.492	55	0	0	0	55	42	0	0	0	42	120	0	0	0	120
		UVILL	1.566	0.1614938	1.404	0.092	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
	Sum		262.421	103.7528	158.669	82.507	391	10	459	94	954	329	7	305	63	703	946	17	562	74	1598
	Sum		262.421	103.7528	158.669	82.507	391	10	459	94	954	329	7	305	63	703	946	17	562	74	1598
	(4) REDEV	MF-HD	16.338	4.311405	12.026	0	-55	14	308	0	267	-37	9	205	0	178	-105	24	377	0	295
		MF-HD-UCOM	19.085	0	19.085	0	-21	19	254	0	252	-14	13	169	0	168	-40	32	311	0	303
		UCENTER	56.012	7.995392	48.017	0	-95	26	2137	443	2511	-63	17	1421	295	1670	-182	44	2615	346	2823
		UCOM	6.275	3.750064	2.525	0	-2	0	10	0	8	-1	0	7	0	5	-4	0	12	0	8
		UHDR	88.891	8.146657	80.744	0	6	172	510	6	694	4	114	339	4	462	11	291	624	5	931
		ULDR	97.575	46.46735	51.108	0	198	0	0	0	198	169	0	0	0	169	488	0	0	0	488
		UMDR	65.938	1.298838	64.639	0	252	0	0	0	252	192	0	0	0	192	552	0	0	0	552
		UVILL	4.603	0	4.603	0	-11	2	87	7	85	-7	1	58	5	57	-21	3	106	5	94
	Sum		354.718	71.9697	282.748	0	272	233	3306	456	4267	242	155	2198	303	2899	698	394	4045	357	5494
	MARKET-READ	UVILL	0.331	0	0.331	0	-1	0	6	0	5	-1	0	6	0	5	-3	0	10	0	8
	Sum		0.331	0	0.331	0	-1	0	6	0	5	-1	0	6	0	5	-3	0	10	0	8
	Sum		355.049	71.9697	283.079	0	271	233	3312	456	4272	241	155	2204	303	2904	695	394	4056	357	5502
Sum			789.402	247.6734	541.729	82.507	1140	277	4077	779	6273	1032	193	2800	593	4618	2974	491	5151	698	9313
Sum			789.402	247.6734	541.729	82.507	1140	277	4077	779	6273	1032	193	2800	593	4618	2974	491	5151	698	9313

Everett MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Everett	CITY12	(1) PENDING		HI	971.757	200.7126	771.045	0	0	25837	0	25837	0	25837	0	25837
				LI2	89.656	32.64233	57.013	0	547	591	0	1139	547	591	0	1139
				MU	79.472	27.73452	51.737	0	1187	0	0	1187	1187	0	0	1187
			Sum		1140.885	261.0894	879.795	0	1735	26428	0	28163	1735	26428	0	28163
		Sum			1140.885	261.0894	879.795	0	1735	26428	0	28163	1735	26428	0	28163
		(2) VACANT		B	15.62	7.392821	8.227	0	88	0	0	88	71	0	0	71
				HI	44.657	11.24937	33.407	0	32	561	0	592	26	453	0	478
				LI1	12.049	4.509671	7.54	0	43	164	2	210	35	133	2	169
				LI2	122.021	57.08153	64.94	0	104	1244	1	1349	84	1004	1	1089
				MU	20.314	3.402479	16.911	0	592	0	0	592	478	0	0	478
				NB	3.543	2.56393	0.979	0	22	0	0	22	17	0	0	17
			Sum		218.204	86.19979	132.004	0	880	1968	3	2852	711	1589	3	2303
			MARKET-READY	HI	19.598	4.97346	14.625	0	14	245	0	259	13	233	0	246
				LI2	1.377	0.7982649	0.579	0	1	11	0	12	1	11	0	11
			Sum		20.975	5.771725	15.203	0	15	256	0	271	14	244	0	258
		Sum			239.179	91.97152	147.207	0	895	2225	3	3124	725	1833	3	2561

Everett	CITY12	(3) PARTUSE		B	18.445	0.3695086	18.075	6.817	164	0	0	164	109	0	0	109
				HI	29.862	1.022954	28.839	21.157	20	355	0	375	13	236	0	249
				LI1	4.752	1.650648	3.101	2.11	13	65	0	78	9	43	0	52
				LI2	110.083	45.63239	64.451	26.424	157	352	2	512	105	234	2	340
				MU	13.48	0.8792751	12.601	4.852	55	0	56	111	37	0	37	74
			Sum		176.622	49.55477	127.068	61.36	410	773	58	1241	273	514	39	825
			MARKET-READY	HI	60.803	26.02875	34.774	22.269	21	374	0	395	20	355	0	375
				MU	0.676	0	0.676	0.043	0	0	0	1	0	0	0	1
			Sum		61.479	26.02875	35.451	22.311	22	374	0	396	21	355	0	376
		Sum			238.102	75.58352	162.518	83.671	431	1146	59	1636	293	869	39	1201
		(4) REDEV		B	118.672	26.25565	92.416	0	767	0	0	767	510	0	0	510
				HI	471.776	201.7878	269.988	0	236	3001	0	3237	157	1995	0	2153
				LI1	61.671	7.216484	54.454	0	287	885	16	1188	191	588	11	790
				LI2	197.876	36.31941	161.557	0	191	1789	3	1984	127	1190	2	1319
				MU	231.899	18.33742	213.561	0	6187	0	0	6187	4115	0	0	4115
				NB	10.131	1.544298	8.587	0	174	0	0	174	116	0	0	116
			Sum		1092.025	291.461	800.564	0	7843	5674	19	13537	5216	3773	13	9002
			MARKET-READY	B	8.299	2.389465	5.909	0	39	0	0	39	37	0	0	37
				HI	0.504	0.2201843	0.284	0	0	5	0	5	0	5	0	5
				LI2	7.263	1.459091	5.804	0	5	111	0	116	5	106	0	110
				MU	7.009	0.4302165	6.579	0	210	0	0	210	200	0	0	200
			Sum		23.075	4.498957	18.576	0	255	116	0	371	242	110	0	352
		Sum			1115.1	295.96	819.14	0	8098	5790	19	13908	5458	3884	13	9354
	Sum				2733.265	724.6044	2008.661	83.671	11160	35590	81	46831	8211	33014	55	41279
Sum					2733.265	724.6044	2008.661	83.671	11160	35590	81	46831	8211	33014	55	41279

Everett MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Everett	CITY21	(4) REDEV		MU	0.22	0	0.22	0	8	0	0	8	5	0	0	5
			Sum		0.22	0	0.22	0	8	0	0	8	5	0	0	5
		Sum			0.22	0	0.22	0	8	0	0	8	5	0	0	5
	Sum				0.22	0	0.22	0	8	0	0	8	5	0	0	5
Sum					0.22	0	0.22	0	8	0	0	8	5	0	0	5

Everett MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Everett	UNINC	(2) VACANT		UCENTER	2.8	2.093517	0.707	0	18	0	1	19	15	0	1	15
				UVILL	0.585	0.1178544	0.467	0	5	0	0	5	4	0	0	4
			Sum		3.385	2.211372	1.174	0	23	0	1	24	19	0	1	19
		Sum			3.385	2.211372	1.174	0	23	0	1	24	19	0	1	19
Everett	UNINC	(3) PARTUSE		MF-HD-UCOM	2.501	0.2182807	2.283	1.629	27	0	0	27	18	0	0	18
				UCENTER	29.548	6.277651	23.271	10.009	260	0	10	270	173	0	7	180
				UI	210.004	104.1042	105.9	104.751	507	1391	25	1923	337	925	17	1279
				UVILL	2.176	0.2537885	1.923	0.115	1	0	0	1	1	0	0	1
			Sum		244.229	110.8539	133.375	116.504	796	1391	35	2222	529	925	23	1478
		Sum			244.229	110.8539	133.375	116.504	796	1391	35	2222	529	925	23	1478
		(4) REDEV		MF-HD-UCOM	19.675	0.5392756	19.135	0	220	13	7	241	146	9	5	160
				UCENTER	56.012	7.995392	48.017	0	1135	0	44	1179	755	0	29	784
				UCOM	6.68	3.821414	2.858	0	33	2	1	36	22	1	1	24
				UVILL	4.603	0	4.603	0	45	0	0	45	30	0	0	30
			Sum		86.969	12.35608	74.613	0	1433	15	52	1501	953	10	35	998
			MARKET-READY	UVILL	0.331	0	0.331	0	3	0	0	3	3	0	0	3
			Sum		0.331	0	0.331	0	3	0	0	3	3	0	0	3

	Sum	87.3	12.35608	74.944	0	1437	15	52	1504	956	10	35	1001
Sum		334.915	125.4214	209.494	116.504	2255	1406	88	3750	1504	935	58	2498
Sum		334.915	125.4214	209.494	116.504	2255	1406	88	3750	1504	935	58	2498

City of Everett

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
A-1, AQ, P, or OS		Case-by-case (usually no development)									
R-S (1995 - 2018)											
	Single Family	20.74	100%	98	4.73	4.73	-	-	-	-	-
R-1 (1995 - 2018)											
	Single Family	67.48	92%	381	5.21	5.21	-	-	-	-	-
	Multi-Family	5.68	8%	114	1.56	1.56	-	-	-	-	-
	Total	**73.17**	**100%**	**495**	**6.77**	**6.77**	**-**	**-**	**-**	**-**	**-**
R-2 (1995 - 2018)							-	-	-	-	-
	Single Family	32.17	71%	196	4.33	4.33	-	-	-	-	-
	Multi-Family	13.07	29%	117	2.59	2.59	-	-	-	-	-
	Total	**45.24**	**100%**	**313**	**6.92**	**6.92**	**-**	**-**	**-**	**-**	**-**
R-2A (1995 - 2018)											
	Single Family	10.22	100%	93	9.10	9.10	-	-	-	-	-
	Multi-Family	2.27	18%	23	1.84	1.84	-	-	-	-	-
	Total	**12.48**	**100%**	**116**	**9.29**	**9.29**	**-**	**-**	**-**	**-**	**-**
NB (New Projects)											
	Multi-Family	0.67	100%	40	60.04	60.04	-	-	-	-	-
	Non-Residential		No Development					No Development			21.85 (1)
	Total	**0.67**	**100%**	**40**	**60.04**	**60.04**	**-**	**-**	**-**	**-**	**21.85 (1)**
(1) The NB zone is based off the old B-1 zone. The sector breakdown is as follows: 7 Retail, 6 Food Services, 6 Services, and 3 FIRE											
NB (Infill Projects)											
	Non-Residential	0.32	100%	-	-	-	2,942	0.21	4	12.99	12.99

City of Everett

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
B (New Projects)											
	Senior Apartments	2.38	17%	180	12.77	12.77	-	-	-	-	-
	Non-Residential	11.71	83%	-	-	-	209,772	0.34	151	10.73	10.73
	Total	**14.09**	**100%**	**180**	**12.77**	**12.77**	**209,772**	**0.34**	**151**	**10.73**	**10.73**
B (Infill Projects)											
	Non-Residential	36.66	100%	-	-	-	434,694	0.27	906	24.08	24.08
MU (New Projects)											
	Multi-Family	0.94	8%	42	3.51	35.80 (2)	-	-	-	-	-
	Mixed Use	4.33	36%	562	46.94	38.08 (2)	170,166	0.33	425	35.50	0.24 (2)
	Non-Residential	6.71	56%	-	-	-	247,888	0.48	387	32.33	34.76 (2)
	Total	**11.97**	**100%**	**604**	**50.45**	**73.88 (2)**	**418,054**	**0.80**	**812**	**67.83**	**35.00 (2)**
(2) Post-2018 actual and proposed projects show a higher residential density and lower employment density than what previously occurred. The assumed job sector breakdown is 26 Services, 5 Food Services, 3 Retail, 1 FIRE.											
MU (Infill Projects)											
	Mixed-Use	2.88	14%	80	4.01	4.01	150	0	1	0.03	0.03
	Non-Residential	17.05	86%	-	-	-	215,541	0.25	456	22.89	22.89
	Total	**19.94**	**100%**	**80**	**4.01**	**4.01**	**215,691**	**0.25**	**457**	**22.92**	**22.92**
UR3											
	Townhouse	6.94	94%	86	11.66	6.70 (3)	-	-	-	-	-
	Multi-Family	0.44	6%	12	1.63	15.03 (3)	-	-	-	-	-
	Total	**7.37**	**100%**	**98**	**13.29**	**21.73 (3)**	**-**	**-**	**-**	**-**	**-**
(3) Projects submitted after 2018 indicate a higher density when averaged with the entire development history.											
UR4											
	Townhouse		No Data			1.42 (3)		No Data			-
	Multi-Family	1.02	100%	81	79.78	92.99 (3)	-	-	-	-	-
	Total					**94.42 (3)**					
(3) Projects submitted after 2018 indicate a higher density when averaged with the entire development history											

City of Everett

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
LI1 (New Projects) (1995 - 2018)											
	Non-Residential	11.78	100%	-	-	-	229,771	0.45	327	27.79	27.79
LI1 (Infill Projects) (1995 - 2018)											
	Non-Residential	4.47	100%	-	-	-	96,806	0.50	166	37.09	37.09
LI2 (New Projects) (1995 - 2018)											
	Non-Residential	222.61	100%	-	-	-	3,051,093	0.31	4,623	20.77	20.77
LI2 (Infill Projects) (1995 - 2018)											
	Non-Residential	109.87	100%	-	-	-	1,087,041	0.23	2,129	19.38	19.38
HI (1995 - 2018)											
	Non-Residential	47.22	100%	-	-	-	565,071	0.27	837	17.73	17.73

Lynnwood MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Lynnwood	CITY12	(1) PENDING		CC-C	4.142	0	4.142	0	0	0	598	0	598	0	0	598	0	598	0	0	1100	0	1100
				CC-W	19.176	3.86362	15.312	0	0	0	1370	0	1370	0	0	1370	0	1370	0	0	2521	0	2521
				CDM	1.452	0	1.452	0	1	0	106	0	107	1	0	106	0	107	3	0	195	0	198
				CR	13.466	0.4143619	13.052	0	0	0	503	0	503	0	0	503	0	503	0	0	926	0	926
				HMU	6.149	1.228108	4.921	0	0	0	231	0	231	0	0	231	0	231	0	0	425	0	425
				NC	3.21	1.918223	1.292	0	1	42	0	0	43	1	42	0	0	43	3	107	0	0	110
				PCD	9.059	1.339168	7.72	0	0	0	387	0	387	0	0	387	0	387	0	0	712	0	712
				PRC	13.785	0	13.785	0	0	0	677	0	677	0	0	677	0	677	0	0	1246	0	1246
				RMM	0.724	0	0.724	0	0	13	0	0	13	0	13	0	0	13	0	33	0	0	33
				RS-7	7.923	0	7.923	0	40	0	0	0	40	40	0	0	0	40	115	0	0	0	115
				RS-8	48.118	11.61176	36.506	0	210	0	0	0	210	210	0	0	0	210	605	0	0	0	605
			Sum		127.204	20.37524	106.829	0	252	55	3872	0	4179	252	55	3872	0	4179	726	140	7124	0	7990
		Sum			127.204	20.37524	106.829	0	252	55	3872	0	4179	252	55	3872	0	4179	726	140	7124	0	7990
Lynnwood	CITY12	(2) VACANT		CC-C	0.717	0.0963533	0.621	0	0	0	38	12	50	0	0	31	10	40	0	0	56	11	68
				CC-N	0.375	0.1580376	0.217	0	0	0	13	4	17	0	0	10	3	14	0	0	19	4	23
				NC	1.771	0	1.771	0	0	17	0	0	17	0	14	0	0	14	0	35	0	0	35
				RMM	0.978	0.1600206	0.818	0	0	0	9	3	12	0	0	7	2	10	0	0	13	3	16
				RS-8	16.59	10.37973	6.21	0	30	0	0	0	30	27	0	0	0	27	77	0	0	0	77
			Sum		20.43	10.79414	9.636	0	30	17	60	19	126	27	14	48	15	104	77	35	89	18	219
			MARKET-READY	NC	1.17	0.2710644	0.899	0	0	8	0	0	8	0	8	0	0	8	0	19	0	0	19

			Sum		1.17	0.2710644	0.899	0	0	8	0	0	8	0	8	0	0	8	0	19	0	0	19
		Sum			21.6	11.06521	10.535	0	30	25	60	19	134	27	21	48	15	112	77	54	89	18	239
		(3) PARTUSE		CC-C	3.377	0	3.377	0.896	0	0	56	18	74	0	0	37	12	49	0	0	69	14	83
				HMU	10.671	0	10.671	5.239	0	0	47	60	107	0	0	31	40	71	0	0	58	47	104
				PCD	10.89	3.078682	7.811	4.759	0	0	35	0	35	0	0	23	0	23	0	0	43	0	43
				RS-7	1.505	0.2798889	1.225	0.309	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				RS-8	15.794	0	15.794	8.794	31	0	0	0	31	27	0	0	0	27	76	0	0	0	76
			Sum		42.237	3.358571	38.879	19.998	32	0	138	78	248	27	0	92	52	171	79	0	169	61	309
		Sum			42.237	3.358571	38.879	19.998	32	0	138	78	248	27	0	92	52	171	79	0	169	61	309
		(4) REDEV		CC-C	53.78	2.563553	51.217	0	0	0	3176	1038	4214	0	0	2112	690	2802	0	0	3886	812	4698
				CC-N	1.748	0.4671466	1.281	0	0	0	80	26	106	0	0	53	17	70	0	0	98	20	118
				CC-W	22.4	1.350192	21.05	0	0	0	1312	434	1746	0	0	872	289	1161	0	0	1605	339	1945
				CDM	13.645	2.283099	11.362	0	-47	0	650	0	603	-31	0	432	0	401	-90	0	795	0	705
				HMU	53.733	2.361328	51.372	0	-7	0	446	568	1007	-5	0	297	378	670	-13	0	546	444	977
				NC	24.134	3.523767	20.611	0	-2	194	0	0	192	-1	129	0	0	128	-4	328	0	0	324
				PCD	26.405	5.572898	20.832	0	0	0	150	0	150	0	0	100	0	100	0	0	184	0	184
				PRC	16.86	0.1528386	16.707	0	0	0	233	0	233	0	0	155	0	155	0	0	285	0	285
				RML	9.143	0	9.143	0	-18	34	75	0	91	-12	23	50	0	61	-34	58	92	0	115
				RMM	6.456	0.1688575	6.287	0	1	0	73	25	99	1	0	49	17	66	2	0	89	20	111
				RS-7	4.089	1.539139	2.55	0	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
				RS-8	33.535	1.189598	32.345	0	69	0	0	0	69	59	0	0	0	59	170	0	0	0	170
			Sum		265.93	21.17242	244.758	0	2	228	6195	2091	8516	16	152	4120	1391	5677	45	386	7580	1635	9646
			MARKET-READY	CC-C	1.37	0.0387692	1.331	0	0	0	83	27	110	0	0	79	26	105	0	0	145	30	175
				CDM	0.601	0	0.601	0	0	0	37	0	37	0	0	35	0	35	0	0	65	0	65
				HMU	3.081	0.3090705	2.772	0	0	0	24	31	55	0	0	23	29	52	0	0	42	35	77
				PCD	3.684	0.9103322	2.774	0	0	0	20	0	20	0	0	19	0	19	0	0	35	0	35
				RS-8	1.768	0	1.768	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
			Sum		10.503	1.258172	9.245	0	5	0	164	58	227	5	0	156	55	216	14	0	287	65	365
		Sum			276.433	22.43059	254.003	0	7	228	6359	2149	8743	20	152	4275	1446	5893	59	386	7867	1700	10011
	Sum				467.475	57.22961	410.245	19.998	321	308	10429	2246	13304	326	228	8288	1513	10355	940	580	15249	1779	18549
Sum					467.475	57.22961	410.245	19.998	321	308	10429	2246	13304	326	228	8288	1513	10355	940	580	15249	1779	18549

Lynnwood MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Lynnwood	CITY21	(4) REDEV		RMH	0.742	0.1873673	0.555	0	-3	0	16	0	13	-2	0	11	0	9	-6	0	20	0	14
			Sum		0.742	0.1873673	0.555	0	-3	0	16	0	13	-2	0	11	0	9	-6	0	20	0	14
		Sum			0.742	0.1873673	0.555	0	-3	0	16	0	13	-2	0	11	0	9	-6	0	20	0	14
	Sum				0.742	0.1873673	0.555	0	-3	0	16	0	13	-2	0	11	0	9	-6	0	20	0	14
Sum					0.742	0.1873673	0.555	0	-3	0	16	0	13	-2	0	11	0	9	-6	0	20	0	14

Lynnwood MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Lynnwood	UNINC	(1) PENDING		TPV	3.105	0	3.105	0	0	0	0	131	131	0	0	0	131	131	0	0	0	154	154
				UCENTER	31.738	4.251347	27.487	0	1	144	1115	0	1260	1	144	1115	0	1260	3	366	2052	0	2421
				UHDR	35.702	8.048712	27.654	0	88	154	57	254	553	88	154	57	254	553	253	392	105	299	1049
				ULDR	41.851	27.40858	14.442	0	169	0	6	0	175	169	0	6	0	175	487	0	11	0	498
				UMDR	5.717	0.8315824	4.886	0	20	8	11	0	39	20	8	11	0	39	58	20	20	0	98
			Sum		118.113	40.54023	77.573	0	278	306	1189	385	2158	278	306	1189	385	2158	801	778	2188	453	4220
		Sum			118.113	40.54023	77.573	0	278	306	1189	385	2158	278	306	1189	385	2158	801	778	2188	453	4220
		(2) VACANT		TPV	0.151	0	0.151	0	0	0	6	1	7	0	0	5	1	6	0	0	9	1	10
				UCENTER	25.497	11.12011	14.377	0	2	6	636	131	775	2	5	514	106	626	5	12	945	124	1086
				UCENTER-BP	2.817	1.2913	1.526	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
				UCOM	1.862	0.0969577	1.765	0	0	0	8	1	9	0	0	6	1	7	0	0	12	1	13
				UHDR	15.181	14.01371	1.167	0	7	4	9	1	21	6	3	7	1	17	16	8	13	1	39
				ULDR	27.994	24.49274	3.502	0	23	0	0	0	23	21	0	0	0	21	59	0	0	0	59
				UMDR	19.86	12.98483	6.875	0	53	0	0	0	53	45	0	0	0	45	129	0	0	0	129
			Sum		93.363	63.99964	29.363	0	86	10	659	134	889	73	8	532	108	722	211	21	979	127	1338
			MARKET-READY	UCENTER	4.534	0	4.534	0	0	3	202	43	248	0	3	192	41	236	0	7	353	48	408
			Sum		4.534	0	4.534	0	0	3	202	43	248	0	3	192	41	236	0	7	353	48	408
		Sum			97.896	63.99964	33.897	0	86	13	861	177	1137	73	11	724	149	957	211	28	1332	175	1747
		(3) PARTUSE		TPV	0.654	0.2716121	0.383	0.028	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
				UCENTER	5.674	0	5.674	4.433	0	2	197	41	240	0	1	131	27	160	0	3	241	32	276
				UHDR	10.215	0	10.215	5.139	17	19	40	5	81	11	13	27	3	54	33	32	49	4	118
				ULDR	52.118	13.52712	38.591	20.585	109	0	0	0	109	93	0	0	0	93	268	0	0	0	268
				UMDR	26.557	7.152601	19.404	8.849	64	0	0	0	64	49	0	0	0	49	140	0	0	0	140
			Sum		95.218	20.95133	74.267	39.034	190	21	238	46	495	153	14	158	31	356	441	36	291	36	804
		Sum			95.218	20.95133	74.267	39.034	190	21	238	46	495	153	14	158	31	356	441	36	291	36	804
		(4) REDEV		TPV	33.016	4.076395	28.939	0	-98	0	1249	233	1384	-65	0	831	155	920	-188	0	1528	182	1523
				UCENTER	45.409	0.1746262	45.235	0	-94	14	1997	400	2317	-63	9	1328	266	1541	-180	24	2444	313	2600
				UCOM	30.691	0.9653943	29.725	0	-5	0	136	11	142	-3	0	90	7	94	-10	0	166	9	165
				UHDR	119.809	16.76226	103.047	0	-4	299	700	30	1025	-3	199	466	20	682	-8	506	857	23	1378
				ULDR	31.757	8.269324	23.488	0	91	0	0	0	91	78	0	0	0	78	224	0	0	0	224
				UMDR	48.597	13.48274	35.114	0	182	0	0	0	182	138	0	0	0	138	398	0	0	0	398
			Sum		309.279	43.73074	265.548	0	72	313	4082	674	5141	82	208	2715	448	3453	237	530	4995	527	6289
			MARKET-READY	UCENTER	0.611	0	0.611	0	0	0	27	4	31	0	0	26	4	29	0	0	47	4	52
				UCOM	4.814	0	4.814	0	0	0	22	2	24	0	0	21	2	23	0	0	38	2	41
			Sum		5.425	0	5.425	0	0	0	49	6	55	0	0	47	6	52	0	0	86	7	92
		Sum			314.704	43.73074	270.973	0	72	313	4131	680	5196	82	208	2761	454	3506	237	530	5080	534	6381
	Sum				625.932	169.2219	456.71	39.034	626	653	6419	1288	8986	587	539	4832	1019	6977	1691	1371	8892	1198	13151
Sum					625.932	169.2219	456.71	39.034	626	653	6419	1288	8986	587	539	4832	1019	6977	1691	1371	8892	1198	13151

Lynnwood MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Lynnwood	CITY12	(1) PENDING		CC-C	6.378	0	6.378	0	7	39	221	267	7	39	221	267
				CC-W	19.176	3.86362	15.312	0	1727	0	0	1727	1727	0	0	1727
				CDM	3.47	0.0012683	3.468	0	0	0	20	20	0	0	20	20
				CG	5.987	0.0921812	5.894	0	53	144	0	197	53	144	0	197
				CR	13.466	0.4143619	13.052	0	192	0	0	192	192	0	0	192
				HMU	0.984	1.788469	0.286	0	26	0	137	163	26	0	137	163
				LI	4.923	1.014563	3.908	0	0	3	65	68	0	3	65	68
				P-1	17.961	0	17.961	0	51	0	81	132	51	0	81	132
				PCD	12.112	1.965043	10.147	0	322	0	0	322	322	0	0	322
				PRC	25.064	0	25.064	0	314	0	0	314	314	0	0	314
				RS-8	2.505	0	2.505	0	25	0	0	25	25	0	0	25

			Sum		112.025	9.139506	103.976	0	2715	186	524	3426	2715	186	524	3426
		Sum			112.025	9.139506	103.976	0	2715	186	524	3426	2715	186	524	3426
		(2) VACANT		BTP	9.412	9.208393	0.204	0	8	0	0	9	7	0	0	7
				CG	3.658	0.5782128	3.079	0	46	2	0	48	37	1	0	38
				NC	1.771	0	1.771	0	18	0	0	18	14	0	0	14
			Sum		14.841	9.786606	5.054	0	72	2	1	74	58	2	0	60
			MARKET-READY	NC	1.93	0.9961609	0.934	0	9	0	0	9	9	0	0	9
			Sum		1.93	0.9961609	0.934	0	9	0	0	9	9	0	0	9
		Sum			16.77	10.78277	5.988	0	81	2	1	84	67	2	0	69
		(3) PARTUSE		HMU	10.671	0	10.671	5.239	76	0	0	76	51	0	0	51
				PCD	10.89	3.078682	7.811	4.759	290	0	2	293	193	0	1	195
				PRC	0.048	0	0.048	0.048	1	0	0	1	0	0	0	0
			Sum		21.609	3.078682	18.53	10.046	367	0	2	370	244	0	2	246
		Sum			21.609	3.078682	18.53	10.046	367	0	2	370	244	0	2	246
Lynnwood	CITY12	(4) REDEV		BTP	14.491	1.173847	13.318	0	541	21	29	590	359	14	19	393
				CC-C	57.875	2.659907	55.215	0.896	4842	0	0	4842	4842	0	0	4842
				CC-N	2.123	0.6251842	1.498	0	178	0	0	178	178	0	0	178
				CC-W	22.4	1.350192	21.05	0	1872	0	0	1872	1872	0	0	1872
				CDM	12.072	1.917259	10.155	0	51	0	0	51	34	0	0	34
				CG	153.885	34.6896	119.195	0	1207	68	6	1280	803	45	4	851
				HMU	54.321	2.361328	51.959	0	575	0	3	577	382	0	2	384
				LI	43.752	6.927844	36.824	0	28	626	0	653	18	416	0	434

				NC	25.4	4.334524	21.065	0	126	0	0	126	84	0	0	84
				PCD	26.984	6.147671	20.836	0	900	0	10	910	599	0	7	605
				PRC	17.053	0.1528386	16.9	0	162	0	0	162	108	0	0	108
			Sum		430.356	62.3402	368.015	0.896	10481	714	47	11242	9279	475	31	9785
			MARKET-READY	CC-C	1.37	0.0387692	1.331	0	114	0	0	114	114	0	0	114
				CDM	0.601	0	0.601	0	3	0	0	3	3	0	0	3
				CG	7.699	0.4363662	7.262	0	92	3	0	96	87	3	0	91
				HMU	3.081	0.3090705	2.772	0	18	0	0	18	17	0	0	17
				LI	2.374	0.0362909	2.338	0	2	50	0	52	2	48	0	50
				PCD	3.684	0.9103322	2.774	0	113	0	1	115	108	0	1	109
			Sum		18.808	1.730829	17.078	0	342	53	2	397	331	51	2	383
		Sum			449.164	64.07103	385.093	0.896	10823	768	49	11639	9609	526	33	10168
	Sum				599.568	87.07198	513.587	10.942	13986	956	576	15519	12636	714	559	13909
Sum					599.568	87.07198	513.587	10.942	13986	956	576	15519	12636	714	559	13909

Lynnwood MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

N/A

Lynnwood MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Lynnwood	UNINC	(1) PENDING		UCENTER-BP												

					2.272	0.3291547	1.943	0	24	0	0	24	24	0	0	24
			Sum		2.272	0.3291547	1.943	0	24	0	0	24	24	0	0	24
		Sum			2.272	0.3291547	1.943	0	24	0	0	24	24	0	0	24
		(2) VACANT		TPV	0.151	0	0.151	0	4	0	0	4	3	0	0	3
				UCENTER	22.563	8.186178	14.377	0	374	0	14	388	302	0	12	313
				UCENTER-BP	2.817	1.2913	1.526	0	40	0	2	41	32	0	1	33
				UCOM	1.862	0.0969577	1.765	0	24	1	1	25	19	1	1	21
				UI	13.857	10.55908	3.298	0	34	57	1	92	27	46	1	74
			Sum		41.25	20.13352	21.117	0	475	58	18	551	383	47	15	445
			MARKET-READY	UCENTER	4.534	0	4.534	0	118	0	5	122	112	0	4	116
				UI	0.849	0	0.849	0	9	15	0	24	8	14	0	22
			Sum		5.382	0	5.382	0	127	15	5	146	120	14	5	139
		Sum			46.633	20.13352	26.499	0	601	72	23	697	504	60	19	583
Lynnwood	UNINC	(3) PARTUSE		TPV	0.654	0.2716121	0.383	0.028	1	0	0	1	0	0	0	1
				UCENTER	5.674	0	5.674	4.433	115	0	4	120	77	0	3	80
				UCENTER-BP	20.179	0	20.179	12.97	337	0	13	350	224	0	9	233
				UCOM	1.07	0	1.07	0.135	2	0	0	2	2	0	0	2
			Sum		27.577	0.2716121	27.305	17.567	455	0	17	473	303	0	12	314
		Sum			27.577	0.2716121	27.305	17.567	455	0	17	473	303	0	12	314
		(4) REDEV		TPV	33.016	4.076395	28.939	0	752	0	29	781	500	0	19	520
				UCENTER	45.409	0.1746262	45.235	0	1056	0	45	1102	702	0	30	733
				UCOM	31.851	0.9856281	30.865	0	353	15	12	380	235	10	8	252
				UI												

				3.671	1.467175	2.204	0	23	38	1	61	15	25	1	41
		Sum		113.947	6.703824	107.243	0	2184	53	87	2324	1453	35	58	1545
		MARKET-READY	UCENTER	0.611	0	0.611	0	13	0	1	13	12	0	1	13
			UCOM	4.814	0	4.814	0	62	1	2	65	59	1	2	62
		Sum		5.425	0	5.425	0	75	1	2	79	71	1	2	75
	Sum			119.372	6.703824	112.668	0	2259	54	89	2403	1524	36	60	1620
Sum				195.853	27.43811	168.415	17.567	3340	126	130	3596	2354	97	91	2542
Sum				195.853	27.43811	168.415	17.567	3340	126	130	3596	2354	97	91	2542

City of Lynnwood

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
RS-8											
	Single Family	202.15	100%	795	3.93	3.93	-	-	-	-	-
RS-7											
	Single Family	7.29	100%	32	4.39	4.39	-	-	-	-	-
RS-4											
	Single Family	No Data: Used for Existing Mobile Home Parks				11.00	-	-	-	-	-
RML											
	Single Family	0.52	8%	7	1.09	1.09	-	-	-	-	-
	Townhouse	2.21	34%	32	4.98	4.98	-	-	-	-	-
	Multi-Family	3.70	58%	63	9.80	9.80	-	-	-	-	-
	Total	**6.43**	**100%**	**102**	**15.87**	**15.87**	**-**	**-**	**-**	**-**	**-**
RMM											
	Single Family	2.39	7%	36	1.08	1.08	-	-	-	-	-
	Townhouse	0.28	1%	5	0.15	0.15	-	-	-	-	-
	Multi-Family	23.63	71%	425	12.74	12.74	-	-	-	-	-
	Senior Apartment	7.06	21%	170	5.10	5.10	-	-	-	-	-
	Total	**33.36**	**100%**	**636**	**19.07**	**19.07**	**-**	**-**	**-**	**-**	**-**
RMH											
	Multi-Family		No Data			36.00	-	-	-	-	-

City of Lynnwood

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
BTP (New Projects)											
	Non-Residential	24.27	100%	-	-	-	484,757	0.46	1,076	44.33	44.33
BTP (Infill Projects)											
	Non-Residential	2.13	100%	-	-	-	30,884	0.33	81	38.02	38.02
CC-C (includes CC-W and CC-N)											
	Mixed-Use		No Data			62.51 (2)		No Data		61.94 (3)	-
	Senior Apartments	3.89	61%	655	102.26	20.82 (2)	-	-	-	-	-
	Non-Residential	2.51	39%	-	-	-	72,035	0.26	180	26.99 (3)	-
	Total	**6.41**	**100%**	**655**	**102.26**	**83.33 (2)**	**72,035**	**0.26**	**180**	**88.93 (3)**	**113.79 (4)**
CDM											
	Multi-Family	1.65	100%	104	62.94	62.94 (5)	-	-	-	-	-
	Non-Residential		No Data			-		No Data			5.00
	Total	**1.65**	**100%**	**104**	**62.94**	**62.94 (5)**	**-**	**-**	**-**	**-**	**5.00**
CG (New Projects)											
	Non-Residential	29.55	100%	-	-	-	349,400	0.27	514	17.39	15.47 (6)

(2) Post-2018 actual and proposed projects are averaged with the development history to derive an assumed residential density.
(3) Post-2018 actual and propsed projects are used to determine the employment density.
(4) City staff recommend using 113.79 employees per acre based on current market trends and a previous study that evaluated the employment capacity for the City Center. The assumed job sector breakdown is: 52 FIRE, 30 Services, 20 Retail, and 12 Government.

(5) While the development history only experienced residential projects, non-residential projects are allowed within this zone so the report assumes a lower residential density than what was achieved. This report assumes that all jobs will be within the Services sector

(6)Post-2018 actual and proposed projects are averaged with the development history to derive an assumed employment density. The job sector breakdown is: 9 Retail, 2 Services, 2 FIRE, 1 Food Service, 1 WTU.

City of Lynnwood

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
CG (Infill Projects)											
	Non-Residential	62.18	100%	-	-	-	634,924	0.23	1,175	18.90	18.90
H99-MU (HMU)											
	Multi-Family		No Data			9.01 (7)					
	Senior Apartments	2.62	15%	295	17.01	11.51 (7)	-	-	-	-	-
	Non-Residential	14.73	85%	-	-	-	125,305	0.17	267	15.38	14.59 (7)
	Total	**17.34**	**100%**	**295**	**17.01**	**20.52 (7)**	**125,305**	**0.17**	**267**	**15.38**	**14.59 (7)**
(7) Post-2018 actual and proposed projects are averaged with the development history to derive an assumed residential and employment density. The job sector breakdown is 8 Services, 3 Retail, 2 FIRE, 1 Food Services.											
CR											
	Mixed-Use		No Data			14.03 (8)		No Data			1.32 (8)
	Non-Residential	15.43	1.00			-	154,163	0.23	220	14.27	11.50 (8)
	Total					**14.03 (8)**					**12.82 (8)**
(8) Post-2018 actual and proposed projects are averaged with the development history to derive an assumed residential and employment density. The job sector breakdown is 12 Retail, 1 FIRE.											
LI											
	Non-Residential	4.39	100%	-	-	-	84,536	0.44	54	12.36	25.32 (9)
(9) This report combines the data for new and infill projects within Light Industrial because a disproportionate share of the new development was for buildings that do not normally generate "covered employment". Without doing this, the report would have assumed an improbably low 12 employees in new projects and a likely too high estimate of 31 jobs in infill projects. The approach used here will result in a more reasonable employment capacity estimate. The assumed job sector breakdown is 21 Manufacturing, 3 WTU, 1 Services.											
NC											
	Townhouse	3.22	100%	42	13.04	10.00 (10)	-	-	-	-	-
	Non-Residential		No Data			-		No Data			10.00 (10)

City of Lynnwood

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
	Total	**3.22**				**10.00 (10)**					**10.00 (10)**
(10) The NC zone only saw one residential project. This assumed density is lowered when considering that non-residential projects are also allowed within the zone. The job sector assumptions are: 6 Services and 4 Retail.											
PCD											
	Mixed-Use		No Data			7.42 (11)		No Data			0.22 (11)
	Non-Residential	10.44	100%	-	-	-	545,750	1.20	1,065	102.00	61.27 (11)
	Total	10.44				**7.42 (11)**					**61.49 (11)**
(11) Post-2018 actual and proposed projects are used to develop an assumed residential and employment density. The job sector breakdown is 37 Services, 20 Retail, 3 Food Services, 1 FIRE.											
PRC											
	Mixed-Use		No Data			14.11 (12)		No Data			3.92 (12)
	Non-Residential					-					9.20 (12)
	Total	-				**14.11 (12)**					**13.12 (12)**
(12) Post-2018 actual and proposed projects are used to develop an assumed residential and employment density. The job sector breakdown is 9 Service, 4 Retail.											

Mill Creek MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Mill Creek	CITY12	(1) PENDING		EGUV	17.347	8.510038	8.837	0	0	0	382	0	382	0	0	382	0	382	0	0	703	0	703
				LDR	3.171	0.1996525	2.972	0	11	0	0	0	11	11	0	0	0	11	32	0	0	0	32
				MDR	4.439	3.943178	0.496	0	35	0	0	0	35	35	0	0	0	35	101	0	0	0	101
				NB	1.009	0.2128857	0.796	0	0	0	23	0	23	0	0	23	0	23	0	0	42	0	42
			Sum		25.967	12.86575	13.101	0	46	0	405	0	451	46	0	405	0	451	132	0	745	0	878
		Sum			25.967	12.86575	13.101	0	46	0	405	0	451	46	0	405	0	451	132	0	745	0	878
		(2) VACANT		EGUV	1.144	0.4583248	0.686	0	0	0	8	6	14	0	0	6	5	11	0	0	12	6	18
				LDR	18.545	12.69201	5.853	0	21	0	0	0	21	19	0	0	0	19	54	0	0	0	54
			Sum		19.689	13.15034	6.539	0	21	0	8	6	35	19	0	6	5	30	54	0	12	6	72
		Sum			19.689	13.15034	6.539	0	21	0	8	6	35	19	0	6	5	30	54	0	12	6	72
		(3) PARTUSE		LDR	18.4	5.645813	12.754	6.637	20	0	0	0	20	17	0	0	0	17	49	0	0	0	49
			Sum		18.4	5.645813	12.754	6.637	20	0	0	0	20	17	0	0	0	17	49	0	0	0	49
		Sum			18.4	5.645813	12.754	6.637	20	0	0	0	20	17	0	0	0	17	49	0	0	0	49
		(4) REDEV		EGUV	4.265	0.0407577	4.224	0	-3	0	54	39	90	-2	0	36	26	60	-6	0	66	30	91
				LDR	7.167	0	7.167	0	15	0	0	0	15	13	0	0	0	13	37	0	0	0	37
			Sum		11.432	0.0407577	11.391	0	12	0	54	39	105	11	0	36	26	73	31	0	66	30	128
		Sum			11.432	0.0407577	11.391	0	12	0	54	39	105	11	0	36	26	73	31	0	66	30	128
	Sum				75.487	31.70266	43.785	6.637	99	0	467	45	611	93	0	447	31	571	267	0	823	36	1126

Sum					75.487	31.70266	43.785	6.637	99	0	467	45	611	93	0	447	31	571	267	0	823	36	1126

Mill Creek MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Mill Creek	CITY21	(1) PENDING		PRD 7200	0.221	0.052019	0.169	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
			Sum		0.221	0.052019	0.169	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
		Sum			0.221	0.052019	0.169	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
	Sum				0.221	0.052019	0.169	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
Sum					0.221	0.052019	0.169	0	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14

Mill Creek MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Mill Creek	UNINC	(1) PENDING		UCENTER	15.559	10.17506	5.384	0	5	8	150	133	296	5	8	150	133	296	14	20	276	156	467
				UCOM	1.815	0	1.815	0	0	26	0	0	26	0	26	0	0	26	0	66	0	0	66
				UHDR	7.131	3.308469	3.823	0	37	46	21	0	104	37	46	21	0	104	107	117	39	0	262
				ULDR	124.509	42.109	82.401	0	595	0	14	0	609	595	0	14	0	609	1714	0	26	0	1739
				UMDR	11.591	1.258457	10.333	0	68	0	0	0	68	68	0	0	0	68	196	0	0	0	196
				UVILL	5.534	1.9671	3.567	0	0	0	83	0	83	0	0	83	0	83	0	0	153	0	153
			Sum		166.14	58.81808	107.322	0	705	80	268	133	1186	705	80	268	133	1186	2030	204	493	156	2883
		Sum			166.14	58.81808	107.322	0	705	80	268	133	1186	705	80	268	133	1186	2030	204	493	156	2883
		(2) VACANT		UCENTER	4.15	3.515535	0.635	0	0	0	28	6	34	0	0	23	5	27	0	0	42	6	47
				UCOM	0.716	0.005729	0.71	0	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
				UHDR	2.728	0.1083276	2.62	0	8	10	20	2	40	6	8	16	2	32	19	21	30	2	71
				ULDR	72.552	53.01593	19.536	0	114	0	0	0	114	102	0	0	0	102	293	0	0	0	293
				UMDR	8.996	6.66902	2.327	0	21	0	0	0	21	18	0	0	0	18	51	0	0	0	51
				UVILL	4.621	0	4.621	0	0	9	93	12	114	0	7	75	10	92	0	18	138	11	168
			Sum		93.763	63.31455	30.449	0	143	19	144	20	326	126	15	116	16	274	363	39	214	19	635
		Sum			93.763	63.31455	30.449	0	143	19	144	20	326	126	15	116	16	274	363	39	214	19	635
		(3) PARTUSE		UCENTER	10.011	5.942857	4.068	4.068	0	3	182	38	223	0	2	121	25	148	0	5	223	30	257
				UHDR	0.876	0.0148338	0.862	0.445	1	1	3	0	5	1	1	2	0	3	2	2	4	0	7
				ULDR	219.185	23.45775	195.728	90.904	448	0	0	0	448	383	0	0	0	383	1103	0	0	0	1103
				UMDR	18.096	5.188246	12.907	7.418	55	0	0	0	55	42	0	0	0	42	120	0	0	0	120
				UVILL	1.772	0	1.772	1.112	0	2	22	2	26	0	1	15	1	17	0	3	27	2	32
			Sum		249.94	34.60369	215.336	103.947	504	6	207	40	757	426	4	138	27	594	1225	10	253	31	1520
		Sum			249.94	34.60369	215.336	103.947	504	6	207	40	757	426	4	138	27	594	1225	10	253	31	1520
		(4) REDEV		UCENTER	17.558	6.904012	10.654	0	-10	3	469	93	555	-7	2	312	62	369	-19	5	574	73	633
				UCOM	9.731	1.196945	8.534	0	0	0	38	3	41	0	0	25	2	27	0	0	46	2	49

			UHDR	28.45	1.277123	27.173	0	7	84	191	11	293	5	56	127	7	195	13	142	234	9	398
			ULDR	132.076	19.01471	113.062	0	443	0	0	0	443	379	0	0	0	379	1091	0	0	0	1091
			UMDR	18.12	4.056387	14.063	0	72	0	0	0	72	55	0	0	0	55	158	0	0	0	158
			UVILL	11.931	2.234433	9.697	0	-3	17	194	24	232	-2	11	129	16	154	-6	29	237	19	279
		Sum		217.866	34.68361	183.182	0	509	104	892	131	1636	429	69	593	87	1179	1237	176	1091	102	2607
	Sum			217.866	34.68361	183.182	0	509	104	892	131	1636	429	69	593	87	1179	1237	176	1091	102	2607
Sum				727.709	191.4199	536.289	103.947	1861	209	1511	324	3905	1686	168	1115	263	3232	4856	429	2052	309	7645
Sum				727.709	191.4199	536.289	103.947	1861	209	1511	324	3905	1686	168	1115	263	3232	4856	429	2052	309	7645

Mill Creek MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Mill Creek	CITY12	(1) PENDING		BP	10.067	5.627529	4.439	0	25	90	0	116	25	90	0	116
				CB	7.225	0.0914537	7.134	0	39	0	0	39	39	0	0	39
				NB	1.009	0.2128857	0.796	0	6	0	0	6	6	0	0	6
			Sum		18.302	5.931869	12.37	0	70	90	0	161	70	90	0	161
		Sum			18.302	5.931869	12.37	0	70	90	0	161	70	90	0	161
Mill Creek	CITY12	(2) VACANT		BP	4.587	4.04749	0.54	0	10	1	0	11	8	0	0	9
				EGUV	1.144	0.4583248	0.686	0	4	0	0	4	3	0	0	3
			Sum		5.731	4.505815	1.225	0	15	1	0	16	12	0	0	13
			MARKET-READY	BP	8.769	5.984309	2.785	0	54	3	3	59	51	3	2	56
			Sum		8.769	5.984309	2.785	0	54	3	3	59	51	3	2	56
		Sum			14.5	10.49012	4.01	0	69	3	3	75	63	3	3	69
		(3) PARTUSE		BP												

					2.038	0.4087261	1.629	0.188	4	0	0	4	2	0	0	3
			Sum		2.038	0.4087261	1.629	0.188	4	0	0	4	2	0	0	3
		Sum			2.038	0.4087261	1.629	0.188	4	0	0	4	2	0	0	3
		(4) REDEV		BP	2.514	0.5672431	1.947	0	34	2	1	38	23	1	1	25
				CB	4.099	1.14261	2.956	0	48	0	0	48	32	0	0	32
				EGUV	4.265	0.0407577	4.224	0	26	0	0	26	17	0	0	17
				MU/HDR	1.052	0.1268752	0.925	0	0	0	0	0	0	0	0	0
				NB	0.807	0.0004418	0.807	0	9	0	0	9	6	0	0	6
			Sum		12.736	1.877928	10.858	0	118	2	2	121	78	1	1	81
			MARKET-READY	BP	6.946	3.609035	3.337	0	65	3	3	71	61	3	3	67
			Sum		6.946	3.609035	3.337	0	65	3	3	71	61	3	3	67
		Sum			19.682	5.486962	14.195	0	182	5	5	192	140	5	4	148
	Sum				54.523	22.31768	32.205	0.188	325	99	8	432	276	98	7	381
Sum					54.523	22.31768	32.205	0.188	325	99	8	432	276	98	7	381

Mill Creek MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

N/A

Mill Creek MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	abbrev	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Mill Creek	UNINC	(1) PENDING		UCOM	0.301	0	0.301	0	10	1	0	11	10	1	0	11
				UI	13.957	0.1112402	13.846	0	0	0	35	35	0	0	35	35

			Sum		14.258	0.1112402	14.146	0	10	1	35	46	10	1	35	46
		Sum			14.258	0.1112402	14.146	0	10	1	35	46	10	1	35	46
		(2) VACANT		UCENTER	4.15	3.515535	0.635	0	17	0	1	17	13	0	1	14
				UCOM	0.716	0.005729	0.71	0	9	0	0	10	8	0	0	8
				UVILL	4.621	0	4.621	0	46	0	0	46	37	0	0	37
			Sum		9.488	3.521264	5.966	0	72	0	1	74	58	0	1	59
		Sum			9.488	3.521264	5.966	0	72	0	1	74	58	0	1	59
		(3) PARTUSE		UCENTER	10.011	5.942857	4.068	4.068	106	0	4	110	70	0	3	73
				UVILL	1.772	0	1.772	1.112	11	0	0	11	7	0	0	7
			Sum		11.782	5.942857	5.84	5.18	117	0	4	121	78	0	3	80
		Sum			11.782	5.942857	5.84	5.18	117	0	4	121	78	0	3	80
Mill Creek	UNINC	(4) REDEV		UCENTER	18.557	7.861154	10.696	0	232	0	11	242	154	0	7	161
				UCOM	14.899	3.967272	10.932	0	102	8	4	114	68	5	3	76
				UI	45.198	13.66872	31.529	0	301	504	14	818	200	335	9	544
				UVILL	11.931	2.234433	9.697	0	92	0	0	92	61	0	0	61
			Sum		90.585	27.73158	62.854	0	726	511	28	1266	483	340	19	842
		Sum			90.585	27.73158	62.854	0	726	511	28	1266	483	340	19	842
	Sum				126.113	37.30694	88.806	5.18	925	513	68	1506	629	342	57	1028
Sum					126.113	37.30694	88.806	5.18	925	513	68	1506	629	342	57	1028

Mill Creek MUGA

Development History (2011-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
PRD-7200											
	Single Family	49.95	92%	204	3.78	3.78	-	-	-	-	-
	Multi-Family	4.08	8%	33	0.61	0.61	-	-	-	-	-
	Total	**54.03**	**100%**	**237**	**4.39**	**4.39**	**-**	**-**	**-**	**-**	**-**
LDR											
	Single Family	155.45	100%	560	3.60	3.60	-	-	-	-	-
MDR											
	Single Family	48.46	85%	340	5.99	5.99	-	-	-	-	-
	Senior Apartments	6.45	11%	148	2.61	2.61	-	-	-	-	-
	Non-Residential	1.81	3%	-	-		23,767	0.01	59	1.05	0.00 (1)
	Total	**56.73**	**100%**	**488**	**8.60**	**8.60**	**-**	**-**	**-**	**-**	**-**
HDR											
	Multi-Family	8.25	91%	215	23.72	26.07 (2)	-	-	-	-	-
	Non-Residential	0.82	9%	-	-	-	13,008	0.03	33	3.64	0.00 (2)
	Total	**9.07**	**100%**	**215**	**23.70**	**26.07**	**-**	**-**	**-**	**-**	**-**

(1) The Lawrence C. Schmidt Medical Center was approved as a conditional use in Medium Density Residential (MDR) on a site with frontage on the Bothell-Everett Highway. While other non-residential development in MDR might take place, few sites with MDR have comparable frontage. Therefore, this report makes an assumption that the remaining sites will develop as residential according to the densities that the past sample would produce by excluding the medical center.

(2) Ashley Gardens Retirement Home was approved in High Density Residential (HDR) as a conditional use. The methodology in this report does not track population capacity in such group quarters, so while new nursing homes are possible this report assumes simplified future development in HDR by looking solely at the multi-family potential.

Mill Creek MUGA

Development History (2011-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
MU-HDR											
	Single Family	9.87	16%	89	1.40	1.40	-	-	-	-	-
	Multi-Family	3.18	5%	95	1.49	1.49	-	-	-	-	-
	Mixed-Use	8.95	14%	266	4.18	4.18	5,085	0.00	13	0.20	0.20
	Senior Apartments	41.61	65%	829	13.03	13.03	-	-	-	-	-
	Total	**63.62**	**100%**	**1,279**	**20.10**	**20.10**	**5,085**	**0.00**	**13**	**0.20**	**0.20**
BP and OP											
	Non-Residential	9.83	100%	-	-	-	97,793	0.23	209	21.27	21.27
CB and NB (New Projects)											
	Non-Residential	34.41	100%	-	-	-	368,544	0.25	653	18.97	18.97
CB and NB (Infill Projects)											
	Non-Residential	35.70	100%	-	-	-	488,011	0.31	1,053	29.49	29.49
PCB											
	Mixed Use	0.48	2%	36	1.58	1.58	4,140	0.00	11	0.47	0.47
	Non-Residential	22.37	98%	-	-	-	341,704	0.34	846	37.02	37.02
	Total	**22.85**	**100%**	**36**	**1.58**	**1.58**	**345,844**	0.35	**857**	**37.49**	**37.49**
EGUV											
	Senior Apartments	2.89	12%	216	9.32	9.32	13,400	0.01	34	1.45	1.45
	Mixed-Use	16.78	72%	302	13.03	13.03	19,601	0.02	49	2.11	2.11
	Non-Residential	3.51	15%	-	-	-	24,000	0.02	60	2.59	2.59
	Total	**23.17**	**100%**	**518**	**22.35**	**22.35**	**57,001**	**0.06**	**143**	**6.15**	**6.15**

Mountlake Terrace MUGA - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
MtLkTerr	CITY12	(1) PENDING		F/T-D	15.424	4.105398	11.319	.000	0	0	628	0	628	0	0	628	0	628	0	0	1156	0	1156
				RMM	1.614	.1002576	1.513	.000	0	30	0	0	30	0	30	0	0	30	0	76	0	0	76
				RS 4800	1.018	.0000000	1.018	.000	7	0	0	0	7	7	0	0	0	7	20	0	0	0	20
				RS 7200	1.781	.1714537	1.609	.000	9	0	0	0	9	9	0	0	0	9	26	0	0	0	26
				RS 8400	17.683	6.920865	10.762	.000	86	0	0	0	86	86	0	0	0	86	248	0	0	0	248
				RS-T	3.415	.0000000	3.415	.000	0	97	0	0	97	0	97	0	0	97	0	247	0	0	247
				TC-3	1.211	.0000000	1.211	.000	0	0	156	0	156	0	0	156	0	156	0	0	287	0	287
				TC-R	1.607	.0000000	1.607	.000	0	54	0	0	54	0	54	0	0	54	0	137	0	0	137
			Sum		43.752	11.29797	32.454	.000	102	181	784	0	1067	102	181	784	0	1067	294	460	1443	0	2197
		Sum			43.752	11.29797	32.454	.000	102	181	784	0	1067	102	181	784	0	1067	294	460	1443	0	2197
		(2) VACANT		BC	1.173	.0000000	1.173	.000	0	6	22	0	28	0	5	18	0	23	0	12	33	0	45
				RMM	2.609	1.225819	1.383	.000	4	3	15	0	22	3	2	12	0	18	9	6	22	0	38
				RS 7200	1.049	.9551655	.094	.000	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
				RS 8400	2.226	.9046951	1.321	.000	9	0	0	0	9	8	0	0	0	8	23	0	0	0	23
				TC-2	.170	.0000000	.170	.000	0	0	18	0	18	0	0	15	0	15	0	0	27	0	27
				TC-3	.187	.0000000	.187	.000	0	0	18	0	18	0	0	15	0	15	0	0	27	0	27
			Sum		7.414	3.085680	4.329	.000	15	9	73	0	97	13	7	59	0	79	38	18	108	0	165
			MARKET-READY	BC	.299	.0000000	.299	.000	0	1	5	0	6	0	1	5	0	6	0	2	9	0	11
				TC-R	.332	.0000000	.332	.000	0	11	0	0	11	0	10	0	0	10	0	27	0	0	27
			Sum		.631	.0000000	.631	.000	0	12	5	0	17	0	11	5	0	16	0	29	9	0	38
		Sum			8.045	3.085680	4.959	.000	15	21	78	0	114	13	19	64	0	95	38	47	117	0	202
		(3) PARTUSE		F/T-A	3.100	.0638253	3.037	.119	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
				F/T-C	3.185	1.120339	2.065	.468	0	0	32	0	32	0	0	21	0	21	0	0	39	0	39
				RML	14.258	.9498591	13.308	12.519	35	3	70	0	108	23	2	47	0	72	67	5	86	0	158
				RMM	.783	.0163653	.767	.116	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
				RS 4800	1.584	.3091233	1.275	1.019	8	0	0	0	8	6	0	0	0	6	18	0	0	0	18

			RS 7200	1.755	.0000000	1.755	1.361	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
			RS 8400	14.623	6.101249	8.522	5.555	30	0	0	0	30	26	0	0	0	26	74	0	0	0	74
			TC-R	.438	.0000000	.438	.333	0	11	0	0	11	0	7	0	0	7	0	19	0	0	19
		Sum		39.726	8.560762	31.165	21.490	79	14	106	0	199	60	9	70	0	140	173	24	130	0	327
	Sum			39.726	8.560762	31.165	21.490	79	14	106	0	199	60	9	70	0	140	173	24	130	0	327
		(4) REDEV	BC	6.369	.0000000	6.369	.000	-6	34	119	0	147	-4	23	79	0	98	-11	58	146	0	192
			F/T-A	1.263	.0000000	1.263	.000	0	0	37	0	37	0	0	25	0	25	0	0	45	0	45
			F/T-B	6.072	.7877918	5.285	.000	0	0	105	0	105	0	0	70	0	70	0	0	128	0	128
			F/T-E	.800	.0000000	.800	.000	-1	0	13	0	12	-1	0	9	0	8	-2	0	16	0	14
			RML	4.691	.0000000	4.691	.000	-12	0	23	0	11	-8	0	15	0	7	-23	0	28	0	5
			RMM	11.802	.1901983	11.612	.000	-10	7	118	0	115	-7	5	78	0	76	-19	12	144	0	137
			RS 4800	12.307	.5938057	11.714	.000	54	0	0	0	54	41	0	0	0	41	118	0	0	0	118
			RS 7200	6.075	.0000000	6.075	.000	20	0	0	0	20	17	0	0	0	17	49	0	0	0	49
			RS 8400	6.224	.2665244	5.958	.000	20	0	0	0	20	17	0	0	0	17	49	0	0	0	49
			RS-T	6.850	.0000000	6.850	.000	-38	174	0	0	136	-29	132	0	0	103	-83	336	0	0	253
			TC-1	17.154	1.533383	15.621	.000	-78	0	1765	0	1687	-52	0	1174	0	1122	-149	0	2160	0	2010
			TC-2	18.934	.5022045	18.432	.000	-46	0	1955	0	1909	-31	0	1300	0	1269	-88	0	2392	0	2304
			TC-3	14.476	.2907060	14.186	.000	-53	0	1332	0	1279	-35	0	886	0	851	-102	0	1630	0	1528
			TC-R	11.816	.0000000	11.816	.000	-35	338	0	0	303	-23	225	0	0	201	-67	572	0	0	505
		Sum		124.834	4.164613	120.670	.000	-185	553	5467	0	5835	-114	384	3636	0	3906	-328	978	6689	0	7339
		MARKET-READY	BC	.616	.0000000	.616	.000	-1	3	11	0	13	-1	3	10	0	12	-3	7	19	0	24
		Sum		.616	.0000000	.616	.000	-1	3	11	0	13	-1	3	10	0	12	-3	7	19	0	24
	Sum			125.450	4.164613	121.286	.000	-186	556	5478	0	5848	-115	387	3646	0	3918	-331	985	6709	0	7363
Sum				216.973	27.10903	189.864	21.490	10	772	6446	0	7228	60	596	4564	0	5221	174	1516	8398	0	10088
Sum				216.973	27.10903	189.864	21.490	10	772	6446	0	7228	60	596	4564	0	5221	174	1516	8398	0	10088

Mountlake Terrace MUGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Mountlake Terrace MUGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
MtLkTerr	UNINC	(4) REDEV		UHDR	.916	.7818683	.134	.000	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
				UMDR	2.111	.0000000	2.111	.000	8	0	0	0	8	6	0	0	0	6	18	0	0	0	18
			Sum		3.027	.7818683	2.245	.000	8	0	1	0	9	6	0	1	0	7	18	0	1	0	19
		Sum			3.027	.7818683	2.245	.000	8	0	1	0	9	6	0	1	0	7	18	0	1	0	19
	Sum				3.027	.7818683	2.245	.000	8	0	1	0	9	6	0	1	0	7	18	0	1	0	19
Sum					3.027	.7818683	2.245	.000	8	0	1	0	9	6	0	1	0	7	18	0	1	0	19

Mountlake Terrace MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
MtLkTerr	CITY12	(1) PENDING		F/T-D	15.424	4.105398	11.319	.000	127	0	0	127	127	0	0	127
				LI/OP	8.739	5.413281	3.326	.000	0	275	0	275	0	275	0	275
				REC	12.821	6.207335	6.614	.000	0	0	74	74	0	0	74	74
				TC-3	1.211	.0000000	1.211	.000	16	0	0	16	16	0	0	16
			Sum		38.195	15.72601	22.469	.000	143	275	74	492	143	275	74	492
		Sum			38.195	15.72601	22.469	.000	143	275	74	492	143	275	74	492
		(2) VACANT		BC	1.173	.0000000	1.173	.000	21	0	0	21	17	0	0	17
				CG	.436	.3409572	.095	.000	8	0	1	9	7	0	0	7
				LI/OP	.858	.7491964	.109	.000	2	1	0	3	1	1	0	2
				SDD C/R	.371	.0000000	.371	.000	5	0	0	5	4	0	0	4
				TC-2	.170	.0000000	.170	.000	4	0	0	4	3	0	0	3
				TC-3	.187	.0000000	.187	.000	2	0	0	2	2	0	0	2
			Sum		3.195	1.090154	2.105	.000	42	1	1	43	34	1	0	35
			MARKET-READY	BC	.299	.0000000	.299	.000	5	0	0	5	5	0	0	5
				TC-R												

			.332	.0000000	.332	.000	5	0	0	5	5	0	0	5
	Sum		.631	.0000000	.631	.000	10	0	0	10	10	0	0	10
Sum			3.826	1.090154	2.736	.000	52	1	1	54	44	1	0	45
	(3) PARTUSE	F/T-A	3.100	.0638253	3.037	.119	5	0	0	5	3	0	0	3
		F/T-C	3.185	1.120339	2.065	.468	21	0	0	21	14	0	0	14
		TC-R	.438	.0000000	.438	.333	5	0	0	5	3	0	0	3
	Sum		6.724	1.184165	5.540	.920	31	0	0	31	20	0	0	20
Sum			6.724	1.184165	5.540	.920	31	0	0	31	20	0	0	20
	(4) REDEV	BC	6.369	.0000000	6.369	.000	87	0	0	87	58	0	0	58
		CG	8.997	.3014313	8.696	.000	711	0	47	758	473	0	31	504
		F/T-A	1.263	.0000000	1.263	.000	44	0	0	44	29	0	0	29
		F/T-B	6.072	.7877918	5.285	.000	86	0	0	86	57	0	0	57
		F/T-E	.800	.0000000	.800	.000	8	0	0	8	5	0	0	5
		F/T-F	.660	.0000000	.660	.000	3	0	0	3	2	0	0	2
		LI/OP	13.511	7.464542	6.046	.000	84	56	4	144	56	37	3	96
		TC-1	17.154	1.533383	15.621	.000	412	0	0	412	274	0	0	274
		TC-2	18.934	.5022045	18.432	.000	332	0	0	332	221	0	0	221
		TC-3	14.476	.2907060	14.186	.000	128	0	0	128	85	0	0	85
		TC-R	11.816	.0000000	11.816	.000	152	0	0	152	101	0	0	101
	Sum		100.052	10.88006	89.172	.000	2048	56	51	2155	1362	37	34	1433
	MARKET-READY	BC	.616	.0000000	.616	.000	10	0	0	10	9	0	0	9
		CG	4.039	.0000000	4.039	.000	304	0	22	325	288	0	21	309
	Sum		4.655	.0000000	4.655	.000	313	0	22	335	298	0	21	319
Sum			104.707	10.88006	93.827	.000	2361	56	73	2490	1660	37	55	1752
Sum			153.452	28.88039	124.572	.920	2587	332	148	3067	1867	313	129	2309
Sum			153.452	28.88039	124.572	.920	2587	332	148	3067	1867	313	129	2309

Mountlake Terrace MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Mountlake Terrace MUGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

N/A

Mountlake Terrace MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Within City Zones											
RS 8400											
	Single Family	14.04	100%	87	6.20	6.20	-	-	-	-	-
RS 7200											
	Single Family	23.01	100%	132	5.74	5.74	-	-	-	-	-
RS 4800											
	Single Family	0.61	100%	5	8.20	8.20	-	-	-	-	-
RML											
	Single Family	6.77	35%	55	2.86	2.86	-	-	-	-	-
	Townhouse	0.53	3%	6	0.31	0.31	-	-	-	-	-
	Multi-Family	11.92	62%	109	5.67	5.67	-	-	-	-	-
	Total	**19.22**	**100%**	**170**	**8.84**	**8.84**	**-**	**-**	**-**	**-**	**-**
RMM											
	Single Family	4.77	26%	80	4.32	4.32					
	Townhouse	1.61	9%	30	1.62	3.19 (1)	-	-	-	-	-
	Multi-Family	12.14	66%	225	12.15	12.15	-	-	-	-	-
	Total	**18.51**	**100%**	**335**	**18.10**	**19.66**	**-**	**-**	**-**	**-**	**-**

(1) Post-2018 actual and proposed projects show a higher townhouse density occuring in the RMM zone.

Mountlake Terrace MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
BC											
	Townhouse	0.47	4%	12	1.10	6.86 (2)	-	-	-	-	-
	Mixed-Use	2.06	19%	252	23.03	18.80 (2)	18,911	0.04	39	3.58	2.92 (2)
	Non-Residential	8.42	77%	-	-	-	111,647	0.23	198	18.14	14.81 (2)
	Total	**10.94**	**100%**	**264**	**24.12**	**25.66 (2)**	**130,558**	**0.27**	**238**	**21.72**	**17.73 (2)**
(2) Post-2018 actual and proposed projects show a different residential and employment density when averaged with the development history. The assumed job sector breakdown is 8 Retail, 6 Food Services, 3 Services, and 1 FIRE.											
RS-T											
	Townhouse	No Development				33.77 (3)	No Development				
(3) Post-2018 actual and proposed projects within the RS-T zone are used to establish an assumed residential density.											
CG											
	Non-Residential	3.67	100%	-	-	-	134,176	0.84	347	94.56	94.56
SDD											
	Non-Residential	8.68	100%	-	-	-	71,004	0.19	123	14.16	14.16
LIOP (New Projects)											
	Non-Residential	14.51	100%	-	-	-	235,688	0.37	378	26.07	26.07
LIOP (Infill Projects)											
	Non-Residential	5.47	100%	-	-	-	25,250	0.09	20	3.66	26.07 (4)
land in LI/OP becomes scarcer. For this reason, the employment density found on new projects in LI/OP will be used on estimates of surplus land for partially used sites.											
F/T District A											
	Non-Residential	4.19	100%	-	-	30.00 (5)	38,369	0.21	94	22.55	40.00 (5)

Mountlake Terrace MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
F/T District B											
	Non-Residential	2.06	100%	-	-	20.00 (5)	40,562	0.45	101	49.11	20.00 (5)
F/T District C											
	Mixed-Use		No Development			70.44 (6)		No Development			45.00 (5)
(6) Post-2018 project known as Terrace Station acheives a building density of 70.44 which is used to model future residential densities in the F/T-C zone.											
F/T District D (7)											
	Mixed-Use		No Development			70.44		No Development			45.00 (5)
(7) City staff recommended applying the assumed densities from the F/T-C district towards the F/T-D district.											
F/T District E											
	Non-Residential		No Development			20.00 (5)		No Development			15.00 (5)
F/T District F											
	Non-Residential		No Development			15.00 (5)		No Development			5.00 (5)
(5) Mountlake Terrace recently adopted changes to the formerly singular Freeway / Tourist zone. These changes include creating separate standards for different districts and encouraging housing. The densities assumed are based on the expected building types in each district under current market conditions; meaning that (a) light rail has yet to reach the Mountlake Terrace transit center and (b) a transfer of development rights program that would allow for higher residential and employment densities has yet to be adopted. If one or both of these considerations changes, then expected densities would be higher. The job sector breakdown for the districts are: District A) 20 Services, 13 Retail, 5 Food Services, 2 FIRE; B) 10 Services, 6 Retail, 3 Food Services, 1 FIRE; C) 25 Services, 10 Retail, 5 Food Services, 5 FIRE; D) 25 Services, 5 FIRE, 5 Gov/Ed, 4 Retail, 1 Food Services; E) 5 Services, 5 Retail, 5 Food Services; and F) 5 Services.											
TC-R											
	Townhouse	No Development; New Zone				33.77 (8)	No Development; New Zone				-
	Non-Residential					-					15.00 (12)
	Total					**33.77 (8)**					**15.00 (12)**
(8) No development has occurred within the new TC-R zone, however, post-2018 actual and proposed development data for townhomes within the RS-T zone is used here.											

Mountlake Terrace MUGA

Development History (1995-2018)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
TC-1											
	Mixed-Use	No Development; New Zone				120.00 (9)	No Development; New Zone				7.00 (12)
	Non-Residential					-					20.00 (12)
	Total					**120.00 (9)**					**27.00 (12)**
(9) City staff recommended using a 20% increase over TC-3 achieved density											
TC-2											
	Mixed-Use	No Development; New Zone				110.00 (10)	No Development; New Zone				7.00 (12)
	Non-Residential					-					15.00 (12)
	Total					**110.00 (10)**					**22.00 (12)**
(10) City staff recommended using a 10% increase over TC-3 achieved density											
TC-3											
	Mixed-Use	1.26	100%	123	97.25	100.00 (11)	12,271	0.22	18	13.86	-
	Non-Residential	No Development; New Zone				-	No Development; New Zone				10.00 (12)
	Total					**100.00 (11)**					**10.00 (12)**
(11) Rounded achieved density figure to aid with calculating the 10% and 20% increase seen in TC-1 and TC-2.											
(12) The job sector breakdown for the Town Center zones are as follows: TC-R) 8 Services, 3 Retail, 3 Food Services, 1 FIRE; TC-1) 12 Services, 8 Retail, 4 Food Services, 3 FIRE; TC-2) 10 Services, 7 Retail, 4 Food Services, 1 FIRE; TC-3) 6 Services, 2 Retail, 2 Food Services											

Mukilteo MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Mukilteo	CITY12	(1) PENDING		MR-13	3.807	2.14804	1.659	0	0	0	41	0	41	0	0	41	0	41	0	0	75	0	75
				PCB(S)	3.275	0.5214914	2.754	0	0	32	0	0	32	0	32	0	0	32	0	81	0	0	81
				RD 12.5	6.841	2.533085	4.308	0	10	0	0	0	10	10	0	0	0	10	29	0	0	0	29
				RD 12.5(S)	1.036	0	1.036	0	3	0	0	0	3	3	0	0	0	3	9	0	0	0	9
				RD 7.5	15.794	7.407448	8.387	0	17	0	0	0	17	17	0	0	0	17	49	0	0	0	49
				RD 9.6	1.62	0	1.62	0	14	0	0	0	14	14	0	0	0	14	40	0	0	0	40
			Sum		32.373	12.61006	19.763	0	44	32	41	0	117	44	32	41	0	117	127	81	75	0	284
		Sum			32.373	12.61006	19.763	0	44	32	41	0	117	44	32	41	0	117	127	81	75	0	284
		(2) VACANT		CB	0.563	0	0.563	0	2	0	4	0	6	2	0	3	0	5	5	0	6	0	11
				DB	0.253	0	0.253	0	0	0	2	0	2	0	0	2	0	2	0	0	3	0	3
				RD 12.5	7.382	2.461585	4.92	0	15	0	0	0	15	13	0	0	0	13	39	0	0	0	39
				RD 12.5(S)	3.425	0.2560715	3.169	0	9	0	0	0	9	8	0	0	0	8	23	0	0	0	23
				RD 7.5	21.631	6.592992	15.038	0	67	0	0	0	67	60	0	0	0	60	172	0	0	0	172
				RD 8.4	0.222	0.1394539	0.083	0	1	0	0	0	1	1	0	0	0	1	3	0	0	0	3
				RD 9.6	1.551	0	1.551	0	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
			Sum		35.026	9.450102	25.576	0	100	0	6	0	106	89	0	5	0	94	257	0	9	0	266
		Sum			35.026	9.450102	25.576	0	100	0	6	0	106	89	0	5	0	94	257	0	9	0	266
		(3) PARTUSE		RD 12.5	10.586	6.118777	4.467	2.62	7	0	0	0	7	6	0	0	0	6	17	0	0	0	17
				RD 7.5	2.974	0.2557593	2.719	1.35	6	0	0	0	6	5	0	0	0	5	15	0	0	0	15
				RD 8.4	2.836	0	2.836	2.201	10	0	0	0	10	9	0	0	0	9	25	0	0	0	25

				RD 9.6	5.119	0	5.119	2.937	8	0	0	0	8	7	0	0	0	7	20	0	0	0	20
			Sum		21.515	6.374536	15.141	9.108	31	0	0	0	31	27	0	0	0	27	76	0	0	0	76
		Sum			21.515	6.374536	15.141	9.108	31	0	0	0	31	27	0	0	0	27	76	0	0	0	76
		(4) REDEV		CB	15.997	0	15.997	0	50	0	121	0	171	33	0	80	0	114	96	0	148	0	244
				DB	0.947	0	0.947	0	0	0	7	0	7	0	0	5	0	5	0	0	9	0	9
				MR-13	2.478	0.943105	1.535	0	-1	0	14	0	13	-1	0	9	0	9	-2	0	17	0	15
				RD 12.5	10.036	1.997773	8.038	0	16	0	0	0	16	14	0	0	0	14	39	0	0	0	39
				RD 7.5	8.337	1.455394	6.881	0	23	0	0	0	23	20	0	0	0	20	57	0	0	0	57
				RD 8.4	0.639	0	0.639	0	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
				RD 9.6	3.693	0	3.693	0	7	0	0	0	7	6	0	0	0	6	17	0	0	0	17
Mukilteo	CITY12	(4) REDEV		RD 9.6(S)	0.733	0	0.733	0	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
			Sum		42.86	4.396272	38.463	0	98	0	142	0	240	74	0	94	0	169	215	0	174	0	388
		Sum			42.86	4.396272	38.463	0	98	0	142	0	240	74	0	94	0	169	215	0	174	0	388
	Sum				131.775	32.83097	98.944	9.108	273	32	189	0	494	234	32	140	0	406	674	81	258	0	1014
Sum					131.775	32.83097	98.944	9.108	273	32	189	0	494	234	32	140	0	406	674	81	258	0	1014

Mukilteo MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

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There are no cases available for REPORT to process.
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Mukilteo MUGA - Additional Population Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Mukilteo	UNINC	(1) PENDING		MF-HD	2.208	0	2.208	0	7	26	0	0	33	7	26	0	0	33	20	66	0	0	86
				UCOM	3.358	0	3.358	0	-1	14	176	0	189	-1	14	176	0	189	-3	36	324	0	357
				ULDR	23.261	15.25971	8.002	0	115	0	0	0	115	115	0	0	0	115	331	0	0	0	331
				ULDR NS	1.609	1.608522	0	0	0	0	2	0	2	0	0	2	0	2	0	0	4	0	4
				ULDR UE	1.546	1.06226	0.484	0	2	0	0	0	2	2	0	0	0	2	6	0	0	0	6
				UMDR	10.737	0.9599797	9.777	0	70	7	4	0	81	70	7	4	0	81	202	18	7	0	227
			Sum		42.718	18.89047	23.828	0	193	47	182	0	422	193	47	182	0	422	556	120	335	0	1010
		Sum			42.718	18.89047	23.828	0	193	47	182	0	422	193	47	182	0	422	556	120	335	0	1010
		(2) VACANT		MF-HD-UCOM	0.79	0.3276922	0.462	0	0	0	5	0	5	0	0	4	0	4	0	0	7	0	7
				UCENTER	0.473	0	0.473	0	0	0	21	4	25	0	0	17	3	20	0	0	31	4	35
				UCOM	0.705	0	0.705	0	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
				UHDR	0.362	0	0.362	0	1	1	2	0	4	1	1	2	0	3	2	2	3	0	7
				ULDR	8.324	7.118525	1.205	0	10	0	0	0	10	9	0	0	0	9	26	0	0	0	26
				ULDR NS	22.627	20.18122	2.446	0	24	0	0	0	24	21	0	0	0	21	62	0	0	0	62
				ULDR UE	28.424	25.86556	2.558	0	12	0	0	0	12	11	0	0	0	11	31	0	0	0	31
				UMDR	12.216	4.377996	7.838	0	64	0	0	0	64	54	0	0	0	54	156	0	0	0	156
			Sum		73.921	57.87099	16.051	0	111	1	31	4	147	96	1	25	3	125	276	2	46	4	328

		Sum			73.921	57.87099	16.051	0	111	1	31	4	147	96	1	25	3	125	276	2	46	4	328
		(3) PARTUSE		UCENTER	4.218	0	4.218	3.243	0	2	145	30	177	0	1	96	20	118	0	3	177	23	204
				ULDR	4.247	0.3088793	3.939	1.595	8	0	0	0	8	7	0	0	0	7	20	0	0	0	20
				UMDR	14.002	0.3748497	13.628	4.998	34	0	0	0	34	26	0	0	0	26	74	0	0	0	74
			Sum		22.468	0.683729	21.785	9.836	42	2	145	30	219	33	1	96	20	150	94	3	177	23	298
		Sum			22.468	0.683729	21.785	9.836	42	2	145	30	219	33	1	96	20	150	94	3	177	23	298
		(4) REDEV		MF-HD	9.272	0.6257781	8.646	0	-27	12	224	0	209	-18	8	149	0	139	-52	20	274	0	243
				MF-HD-UCOM	23.329	1.908429	21.42	0	-2	25	288	0	311	-1	17	192	0	207	-4	42	352	0	391
Mukilteo	UNINC	(4) REDEV		UCENTER	25.638	1.195742	24.442	0	-34	14	1089	227	1296	-23	9	724	151	862	-65	24	1333	178	1469
				UCOM	3.327	0	3.327	0	-1	0	13	0	12	-1	0	9	0	8	-2	0	16	0	14
				UHDR	12.325	1.368828	10.957	0	4	34	75	1	114	3	23	50	1	76	8	58	92	1	158
				ULDR	5.846	0	5.846	0	20	0	0	0	20	17	0	0	0	17	49	0	0	0	49
				UMDR	61.647	4.492697	57.155	0	282	0	0	0	282	214	0	0	0	214	617	0	0	0	617
			Sum		141.384	9.591473	131.793	0	242	85	1689	228	2244	192	57	1123	152	1523	552	144	2067	178	2940
		Sum			141.384	9.591473	131.793	0	242	85	1689	228	2244	192	57	1123	152	1523	552	144	2067	178	2940
	Sum				280.492	87.03666	193.456	9.836	588	135	2047	262	3032	513	106	1427	175	2220	1478	269	2625	206	4577
Sum					280.492	87.03666	193.456	9.836	588	135	2047	262	3032	513	106	1427	175	2220	1478	269	2625	206	4577

Mukilteo MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES: Total parcel acres
UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2 Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
Mukilteo	CITY12	(1) PENDING		PI	4.044	0	4.044	0	0	74	0	74	0	74	0	74
			Sum		4.044	0	4.044	0	0	74	0	74	0	74	0	74
		Sum			4.044	0	4.044	0	0	74	0	74	0	74	0	74
		(2) VACANT		CB	0.563	0	0.563	0	12	0	0	12	10	0	0	10
				CB(S)	4.418	0.6242103	3.794	0	87	17	25	128	70	14	20	104
Mukilteo	CITY12	(2) VACANT		DB	0.253	0	0.253	0	10	0	0	11	8	0	0	9
				IP	16.048	1.358362	14.69	0	46	376	2	424	37	304	2	342
				LI	13.593	5.108485	8.485	0	76	138	1	215	61	112	1	173
				PCB	1.099	0	1.099	0	32	0	3	35	26	0	2	28
				PCB(S)	5.017	0	5.017	0	146	0	12	158	118	0	10	127
				PI	7.197	0	7.197	0	0	30	0	30	0	24	0	24
			Sum		48.187	7.091058	41.096	0	409	561	43	1013	330	453	35	818

	Sum			48.187	7.091058	41.096	0	409	561	43	1013	330	453	35	818
	(3) PARTUSE		IP	8.487	0	8.487	1.457	5	34	0	39	3	22	0	26
			LI	3.613	0	3.613	0.859	8	13	0	21	5	8	0	14
			PI	5.438	0	5.438	3.78	16	9	1	26	11	6	1	17
		Sum		17.538	0	17.538	6.097	29	55	1	85	19	37	1	57
	Sum			17.538	0	17.538	6.097	29	55	1	85	19	37	1	57
	(4) REDEV		CB	16.234	0.2119228	16.022	0	335	0	2	336	223	0	1	224
			CB(S)	13.232	0	13.232	0	269	38	86	394	179	25	57	262
			DB	4.911	0.1062193	4.805	0	177	0	9	186	118	0	6	124
			IP	0.675	0	0.675	0	2	17	0	19	1	11	0	13
			LI	38.015	1.38536	36.629	0	295	411	3	710	196	274	2	472
			PCB(S)	1.651	0.0053862	1.645	0	14	0	4	18	9	0	3	12
			PI	6.624	0	6.624	0	0	18	0	18	0	12	0	12
		Sum		81.341	1.708888	79.632	0	1092	485	104	1682	726	323	69	1118
	Sum			81.341	1.708888	79.632	0	1092	485	104	1682	726	323	69	1118
Sum				151.11	8.799946	142.31	6.097	1530	1176	148	2854	1076	887	105	2067
Sum				151.11	8.799946	142.31	6.097	1530	1176	148	2854	1076	887	105	2067

Mukilteo MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

City (in areas annexed since December 13, 2012)

N/A

Mukilteo MUGA - Additional Employment Capacity DRAFT (Jun-23-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2

Mukilteo	UNINC	(1) PENDING		UI	9.917	1.666004	8.251	0	253	82	0	335	253	82	0	335
			Sum		9.917	1.666004	8.251	0	253	82	0	335	253	82	0	335
		Sum			9.917	1.666004	8.251	0	253	82	0	335	253	82	0	335
		(2) VACANT		MF-HD-UCOM	0.79	0.3276922	0.462	0	6	0	0	7	5	0	0	5
				UCENTER	0.473	0	0.473	0	12	0	0	13	10	0	0	10
				UCOM	0.705	0	0.705	0	9	0	0	10	8	0	0	8
				UI	39.623	17.95083	21.672	0	223	372	9	604	180	300	8	487
			Sum		41.591	18.27852	23.312	0	250	372	10	633	202	301	8	511
		Sum			41.591	18.27852	23.312	0	250	372	10	633	202	301	8	511
		(3) PARTUSE		MF-HD-UCOM	2.966	1.380698	1.585	1.069	18	0	0	18	12	0	0	12
Mukilteo	UNINC	(3) PARTUSE		UCENTER	4.218	0	4.218	3.243	84	0	3	88	56	0	2	58
				UI	3.976	1.382231	2.594	1.602	8	21	0	29	5	14	0	20
			Sum		11.16	2.762929	8.398	5.913	110	21	4	135	73	14	2	90
		Sum			11.16	2.762929	8.398	5.913	110	21	4	135	73	14	2	90
		(4) REDEV		MF-HD-UCOM	25.239	3.066969	22.172	0	228	15	8	251	151	10	6	167
				UCENTER	25.638	1.195742	24.442	0	552	0	24	577	367	0	16	383
				UCOM	3.327	0	3.327	0	40	2	1	44	27	1	1	29
				UI	64.544	10.47944	54.065	0	538	817	23	1378	358	543	15	916
			Sum		118.747	14.74215	104.005	0	1358	834	57	2250	903	555	38	1496
			MARKET-READY	UI	4.016	0	4.016	0	41	69	2	112	39	65	2	106
			Sum		4.016	0	4.016	0	41	69	2	112	39	65	2	106

	Sum	122.763	14.74215	108.021	0	1399	903	59	2362	942	620	40	1602
Sum		185.431	37.4496	147.981	5.913	2013	1379	73	3465	1471	1017	50	2539
Sum		185.431	37.4496	147.981	5.913	2013	1379	73	3465	1471	1017	50	2539

City of Mukilteo

Development History (1995 - 2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
RD 12500 (2000 to 2018 Sample)											
	Single Family	14.97	100%	49	3.27	3.27	-	-	-	-	-
RD 9600											
	Single Family	23.42	100%	87	3.72	3.72	-	-	-	-	-
RD 8400											
	Single Family	3.60	100%	18	5.01	5.01	-	-	-	-	-
RD 7500											
	Single Family	19.80	58%	73	3.69	5.10 (1)	-	-	-	-	-
(1) This report assumes higher densities in response to market conditions and per city direction.											
RD 7200											
	Single Family	33.22	100%	181	5.45	5.45	-	-	-	-	-
MRD											
	Single Family	1.25	16%	12	1.58	1.58					
	Multi-Family	6.35	84%	74	9.74	9.74	-	-	-	-	-
	Total	**7.59**	**100%**	**86**	**11.32**	**11.32**					
MR and MR PRD (Multi-Family sample only) (also applies to remaining triple-zoned land with PCB(S), MR, BP zoning)											
	Multi-Family	13.10	100%	238	18.16	18.16	-	-	-	-	-

City of Mukilteo

Development History (1995 - 2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
CB (New Projects)											
	Single-Family	1.35	17%	15	1.86	4.00 (2)	-	-	-	-	-
	Mixed-Use	2.20	27%	8	0.99	8.00 (2)	17,570	0.05	44	5.44	5.44
	Non-Residential	4.53	56%	-	-	-	52,755	0.15	133	16.42	16.42
	Total	**8.07**	**100%**	**23**	**2.85**	**12.00 (2)**	**70,325**	**0.20**	**176**	**21.86**	**21.86**
(2) This report assumes higher residential densities in CB than have been observed in the past because the zoning code was modified in the mid-2000s to encourage housing and the sample includes projects from before the time that it was possible to build residential or mixed-use projects in the zone. Hence, future development will likely include more housing than was observed during the 1995 to 2010 period.											
CB (Infill Projects)											
	Non-Residential					No Data					20.00 (3)
(3) The assumed new jobs by employment sector are: 10 Services, 6 Retail, 2 FIRE, and 2 Food Services.											
CB(S) (New Projects)											
	Non-Residential	10.28	100%	-	-	-	145,912	0.33	348	33.86	33.86
CB(S) (Infill Projects)											
	Non-Residential	1.34	100%	-	-	-	4,872	0.08	9	6.70	20.00 (4)
(4) Future business expansions and new uses on sites with existing uses will likely have higher average employment densities than the infill project that this sample relies on (a new self-service car wash and espresso stand next to an existing auto repair shop). The assumed new jobs by employment sector are: 10 Services, 6 Retail, 2 FIRE, and 2 Food Services.											
PCB(S) and PCB (5)											
	Non-Residential	21.79	100%	-	-	-	274,392	0.67	685	31.46	31.46
(5) The employment density for new projects is also being applied to infill projects because the infill data sample size is too small to be reliable (one project: a new car wash added onto an existing gas station).											
DB											
	Mixed-Use	1.91	100%	17	8.89	8.89	31,200	0.37	83	43.43	43.43

City of Mukilteo

Development History (1995 - 2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
WMU	Mixed Use		New Zone: No Data			5.00 (6)		New Zone: No Data			25.00 (6)
(6) The city revised Waterfront Mixed Use in 2009 and the zone now covers land formerly zoned Downtown Business. The only recent building in WMU is the Silver Cloud Inn (permitted 1999 under DB zoning); however, Silver Cloud is not predictive of likely future development in WMU because it exceeds the new height limit for buildings north of Front Street. The assumed job sector breakdown is 14 Service, 4 Food Service, 4 Retail, and 3 Government.											
IP and BP (New Projects)											
	Non-Residential	39.93	100%	-	-	-	608,815	0.35	1,153	28.87	28.87
IP and BP (Infill Projects)											
	Non-Residential	8.52	100%	-	-	-	155,762	0.37	227	26.63	26.63
LI and HI (New Projects)											
	Non-Residential	36.03	100%	-	-	-	555,369	0.60	911	25.29	25.29
LI and HI (Infill Projects)											
	Non-Residential	32.29	100%	-	-	-	403,687	0.28	776	24.02	24.02
PI (New Projects)											
	Non-Residential	13.70	100%	-	-	-	57,404	0.10	57	4.16	4.16
PI (Infill Projects)											
	Non-Residential	16.78	100%	-	-	-	254,557	0.40	115	6.84	6.84
OS				Case-by-case for known pending projects in Open Space							
PSP				Case-by-case for known pending projects in Public / Semi-Public							

Woodway MUGA - Additional Population Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
GBACRES – Gross buildable acres
SURP_AC – Surplus acres (for partially-used parcels)

AHCSFTOT – Additional housing unit capacity for single family units (prior to market and public purpose reductions)
AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
AHCTH_A2 – Additional housing unit capacity for townhouse units (after market and public purpose reductions)
AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
AHCSA_A2 – Additional housing unit capacity for senior apt units (after market and public purpose reductions)
AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
AHCPOPTH – Additional population capacity in townhouse units (after market and public purpose reductions)
AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
AHCPOPSA – Additional population capacity in senior apt units (after market and public purpose reductions)
AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Woodway	CITY12	(1) PENDING		FRP R-87	13.424	.0000000	13.424	.000	5	0	0	0	5	5	0	0	0	5	14	0	0	0	14
				SR R-14.5	2.185	.4137429	1.772	.000	6	0	0	0	6	6	0	0	0	6	17	0	0	0	17
			Sum		15.609	.4137429	15.195	.000	11	0	0	0	11	11	0	0	0	11	32	0	0	0	32
		Sum			15.609	.4137429	15.195	.000	11	0	0	0	11	11	0	0	0	11	32	0	0	0	32
		(2) VACANT		FRP R-87	4.705	2.373595	2.331	.000	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
				SR R-14.5	1.269	.0000000	1.269	.000	2	0	0	0	2	2	0	0	0	2	5	0	0	0	5
			Sum		5.974	2.373595	3.600	.000	4	0	0	0	4	4	0	0	0	4	10	0	0	0	10
		Sum			5.974	2.373595	3.600	.000	4	0	0	0	4	4	0	0	0	4	10	0	0	0	10
		(3) PARTUSE		FRP R-87	31.743	8.136642	23.606	17.481	5	0	0	0	5	4	0	0	0	4	12	0	0	0	12
				FRP R43	6.924	.0000000	6.924	4.325	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
				SR R-14.5	2.692	.0331033	2.659	1.674	3	0	0	0	3	3	0	0	0	3	7	0	0	0	7
			Sum		41.358	8.169745	33.189	23.480	11	0	0	0	11	9	0	0	0	9	27	0	0	0	27
		Sum			41.358	8.169745	33.189	23.480	11	0	0	0	11	9	0	0	0	9	27	0	0	0	27
	Sum				62.941	10.95708	51.984	23.480	26	0	0	0	26	24	0	0	0	24	69	0	0	0	69
Sum					62.941	10.95708	51.984	23.480	26	0	0	0	26	24	0	0	0	24	69	0	0	0	69

Woodway MUGA - Additional Population Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Woodway	CITY21	(1) PENDING		UR	36.152	27.75041	8.401	.000	36	0	0	0	36	36	0	0	0	36	104	0	0	0	104
			Sum		36.152	27.75041	8.401	.000	36	0	0	0	36	36	0	0	0	36	104	0	0	0	104
		Sum			36.152	27.75041	8.401	.000	36	0	0	0	36	36	0	0	0	36	104	0	0	0	104

	Sum				36.152	27.75041	8.401	.000	36	0	0	0	36	36	0	0	0	36	104	0	0	0	104
Sum					36.152	27.75041	8.401	.000	36	0	0	0	36	36	0	0	0	36	104	0	0	0	104

Woodway MUGA - Additional Population Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
Woodway	UNINC	(4) REDEV	MARKET-READY	UVILL	62.223	49.66465	12.558	.000	0	25	255	33	313	0	24	242	31	297	0	60	446	37	543
			Sum		62.223	49.66465	12.558	.000	0	25	255	33	313	0	24	242	31	297	0	60	446	37	543
		Sum			62.223	49.66465	12.558	.000	0	25	255	33	313	0	24	242	31	297	0	60	446	37	543
	Sum				62.223	49.66465	12.558	.000	0	25	255	33	313	0	24	242	31	297	0	60	446	37	543
Sum					62.223	49.66465	12.558	.000	0	25	255	33	313	0	24	242	31	297	0	60	446	37	543

Woodway MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

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UB_ACRES: Unbuildable acres
GBACRES: Gross buildable acres
SURP_AC: Surplus acres (for partially-used parcels)

AEC_COMM: Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND: Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT: Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

N/A

Woodway MUGA - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Woodway MUGA - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
Woodway	UNINC	(4) REDEV	MARKET-READY	UVILL	62.223	49.66465	12.558	.000	126	0	0	126	119	0	0	119
			Sum		62.223	49.66465	12.558	.000	126	0	0	126	119	0	0	119
		Sum			62.223	49.66465	12.558	.000	126	0	0	126	119	0	0	119
	Sum				62.223	49.66465	12.558	.000	126	0	0	126	119	0	0	119
Sum					62.223	49.66465	12.558	.000	126	0	0	126	119	0	0	119

Town of Woodway

Development History (1995 - 2018)

Zone	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
Development Within City Zones											
R-87,000											
	Single Family		No Data			0.50	-	-	-	-	-
R-43,000											
	Single Family		No Data			1.00	-	-	-	-	-
R-14,500											
	Single Family	47.62	100%	101	2.12	2.12	-	-	-	-	-

Lake Stickney Gap - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES – Total parcel acres
UB_ACRES – Unbuildable acres
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AHCTHTOT – Additional housing unit capacity for townhouse units (prior to market and public purpose reductions)
AHCMFTOT – Additional housing unit capacity for multi-family units (prior to market and public purpose reductions)
AHCSATOT – Additional housing unit capacity for senior apt units (prior to market and public purpose reductions)
AHCTOTAL – Additional housing unit capacity for all units (prior to market and public purpose reductions)

AHCSF_A2 – Additional housing unit capacity for single family units (after market and public purpose reductions)
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AHCMF_A2 – Additional housing unit capacity for multi-family units (after market and public purpose reductions)
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AHCTOTA2 – Additional housing unit capacity for all units (after market and public purpose reductions)

AHCPOPSF – Additional population capacity in single family units (after market and public purpose reductions)
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AHCPOPMF – Additional population capacity in multi-family units (after market and public purpose reductions)
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AHCPOP_T – Additional population capacity in all units (after market and public purpose reductions)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T

There are no cases available for REPORT to process.

Lake Stickney Gap - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Lake Stickney Gap - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
LkStickney	UNINC	(1) PENDING		MF-HD	3.451	.9195411	2.532	.000	6	12	45	0	63	6	12	45	0	63	17	31	83	0	131
				MF-HD-UCOM	7.470	.0000000	7.470	.000	0	0	160	0	160	0	0	160	0	160	0	0	294	0	294
				UHDR	25.752	8.563757	20.931	.000	60	249	2	0	311	60	249	2	0	311	173	633	4	0	810

		UMDR	27.054	.1681988	26.886	.000	188	33	0	0	221	188	33	0	0	221	541	84	0	0	625
	Sum		63.727	9.651497	57.819	.000	254	294	207	0	755	254	294	207	0	755	732	748	381	0	1860
Sum			63.727	9.651497	57.819	.000	254	294	207	0	755	254	294	207	0	755	732	748	381	0	1860
	(2) VACANT	MF-HD	.521	.2964408	.224	.000	0	0	6	0	6	0	0	5	0	5	0	0	9	0	9
		MF-HD-UCOM	1.499	.8008610	.698	.000	0	0	8	0	8	0	0	6	0	6	0	0	12	0	12
		UCENTER	.184	.0000000	.184	.000	0	0	8	1	9	0	0	6	1	7	0	0	12	1	13
		UCOM	.300	.0000000	.300	.000	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1
		UHDR	7.750	18.80338	6.730	.000	24	25	53	7	109	19	20	43	6	88	56	51	79	7	193
		UMDR	10.409	39.99166	6.873	.000	55	0	0	0	55	47	0	0	0	47	134	0	0	0	134
	Sum		20.663	59.89234	15.009	.000	79	25	76	8	188	66	20	61	6	154	190	51	113	8	362
Sum			20.663	59.89234	15.009	.000	79	25	76	8	188	66	20	61	6	154	190	51	113	8	362
	(3) PARTUSE	MF-HD	1.259	.0000000	1.259	.116	0	0	3	0	3	0	0	2	0	2	0	0	4	0	4
		UHDR	14.059	.0890715	13.970	9.499	34	39	77	12	162	23	26	51	8	108	65	66	94	9	235
		UMDR	39.737	11.75898	27.978	14.733	108	0	0	0	108	82	0	0	0	82	236	0	0	0	236
	Sum		55.056	11.84806	43.208	24.348	142	39	80	12	273	105	26	53	8	192	302	66	98	9	475
Sum			55.056	11.84806	43.208	24.348	142	39	80	12	273	105	26	53	8	192	302	66	98	9	475
	(4) REDEV	MF-HD	7.903	.0441561	7.858	.000	-6	20	212	0	226	-4	13	141	0	150	-11	34	259	0	282
		MF-HD-UCOM	24.983	4.339716	20.643	.000	-33	22	274	0	263	-22	15	182	0	175	-63	37	335	0	309
		UCENTER	12.619	1.262783	11.356	.000	-38	6	506	105	579	-25	4	336	70	385	-73	10	619	82	639
		UHDR	27.800	5.060355	22.739	.000	26	79	160	7	272	17	53	106	5	181	50	134	196	5	385
		UMDR	49.907	6.581974	43.325	.000	291	1	3	0	295	221	1	2	0	224	637	2	4	0	643
	Sum		123.212	17.28898	105.923	.000	240	128	1155	112	1635	187	85	768	74	1115	539	217	1414	88	2257
Sum			123.212	17.28898	105.923	.000	240	128	1155	112	1635	187	85	768	74	1115	539	217	1414	88	2257
Sum			262.658	98.68087	221.958	24.348	715	486	1518	132	2851	612	425	1090	89	2216	1762	1082	2005	105	4954
Sum			262.658	98.68087	221.958	24.348	715	486	1518	132	2851	612	425	1090	89	2216	1762	1082	2005	105	4954

Lake Stickney Gap - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

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AECTOTAL: Total additional employment capacity (prior to market and public purpose reductions)

AEC_COMM2: Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

N/A

Lake Stickney Gap - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Lake Stickney Gap - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM2	AEC_IND2	AEC_GOVT2	AECTOTA2
LkStickney	UNINC	(1) PENDING		MF-HD-UCOM	.860	.1992753	.661	.000	0	11	0	11	0	11	0	11
				UCOM	2.127	.0573116	2.069	.000	0	19	0	19	0	19	0	19
			Sum		2.987	.2565870	2.730	.000	0	30	0	30	0	30	0	30
		Sum			2.987	.2565870	2.730	.000	0	30	0	30	0	30	0	30
		(2) VACANT		MF-HD-UCOM	1.499	.8008610	.698	.000	9	0	0	10	8	0	0	8
				UCENTER	.184	.0000000	.184	.000	5	0	0	5	4	0	0	4
				UCOM	.300	.0000000	.300	.000	4	0	0	4	3	0	0	3
			Sum		1.983	.8008610	1.182	.000	18	1	1	19	15	1	0	16

Sum			1.983	.8008610	1.182	.000	18	1	1	19	15	1	0	16
(4) REDEV		MF-HD-UCOM	24.983	4.339716	20.643	.000	217	14	8	239	144	10	5	159
		UCENTER	12.619	1.262783	11.356	.000	286	0	11	297	190	0	7	197
	Sum		37.602	5.602499	32.000	.000	503	14	19	536	334	10	12	356
Sum			37.602	5.602499	32.000	.000	503	14	19	536	334	10	12	356
Sum			42.572	6.659947	35.912	.000	521	46	19	585	349	41	13	402
Sum			42.572	6.659947	35.912	.000	521	46	19	585	349	41	13	402

Larch Way Overlap - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

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uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T

There are no cases available for REPORT to process.

Larch Way Overlap - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Larch Way Overlap - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
LarchWay Ov	UNINC	(1) PENDING		UCENTER	1.462	.0000000	1.462	.000	0	0	123	0	123	0	0	123	0	123	0	0	226	0	226
				UHDR	.895	.0000000	.895	.000	2	10	0	0	12	2	10	0	0	12	6	25	0	0	31
				ULDR	19.374	.0000000	19.374	.000	98	0	0	0	98	98	0	0	0	98	282	0	0	0	282

			UMDR	6.795	.0000000	6.795	.000	0	88	0	0	88	0	88	0	0	88	0	224	0	0	224
		Sum		28.525	.0000000	28.525	.000	100	98	123	0	321	100	98	123	0	321	288	249	226	0	764
	Sum			28.525	.0000000	28.525	.000	100	98	123	0	321	100	98	123	0	321	288	249	226	0	764
		(2) VACANT	UCENTER	3.984	.0000000	3.984	.000	0	1	177	34	212	0	1	143	27	171	0	2	263	32	297
			UHDR	1.392	.0000000	1.392	.000	4	5	10	1	20	3	4	8	1	16	9	10	15	1	35
			ULDR	11.379	.0000000	11.379	.000	63	0	0	0	63	56	0	0	0	56	162	0	0	0	162
		Sum		16.755	.0000000	16.755	.000	67	6	187	35	295	59	5	151	28	244	171	12	278	33	495
	Sum			16.755	.0000000	16.755	.000	67	6	187	35	295	59	5	151	28	244	171	12	278	33	495
		(3) PARTUSE	UCENTER	3.561	.0000000	3.561	1.759	0	0	77	16	93	0	0	51	11	62	0	0	94	13	107
			UHDR	2.885	.0000000	2.885	1.870	6	8	15	2	31	4	5	10	1	21	11	14	18	2	45
			ULDR	64.107	.0000000	64.107	35.071	180	0	0	0	180	154	0	0	0	154	443	0	0	0	443
			UMDR	.544	.0000000	.544	.122	1	0	0	0	1	1	0	0	0	1	2	0	0	0	2
		Sum		71.097	.0000000	71.097	38.821	187	8	92	18	305	159	5	61	12	237	457	14	113	14	597
	Sum			71.097	.0000000	71.097	38.821	187	8	92	18	305	159	5	61	12	237	457	14	113	14	597
		(4) REDEV	UCENTER	11.590	.0000000	11.590	.000	-13	2	511	103	603	-9	1	340	68	401	-25	3	625	81	684
			UHDR	6.092	.0000000	6.092	.000	0	18	40	1	59	0	12	27	1	39	0	30	49	1	80
			ULDR	34.747	.0000000	34.747	.000	142	0	0	0	142	121	0	0	0	121	350	0	0	0	350
			UMDR	1.545	.0000000	1.545	.000	7	0	0	0	7	5	0	0	0	5	15	0	0	0	15
		Sum		53.973	.0000000	53.973	.000	136	20	551	104	811	118	13	366	69	567	340	34	674	81	1129
	Sum			53.973	.0000000	53.973	.000	136	20	551	104	811	118	13	366	69	567	340	34	674	81	1129
Sum				170.350	.0000000	170.350	38.821	490	132	953	157	1732	436	121	702	109	1369	1256	309	1291	129	2985
Sum				170.350	.0000000	170.350	38.821	490	132	953	157	1732	436	121	702	109	1369	1256	309	1291	129	2985

Larch Way Overlap - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

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AEC_IND2:	Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2:	Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2:	Total additional employment capacity (after market and public purpose reductions)

N/A

Larch Way Overlap - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Larch Way Overlap - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
LarchWay Ov	UNINC	(2) VACANT		UCENTER	3.984	.0000000	3.984	.000	104	0	4	108	84	0	3	87
			Sum		3.984	.0000000	3.984	.000	104	0	4	108	84	0	3	87
		Sum			3.984	.0000000	3.984	.000	104	0	4	108	84	0	3	87
		(3) PARTUSE		UCENTER	3.561	.0000000	3.561	1.759	46	0	2	47	30	0	1	32
			Sum		3.561	.0000000	3.561	1.759	46	0	2	47	30	0	1	32
		Sum			3.561	.0000000	3.561	1.759	46	0	2	47	30	0	1	32
		(4) REDEV		UCENTER	11.590	.0000000	11.590	.000	272	0	12	283	181	0	8	188
			Sum		11.590	.0000000	11.590	.000	272	0	12	283	181	0	8	188

	Sum	11.590	.0000000	11.590	.000	272	0	12	283	181	0	8	188
Sum		19.135	.0000000	19.135	1.759	421	0	17	438	295	0	12	307
Sum		19.135	.0000000	19.135	1.759	421	0	17	438	295	0	12	307

Paine Field Area - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

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AEC_IND2: Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2: Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2: Total additional employment capacity (after market and public purpose reductions)

N/A

Paine Field Area - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Paine Field Area - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
PaineFld	UNINC	(2) VACANT		UI	252.244	94.06124	158.182	.000	1625	2713	68	4405	1312	2191	55	3557
			Sum		252.244	94.06124	158.182	.000	1625	2713	68	4405	1312	2191	55	3557
		Sum			252.244	94.06124	158.182	.000	1625	2713	68	4405	1312	2191	55	3557
		(3) PARTUSE		UI	7.187	.7411989	6.446	3.740	18	50	1	69	12	33	1	46
			Sum		7.187	.7411989	6.446	3.740	18	50	1	69	12	33	1	46
		Sum			7.187	.7411989	6.446	3.740	18	50	1	69	12	33	1	46
		(4) REDEV		UI	2.900	.9480284	1.952	.000	20	33	1	54	13	22	1	36
			Sum		2.900	.9480284	1.952	.000	20	33	1	54	13	22	1	36

	Sum	2.900	.9480284	1.952	.000	20	33	1	54	13	22	1	36
Sum		262.331	95.75046	166.581	3.740	1663	2796	70	4528	1337	2246	56	3639
Sum		262.331	95.75046	166.581	3.740	1663	2796	70	4528	1337	2246	56	3639

Silver Firs Gap - Additional Population Capacity DRAFT (May-10-2021)
City (within boundaries as of December 13, 2012)

Key to report column headers:

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uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T

There are no cases available for REPORT to process.

Silver Firs Gap - Additional Population Capacity DRAFT (May-10-2021)
City (in areas annexed since December 13, 2012)

There are no cases available for REPORT to process.

Silver Firs Gap - Additional Population Capacity DRAFT (May-10-2021)
Unincorporated UGA (in currently unincorporated portion of UGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AHCSFTOT	AHCTHTOT	AHCMFTOT	AHCSATOT	AHCTOTAL	AHCSF_A2	AHCTH_A2	AHCMF_A2	AHCSA_A2	AHCTOTA2	AHCPOPSF	AHCPOPTH	AHCPOPMF	AHCPOPSA	AHCPOP_T
SilverFirs	UNINC	(1) PENDING		UCOM	34.219	.0040625	34.215	.000	0	328	0	0	328	0	328	0	0	328	0	834	0	0	834
				ULDR	63.135	.0702702	63.065	.000	260	0	0	0	260	260	0	0	0	260	749	0	0	0	749
				UMDR	144.748	1.660858	143.087	.000	525	525	0	0	1050	525	525	0	0	1050	1512	1336	0	0	2848

		Sum		242.102	1.735191	240.367	.000	785	853	0	0	1638	785	853	0	0	1638	2261	2170	0	0	4431
	Sum			242.102	1.735191	240.367	.000	785	853	0	0	1638	785	853	0	0	1638	2261	2170	0	0	4431
		(2) VACANT	UCOM	1.070	.0025968	1.068	.000	0	0	5	0	5	0	0	4	0	4	0	0	7	0	7
			ULDR	8.775	.0000000	8.775	.000	51	0	0	0	51	46	0	0	0	46	131	0	0	0	131
		Sum		9.845	.0025968	9.843	.000	51	0	5	0	56	46	0	4	0	50	131	0	7	0	139
		MARKET-READY	ULDR	19.960	.0000000	19.960	.000	118	0	0	0	118	112	0	0	0	112	323	0	0	0	323
		Sum		19.960	.0000000	19.960	.000	118	0	0	0	118	112	0	0	0	112	323	0	0	0	323
	Sum			29.805	.0025968	29.803	.000	169	0	5	0	174	158	0	4	0	162	454	0	7	0	461
		(3) PARTUSE	ULDR	56.723	3.074282	53.649	44.365	253	0	0	0	253	216	0	0	0	216	623	0	0	0	623
		Sum		56.723	3.074282	53.649	44.365	253	0	0	0	253	216	0	0	0	216	623	0	0	0	623
	Sum			56.723	3.074282	53.649	44.365	253	0	0	0	253	216	0	0	0	216	623	0	0	0	623
		(4) REDEV	ULDR	60.932	3.202574	57.730	.000	323	0	0	0	323	276	0	0	0	276	795	0	0	0	795
		Sum		60.932	3.202574	57.730	.000	323	0	0	0	323	276	0	0	0	276	795	0	0	0	795
	Sum			60.932	3.202574	57.730	.000	323	0	0	0	323	276	0	0	0	276	795	0	0	0	795
Sum				389.563	8.014644	381.548	44.365	1530	853	5	0	2388	1435	853	4	0	2292	4133	2170	7	0	6311
Sum				389.563	8.014644	381.548	44.365	1530	853	5	0	2388	1435	853	4	0	2292	4133	2170	7	0	6311

Silver Firs Gap - Additional Employment Capacity DRAFT (May-10-2021)

City (within boundaries as of December 13, 2012)

Key to report column headers:

TOTACRES:	Total parcel acres
UB_ACRES:	Unbuildable acres
GBACRES:	Gross buildable acres
SURP_AC:	Surplus acres (for partially-used parcels)
AEC_COMM:	Additional commercial employment capacity (prior to market and public purpose reductions)
AEC_IND:	Additional industrial employment capacity (prior to market and public purpose reductions)
AEC_GOVT:	Additional government employment capacity (prior to market and public purpose reductions)
AECTOTAL:	Total additional employment capacity (prior to market and public purpose reductions)
AEC_COMM2:	Additional commercial employment capacity (after market and public purpose reductions)
AEC_IND2:	Additional industrial employment capacity (after market and public purpose reductions)
AEC_GOVT2:	Additional government employment capacity (after market and public purpose reductions)
AECTOTAL2:	Total additional employment capacity (after market and public purpose reductions)

N/A

Silver Firs Gap - Additional Employment Capacity DRAFT (May-10-2021)

City (in areas annexed since December 13, 2012)

N/A

Silver Firs Gap - Additional Employment Capacity DRAFT (May-10-2021)

Unincorporated MUGA (in currently unincorporated portion of MUGA)

uga_name	JURIS	LNDSTAT	MKT_READY	Zone	TOTACRES	UB_Acres	GBACRES	SURP_AC	AEC_COMM	AEC_IND	AEC_GOVT	AECTOTAL	AEC_COMM 2	AEC_IND2	AEC_GOVT 2	AECTOTA2
SilverFirs	UNINC	(1) PENDING		UCOM	30.979	.0000000	30.979	.000	20	0	0	20	20	0	0	20
			Sum		30.979	.0000000	30.979	.000	20	0	0	20	20	0	0	20
		Sum			30.979	.0000000	30.979	.000	20	0	0	20	20	0	0	20
		(2) VACANT		UCOM	1.070	.0025968	1.068	.000	14	1	0	15	12	1	0	12
			Sum		1.070	.0025968	1.068	.000	14	1	0	15	12	1	0	12
		Sum			1.070	.0025968	1.068	.000	14	1	0	15	12	1	0	12
	Sum				32.049	.0025968	32.046	.000	34	1	0	35	31	1	0	32
Sum					32.049	.0025968	32.046	.000	34	1	0	35	31	1	0	32

Unincorporated Southwest UGA

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development: Dwelling Units	Residential Development: Units / Acre in Total Zone	Residential Development: Density Assumed	Non-Residential Development: Non-Res. Square Feet	Non-Residential Development: Floor Area Ratio	Non-Residential Development: Estimated Total Emp.	Non-Residential Development: Estimated Employment Per Acre	Non-Residential Development: Employment Density Assumed
Development Within County Designations											
Unsewerable Enclave			No Data			2.00 (1)	-	-	-	-	-
(1) The type of projects typically built in Unswerable Enclaves, small short plat subdivisions, are not included in the data sampling used to predict future densities. However, an examination of such projects shows that 2 units per buildable acre is a reasonable assumption.											
ULDR											
	Single Family	665.60	100%	3,938	5.92	5.92	-	-	-	-	-
	Total	**665.60**	**100%**	**3,938**	**5.92**	**5.92**	**-**	**-**	**-**	**-**	**-**
UMDR											
	Single Family	331.10	96%	2,886	8.41	8.41	-	-	-	-	-
	Townhouse	5.80	2%	70	0.20	0.20	-	-	-	-	-
	Multi-Family	6.31	1.84%	82	0.24	0.24	-	-	-	-	-
	Total	**343.20**	**100%**	**3,038**	**8.85**	**8.85**	**-**	**-**	**-**	**-**	**-**
UHDR (3)											
	Single Family	106.64	44%	1,123	4.64	3.72 (2)	-	-	-	-	-
	Townhouse	50.59	21%	801	3.31	4.36 (2)	-	-	-	-	-
	Multi-Family	74.23	31%	1,840	7.61	8.27 (2)	-	-	-	-	-
	Senior Apartments	10.03	4%	253	1.05	1.38 (2)	135,880	0.01	340	1.40	1.40
	Non-Residential	0.40	0.17%	-	-	-	2,652	0.00	7	0.03	0.03
	Total	**241.89**	**100%**	**4,017**	**16.61**	**17.73 (2)**	**138,532**	**0.01**	**346**	**1.43**	**1.43**

(2) This report assumes that the densities achieved during the most recent development history (2011-2018) are expected to continue in the Urban High Density Residential (UHDR) designation compared to what was used in the 2012 BLR.

(3) In UHDR designated areas along Highway 99 that allow for increased multifamily residential densities through the use of TDR credits (Amended Ord. 18-026), townhouse densities of 2.98 and multifamily densities of 27.38 were applied.

Unincorporated Southwest UGA

Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
UCOM (New Projects) (5)											
	Single Family	1.21	1%	18	0.09	0.00 (4)					
	Multi-Family	39.58	19%	807	3.92	3.92	-	-	-	-	-
	Senior Apartments	3.42	2%	143	0.69	0.69	-	-	-	-	-
	Mixed-Use	9.72	5%	201	0.98	0.98	29,380	0.00	73	0.36	0.36
	Non-Residential	153.40	74%	-	-	-	1,773,336	0.20	2,910	14.12	14.12
	Total	**206.11**	**100%**	**1,169**	**5.67**	**5.58**	**1,802,716**	**0.20**	**2,984**	**14.48**	**14.48**
UCOM (Infill Projects)											
	Non-Residential	3.44	100%	-	-	-	29,731.00	0.20	58	16.75	16.75
UI (New Projects)											
	Non-Residential	164.47	100%	-	-	-	2,310,692	0.32	4,581	27.85	27.85
UI (Infill Projects)											
	Non-Residential	31.20	100%	-	-	-	333,076	0.25	573	18.35	18.35
UV											
	Townhouse	4.02	13%	63	2.01	2.01	-	-	-	-	-
	Multi-Family	8.80	28%	280	8.96	8.96	-	-	-	-	-
	Senior Apartments		No Data			2.68 (4)	-	-	-	-	-
	Mixed-Use	18.44	59%	355	11.35	11.35	71,300	0.05	181	5.79	10.00 (5)
	Total	**31.27**	**100%**	**698**	**22.32**	**25.00**	**71,300**	**0.05**	**181**	**5.79**	**10.00 (5)**

(4) Single Family projects are no longer an allowed use within the the Urban Commercial designation.

(5) In Urban Commercial designated areas along Highway 99 that allow for increased multifamily residential densities through the use of TDR credits (Amended Ord. 18-026), townhouse densities of 1.49 and multifamily densities of 13.69 were applied.

(4) Senior Apartment densities are based off what was achieved in the Urban Center and Transit/Pedestrian Village (UC/TPV) designation.

(5)The assumed job sector breakdown is 6 Services, 2 Retail, 1 FIRE, and 1 Food Services.

Unincorporated Southwest UGA

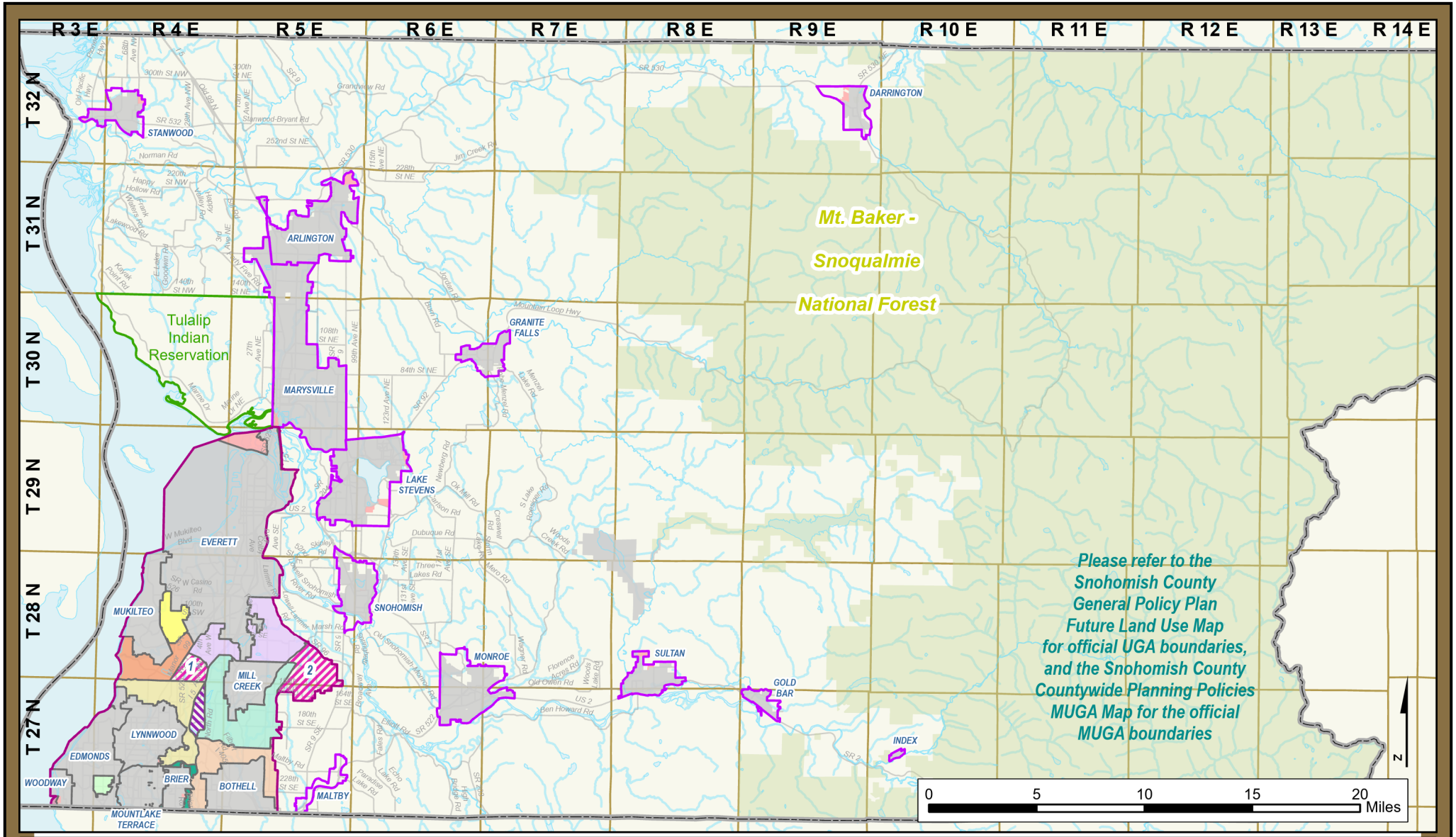
Development History (Projects Modeled as Predictive)

Zone or Plan	Type of Development	Buildable Acres Developed	% Buildable Acres Developed	Residential Development			Non-Residential Development				
				Dwelling Units	Units / Acre in Total Zone	Density Assumed	Non-Res. Square Feet	Floor Area Ratio	Estimated Total Emp.	Estimated Employment Per Acre	Employment Density Assumed
UC and TPV											
	Townhouse	6.55	4%	134	0.76	0.76	-	-	-	-	-
	Multi-Family	63.03	36%	2,225	12.57	22.57	-	-	-	-	-
	Senior Apartments	5.84	3%	395	2.23	9.49	-	-	-	-	-
	Mixed-Use	100.94	57%	3,925	22.18	22.18	566,834	0.07	1,677	9.48	
	Non-Residential	0.62	0.35%	-	-	-	7,715	0.00	11	0.06	27.00 (6)
	Total	**176.99**	**100%**	**6,679**	**37.74**	**55.00 (7)**	**574,549**	**0.07**	**1,688**	**9.54**	**27.00 (6)**

(6) This report assumes that the opening of the light rail stations will push towards higher employment density similar to what is being achieved in the Lynnwood City Center zones. The assumed job sector breakdown is 13 Services, 5 retail, 4 FIRE, 4 Food Services, and 1 Government.

(7) Post-2018 actual and proposed projects show a much greater achieved buildable density than what was previously seen in the UC/TPV designation.

Appendix



2021 SCT Buildable Lands Report: Urban Growth Area Reference Map

Snohomish County
Planning and Development Services

- Snohomish County Boundary
- Southwest UGA Boundary
- Other UGA Boundary
- MUGA Boundary
- *Tulalip Indian Reservation Boundary (Boundary Not Intended to Display Reservation Tidelands)*
- City Boundary As of Dec. 13, 2012
- City Area Annexed Since Dec. 13, 2012
- National Forest Boundary

MUGA Boundaries

- Bothell MUGA
- Brier MUGA
- Edmonds MUGA
- Everett MUGA
- Lynnwood MUGA
- Mill Creek MUGA
- Mountlake Terrace MUGA
- Mukilteo MUGA
- Woodway MUGA
- Paine Field Area
- Overlap Area Claimed by 2 Cities (Larch Way Overlap)
- Gap Areas Not Claimed by Any City:
  1. Lake Stickney Gap
  2. Silver Firs Gap

SNOHOMISH COUNTY DATA and MAP DISCLAIMER

All maps, data, and information set forth herein ("Data"), are for illustrative purposes only and are not to be considered an official citation to, or representation of, the Snohomish County Code. Amendments and updates to the Data, together with other applicable County Code provisions, may apply which are not depicted herein. Snohomish County makes no representation or warranty concerning the content, accuracy, currency, completeness or quality of the Data contained herein and expressly disclaims any warranty of merchantability or fitness for any particular purpose. All persons accessing or otherwise using this Data assume all responsibility for use thereof and agree to hold Snohomish County harmless from and against any damages, loss, claim or liability arising out of any error, defect or omission contained within said Data. Washington State Law, Ch. 42.56 RCW, prohibits state and local agencies from providing access to lists of individuals intended for use for commercial purposes and, thus, no commercial use may be made of any Data comprising lists of individuals contained herein.

Parcel lines and designation boundaries are adjusted to the Snohomish County Assessor Integrated Land Records Parcel Data Base as of November 2012.

This map is a graphic representation applied from the Snohomish County Geographic Information System. It does not represent survey accuracy. This map is based on the best available information as of the date shown on the map.

For the purposes of land use application review, final determination of future land use designations will be made by the County during the review process.

Path: S:\Planning\DEMOG\BLR2012\Report\UGA MUGA Overview\UGA_MUGA_Overview_v2.2.mxd

Errata Sheet

Page	Reads	Should Read
101	Two tables under "Maltby UGA - Additional Employment Capacity," are incorrectly labeled as part of the "Woodway UGA."	The two labels should instead be labeled as part of the "Maltby UGA."
195	In the UHDR Pending row shown under the Lynnwood Unincorporated MUGA, the number of pending Senior Apartment units is shown as 254.	The number of pending Senior Apartments should be 124, consequently lowering the additional population capacity for Senior Apartments to 146 persons [124 units x .98 occupancy rate x 1.2 persons per household for senior apartments], down by 153 from 299 persons.

FCS GROUP
Solutions-Oriented Consulting

| Memorandum

To: Patricia Love and Tansy Schroeder, City of Stanwood

From: Todd Chase, AICP, LEED, and Timothy Wood, FCS GROUP

Date: September 8, 2022

CC: Caitlin Hepworth, Blueline; Clay White, Matt Covert, Samantha Adams, LDC

RE Stanwood Economic Analysis of Land Use Options

I. INTRODUCTION

This Memorandum identifies market trends that are shaping future development opportunities within the City of Stanwood municipal boundary (City). The findings are intended to inform the 2024 update of the Stanwood Comprehensive Plan by conducting an Economic Analysis of Land Use Options. Key subtasks include.

- Existing Conditions Analysis
- Demographic Profile
- Economic Analysis of Land Use Alternatives

An important element of this work is to identify and evaluate potential land use/zoning options that the City should consider as it prepares a new Comprehensive Plan and development code. Potential changes to the official zoning map and land use designations may be required to fulfill state and regional requirements per WAC 365-196-325 and RCW 36.70A.115 for "providing sufficient land capacity suitable for development" which is provided in **Appendix A**.

As part of this effort, the FCS/Blueline/LDC consultant team conducted the following activities:

1. Reviewed background planning documents and current City zoning/development code regulations.
2. Summarized current community demographic and socio-economic conditions using the most recent available Census data.
3. Analyzed buildable lands and current major developments that are now in the planning "pipeline" as part of a periodic review of the City's ability to meet land capacity requirements for housing and jobs.
4. Identified land use and zoning alternatives that could enhance the consistency between land capacity and growth allocations.
5. Evaluated three land use/zoning alternatives in terms of housing/employment capacity, impacts on the City's general fund, and the potential value of new private investment.

Memorandum Contents

I. Introduction
II. Planning Background
III. Community Overview
IV. Land Use Alternatives Analysis
V. Evaluation of the Alternatives
VI. Other Considerations and Next Steps

Firm Headquarters
Redmond Town Center
7525 166th Ave NE, Ste D-215
Redmond, Washington 98052

Locations
Washington | 425.867.1802
Oregon | 503.841.6543
Colorado | 719.284.9168

The land use/zoning alternatives presented in this Memorandum will also be evaluated with respect to their transportation and infrastructure capacity impacts in separate studies.

Assumptions contained in this analysis are for long-range planning purposes only. Findings take into account input received from City of Stanwood planning staff, and community feedback obtained during recent land use discussions with the Stanwood Community Development Committee, Planning Commission, and community surveys.

II. PLANNING BACKGROUND

The City of Stanwood is a unique community with a rich and colorful history. Originally platted in 1898 and incorporated in 1903 the Town of Stanwood established itself as a trading hub on the banks of the Stillaguamish River in northwest Snohomish County. In 1906 East Stanwood was platted and later incorporated around the railroad depot. These two communities consolidated operations as one City in 1960. The City now serves as the commercial center for local residents as well as Camano Island in Island County to the west and those of the river valley east of Interstate 5 and north of the Tulalip Reservation.

Stanwood has been proactively managing its growth and development for decades as its population and job base expands. Selected background planning initiatives include:

- 2003 Design Stanwood
- 2010 Economic Development Action Plan
- 2012 SDAT: Density by Design
- 2015 Downtown Plan
- 2015 Comprehensive Plan
- 2019 Planning Café Open House
- 2020 City Beautification Action Plan
- 2022 Stanwood Housing Needs Assessment
- 2022-ongoing Twin City Mile Project. Includes a new Vision and Project Goals for Downtown which will set the stage for redevelopment (**Exhibit 1**).

Exhibit 1: Downtown Revitalization Vison & Goals

Source: City of Stanwood, Community Development Committee Staff Report, July 7, 2022.

These local plans and initiatives help to shape land use patterns in the City. The current Zoning Map of the City is illustrated in **Exhibit 2**.

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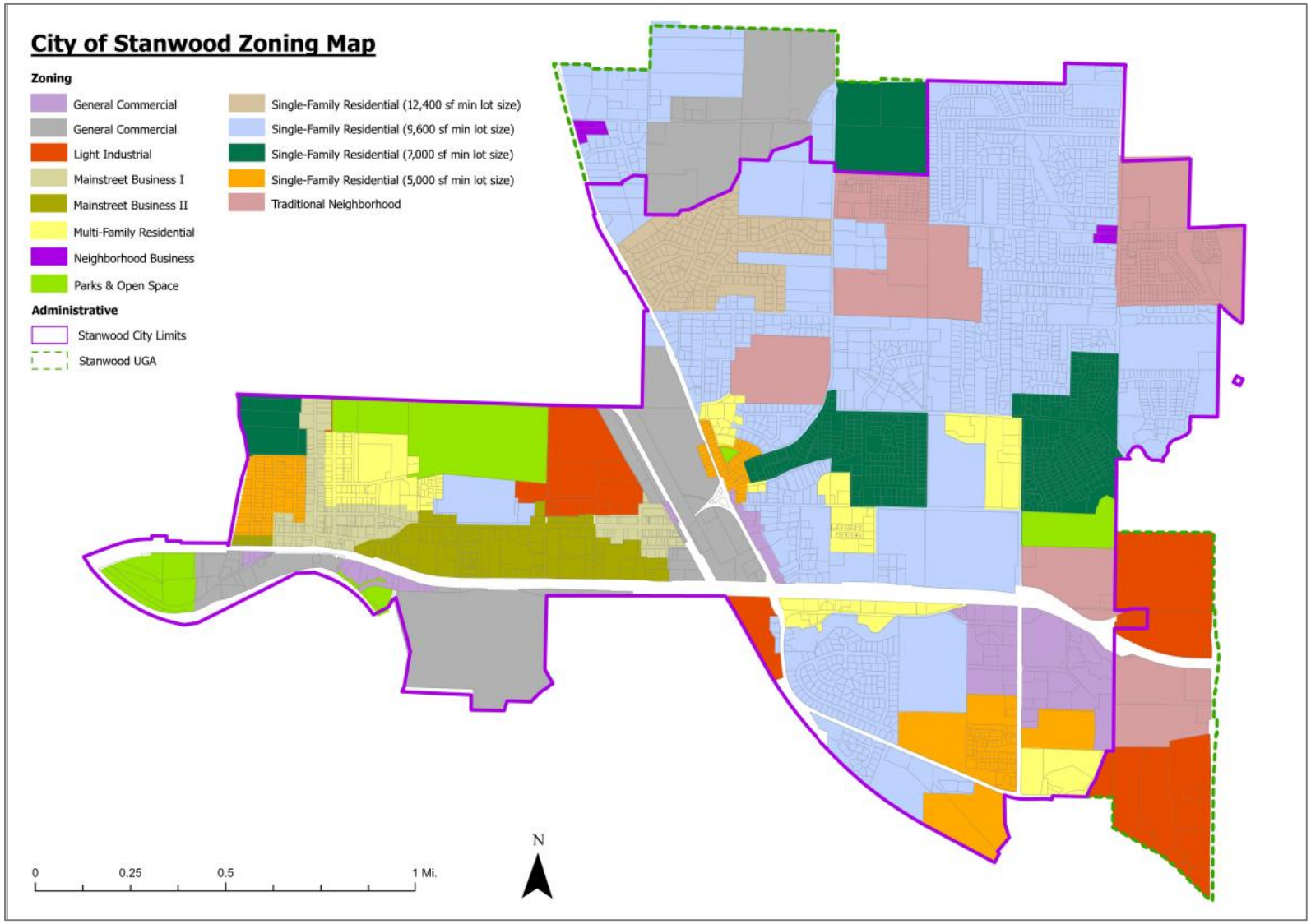
Exhibit 2: Stanwood Zoning Map



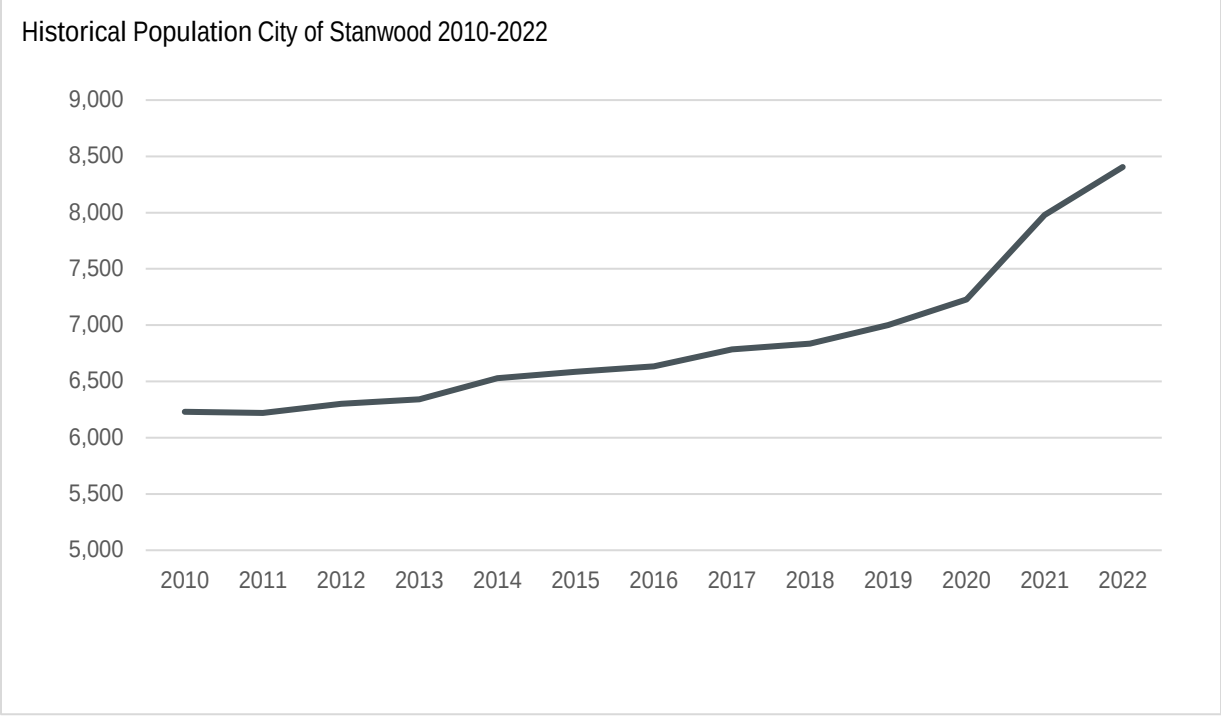
III COMMUNITY OVERVIEW

As part of this economic and land use analysis, current demographic and socio-economic data trends were compiled (see **Appendix C**). Key findings are summarized below.

Population and Income

- Stanwood has an area of approximately 2.8 square miles
- The current population of Stanwood (8,405) is it's peak population
- The population of Stanwood has grown 135% over past 12 years: 2010-2022 (**Exhibit 3**).
- According to current Census statistics, 12.7% of the residents of Stanwood are 65 or older. As shown in **Exhibit 4,** the City has a relatively large share of residents under age 24.
- The racial demographics of Stanwood are 93.5% White, 4.3% Two or more races, 1.6% Asian, 0.4% American Indian and 0.2% Black. Additionally, 4.4% of the population identifies as Hispanic.
- The median household income in Stanwood is $75,767.
- In Stanwood, 7.5% of residents have an income below the poverty line, and the child poverty rate is 8.0%. On a per-household basis, 5.6% of families are below the poverty line in Stanwood.

Exhibit 3: Population Trends



Source: Washington Office of Financial Management and U.S. Census estimates.

Exhibit 4: Population by Generation, 2020

Generation	Age range	Washington	Seattle MSA	Snohomish County	Stanwood
Gen Z	under 24	31%	30%	30%	40%
Millennials	25 to 44	29%	32%	29%	27%
Gen X	45 to 59	19%	19%	20%	17%
Baby Boomers	60 to 74	16%	14%	15%	9%
Golden Seniors	75+	6%	5%	5%	7%
Total		100%	100%	100%	100%

Source: US Census Bureau 2016-2020 ACS Table DP05

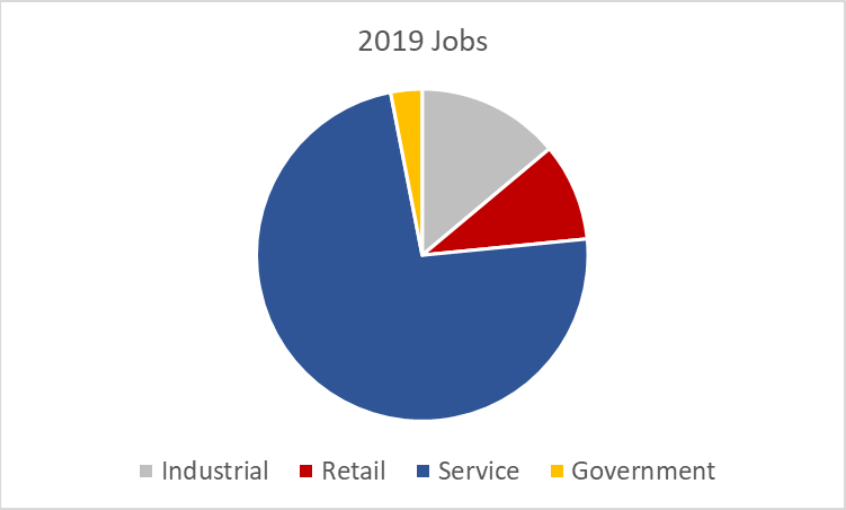
Employment

- The unemployment rate in Stanwood is 2.1%, which is calculated among residents aged 16 or older who are in the labor force.
- Within the City, 73% of the jobs are in the service sector, 14% are in the industrial sector, 10% retail sector and 3% in the government sector. Virtually all net new job growth over the past 10 years has occurred in the service and government sectors (**Exhibit 5**).

Exhibit 5: At Place of Work Employment, City of Stanwood, 2009-2019

Sector	2009 Jobs	2019 Jobs	Change	2009-2019 AGR
Industrial	554	477	(77)	-1.5%
Retail	352	326	(26)	-0.8%
Service	2,211	2,518	307	1.3%
Government	46	105	59	8.6%
Total	3,163	3,426	263	0.8%

Source: U.S. Census On the Map Data. AGR = average annual growth rate.



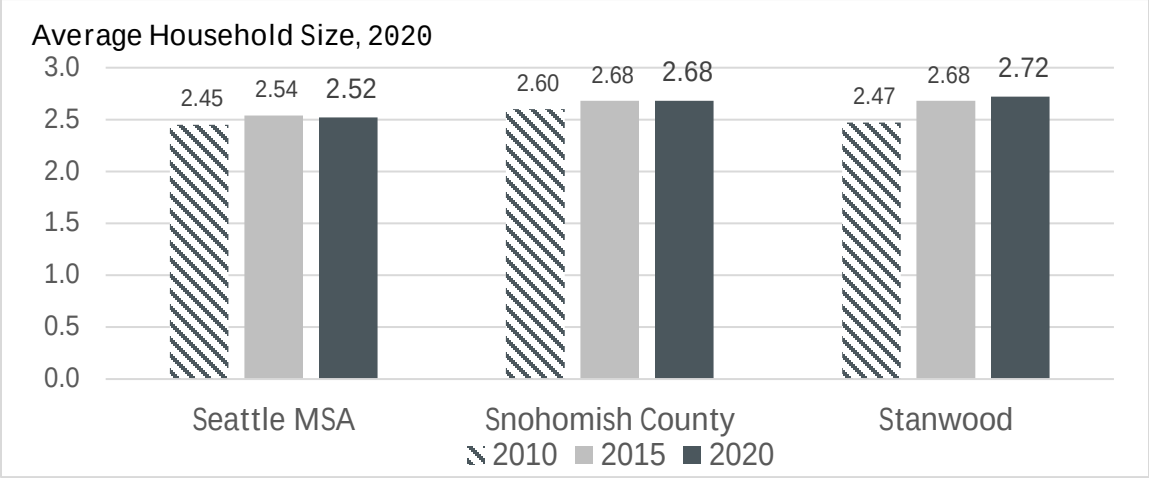
DRAFT

- It is estimated that approximately 10 percent of City's working residents work from home at least part of the week. The share of home-based workers increased significantly during the peak of the Covid-19 global pandemic (2020) but has since decreased.
- Among the adult population 25 years old and over, 95.4% of Stanwood residents have at least a high school degree or equivalent, 22.2% have a bachelor's degree and 7.7% have a graduate or professional degree.
- In Stanwood, it is estimated just over 85% of households have an active broadband internet connection, which is on par with the national averages.

Housing

- In Stanwood, 70.4% of housing units are occupied by their owners. Renters occupy 29.6% of housing units.
- An influx of relatively younger households with children is starting to drive up the average household size. Average household size has been increasing in Stanwood but decreasing or flat in Snohomish County and the greater Seattle Metropolitan Area (**Exhibit 6**).
- Of all the housing units in Stanwood, 7.6% of them were built before 1940. Over 41% of the total housing units were built after the year 2000.
- The *2022 Stanwood Housing Needs Assessment* forecasts a need for 1,522 net new dwelling units by 2044. This forecast is comprised of 1,017 single family dwellings and 505 multifamily dwelling units.
- Several additional projects are in the predevelopment pipeline (see **Appendix D**). While construction of these projects will likely take many years to complete, they are estimated to support 1,124 new dwelling units (544 single family and 580 multifamily units) and 177 jobs within the current City limits.

Exhibit 6: Average Household Size, City of Stanwood, 2010-2020



Source: American Community Survey and U.S. Census data.

Development Overview

Stanwood is a stable community with an upward growth trajectory. The community continues to experience strong demand with households moving into the area well as small business seeking to expand operations.

Housing Market Overview

- New housing construction has been robust. The City added 649 new dwelling units between 2017 and 2020; plus there are now over 1,120 housing units in the development pipeline. Prior to 2020, nearly 2/3 of the new construction permits were issued for single family homes and 1/3 were for multifamily. In more recent years, the share of multifamily permitting activity has exceeded the single family share (please refer to discussion of pipeline projects below).
- Median home sales prices in Stanwood increased 24.6% (year to date) to $573,000 in July 2022. There were only 42 homes with active listings in July 2022 compared to 45 12 months prior. Ten days is the average sales time for new listings and 60% of the homes were sold for more than their asking prices. (Source: RMLS)
- Rental market activity has been brisk and vacancy rates are very low with only 17 vacant units listed on Apartmentfinder.com (as of July 2022). Recent developments such as Cambridge Place/Madison Place Apartments, Creekside Apartments, and Stanwood-Camano Village apartments have established a high level of design for market-rate rentals with average monthly rents ranging from $2.30 to $2.45 per SF.

Commercial and Industrial Overview

Overall retail vacancy rates in Snohomish County were 2.6% (2nd Q 2022) and have been decreasing year over year as rents have increased 5% or more.

The office market is rebounding more slowly than the retail and industrial market since the pandemic. In Snohomish County office vacancy rates remained in the low to mid 7% range and are down slightly from the prior year. Average rents range from $28-29 per SF (annual) which compare favorably with other parts of the Region.

Industrial market growth in the Region has been mostly concentrated in transportation and warehousing. Manufacturing activity has been relatively stable with moderate job growth overall. According to Kidder Matthews Market Report industrial vacancy rates have declined in the Snohomish County submarket to just 3.1%; and there is now currently over 4.1 million square feet in 23 industrial developments in the predevelopment pipeline.

The 189,000 LSF former Twin City Foods food processing/packaging/warehouse building is currently being marketed as a for-lease opportunity in the City of Stanwood. Given the very low industrial building vacancy rates in the region, this underutilized building offers an excellent opportunity for significant job growth for uses such as food and beverage processing and distribution. A new industrial operation at this location is expected to add 140 to 180 jobs on site.

Since overall local industrial job growth declined between 1999 and 2019 (as shown earlier in **Exhibit 5**), it is recommended that the City of Stanwood consider changes to its Zoning Map and development code to provide added flexibility in the types of uses that can occur on industrial-zoned properties. Potential changes to local zoning are discussed in the next section of this Memorandum.

Pipeline Projects and Related Buildable Land Capacity Update

As noted in the Introduction, this Memorandum includes findings regarding the City's current ability to provide sufficient land capacity suitable for development per *WAC 365196-325 and RCW 36.70A 115.*

The associated land capacity analysis and documentation aim to depict the relationship between land capacity and targeted housing and job creation within the City and the Stanwood Urban Growth Area (UGA).

The method used to accomplish the land capacity analysis is described in **Appendix D** and included the following steps:

1. **Review and document most recent adopted land capacity findings** that are contained in the *Snohomish County* Ordinance No. 22-003 adopted February 23, 2022, and the *Snohomish County Buildable Land Report 2021*. Please refer to **Appendix B** for maps depicting the BLR findings for housing and employment land capacity within the Stanwood UGA as of February 2022.

   As shown in **Exhibit 7**, those documents indicated that based on current zoning and an assessment of gross buildable land area within the City of Stanwood (current municipal boundary), there was a projected capacity surplus of population by year 2044 of 701 persons. In other words, the City had the zoned land use capacity to increase its population from 7,705

in 2020 to 11,664 residents by 2044; thereby exceeding the 2044 target population forecast of 10,963.

The February 23, 2022 adopted Buildable Lands Report (BLR) also indicated that the City of Stanwood is expected to have a zoned-land use capacity shortfall of 251 jobs. However, the adjacent unincorporated area within the Stanwood UGA was found to have a capacity surplus of 756 jobs. **While the combined City/UGA area was found to have a capacity surplus of 505 jobs, this Memorandum identifies land use policy alternatives designed to fully address any employment capacity shortfall within the current City municipal boundary.**

Exhibit 7: City of Stanwood and Stanwood UGA Capacity Fundings as of February 2022

Population	2020 Actual	Capacity per 2021 Buildable Land Report*	2044 Target**	2035-2044 Capacity Surplus/ (Shortfall)	AGR
City of Stanwood	7,705	11,664	10,963	701	1.5%
Stanwood, Unincorp.	142	870	432	438	4.7%
Total	7,847	12,534	11,395	1,139	1.6%
Jobs	**2019 Actual**	**Capacity per 2021 Buildable Land Report***	**2044 Target****	**2035-2044 Capacity Surplus/ (Shortfall)**	**AGR**
City of Stanwood	3,865	4,822	5,073	(251)	1.1%
Stanwood, Unincorp.	192	1,482	726	756	5.5%
Total	4,057	6,304	5,799	505	1.4%

Source notes:
** capacity estimates based on Final 2021 Buildable Land Report.*
*** 2044 targets are from Snohomish County Ord. No. 22-003, adopted growth forecast, Feb. 23, 2022.*
AGR = average annual growth rate.

2. **Review and assess current land use projects in the predevelopment pipeline** to reconcile the findings noted above in **Exhibit 7** with current expected land capacity assumptions within the City. The intent is to identify how new development has impacted the anticipated employment and housing growth, projected by the BLR. The methodology and results of this process are described in **Appendix D**.

   The analysis of pipeline developments is summarized in **Exhibits 8A and 8B** and illustrated in the map provided in **Exhibit 9**. The findings indicate that the current projects in the development pipeline are expected to *overachieve* their housing capacity forecast by 165 dwelling units. In other words, the parcels identified in the BLR for housing growth are currently planned to be developed at a higher density than was assumed by the February 2022 BLR. Conversely, this pipeline project analysis indicates that the pipeline projects are expected to *underachieve* their employment capacity by 22 jobs.

   The current development pipeline in the Downtown area (see prior **Exhibit 8A**) includes seven significant private developments that will add housing, office/warehousing and mini-storage developments. These projects are expected to create 106 townhomes and nearly

106,000 SF of improved non-residential building floor area that would likely support 77 jobs on site.

Outside of the Downtown area, there are 14 projects in the planning pipeline (**see prior Exhibit 8B**), three of which include an employment component. These three developments combined are expected to support a total of 100 jobs on site.

Exhibit 8A: Downtown Stanwood Pipeline Projects

Map #	Project Name	Use	Description	Status	Housing Units Expected	Approx. Net rentable SF Expected	Approx. Jobs
1	Viking Village	Townhomes	90-unit townhome	pre-application	90	-	-
3	McDay Holdings	Industrial	potential mini storage	pre-application	-	69,600	5.0
4	Liberty Properties	Townhomes	6-unit townhome	pending construction	6	-	-
5	Wolfkill	Industrial	office and warehousing	pending construction	-	21,968	30.2
13	Inland Steel	Industrial	office and warehousing	in land use review	-	14,401	41.4
14	Brunner	Townhomes	3 or 4 unit townhome	pre-application	3	-	-
15	Sequim Land	Townhomes	7-unit townhome	in land use review	7	-	-
					106	**105,969**	**76.6**

Source: City of Stanwood and project consultant team employment estimates.

Exhibit 8B: Other Pipeline Projects Outside Downtown Stanwood

Map #	Project Name	Use	Description	Status	Housing Units Expected	Approx. Net rentable SF Expected	Approx. Jobs
2	Creekside/Vine St	Mixed Use	400+ unit mixed use/multi family	pre-application	400	26,800	67
4	Liberty Properties	Townhomes	6-unit townhome	pending construction	6	-	-
6	Chandler's Reserve	Subdivision	91-lot subdivision	pending final plat	91	-	-
7	Kottsick	Subdivision	127-lot subdivision	pending annexation	127	-	-
8	Affordable Pet Care	Commercial	vet clinic	pending construction	0	5,771	17
9	Grandview Lot 2	Mixed Use	36-unit mixed use multi family	pending construction	36	6,612	17
10	Grandview Lot 16	Multi-Family	34-unit multi family	pending construction	34	-	-
11	Bakerview	Subdivision	114-unit subdivision	pending preliminary pl	114	-	-
12	Summerset Division II	Subdivision	22-lot subdivision	pending preliminary pl	22	-	-
16	Schonberg	Subdisivion	TN zoned subdivision	pre-application	163	-	-
17	Buddy Shelters	Townhomes	4-unit townhome	pending construction	4	-	-
18	Hammond	Shortplat	6-unit shortplat	pending final plat	6	-	-
19	Brandt	Shortplat	4-unit shortplat	pending final plat	4	-	-
20	Faulkner	Subdivision	17-lot subdivision	pre-application	17	-	-
					1,024	**39,183**	**100**

Source: City of Stanwood and project consultant team employment estimates.

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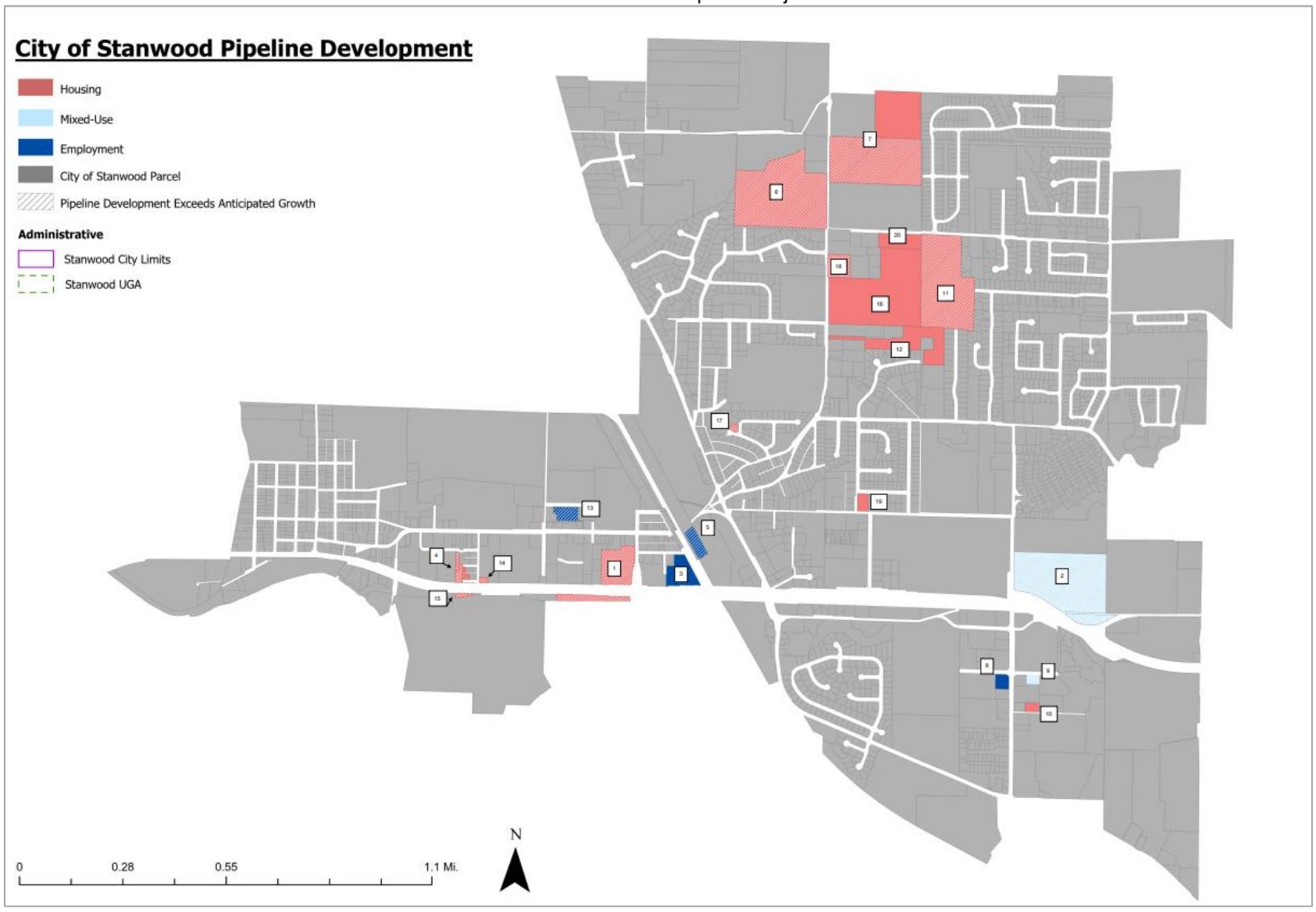
Exhibit 9: Location of Pipeline Projects



3. **Update employment capacity assumptions** within the current Stanwood municipal boundary. The combination of capacity findings from the prior BLR and the current analysis of pipeline projects indicates that the City is likely to have a capacity surplus for meeting its 2044 targets for population and housing, but a shortfall in job capacity based on current zoning. As indicated in **Exhibit 10**, the combination of the projected shortfall in employment growth determined by the BLR (251 jobs) along with the employment shortfall created from the current pipeline projects (22 jobs) indicates that **there would likely be an overall 2033 employment capacity shortfall of 273 jobs based on current zoning and development assumptions**.

Exhibit 10: City of Stanwood 2044 Employment Capacity as of August 2022 (jobs)*

Citywide Employment Capacity Shortfall (Feb. 2022 BLR findings)**	(251)
Pipeline Project Impact (as of Aug. 2022)***	(22)
Proj. 2044 Job Capacity Shortfall	(273)

** Reflects land capacity inside existing city limits based on current zoning. See prior exhibits.*

*** Snohomish County Ord. No. 22-003, adopted growth forecast, Feb. 23, 2022.*

**** Derived from analysis in Appendix D.*

Maps depicting remaining employment and housing capacity are provided in **Exhibits 11 and 12.**

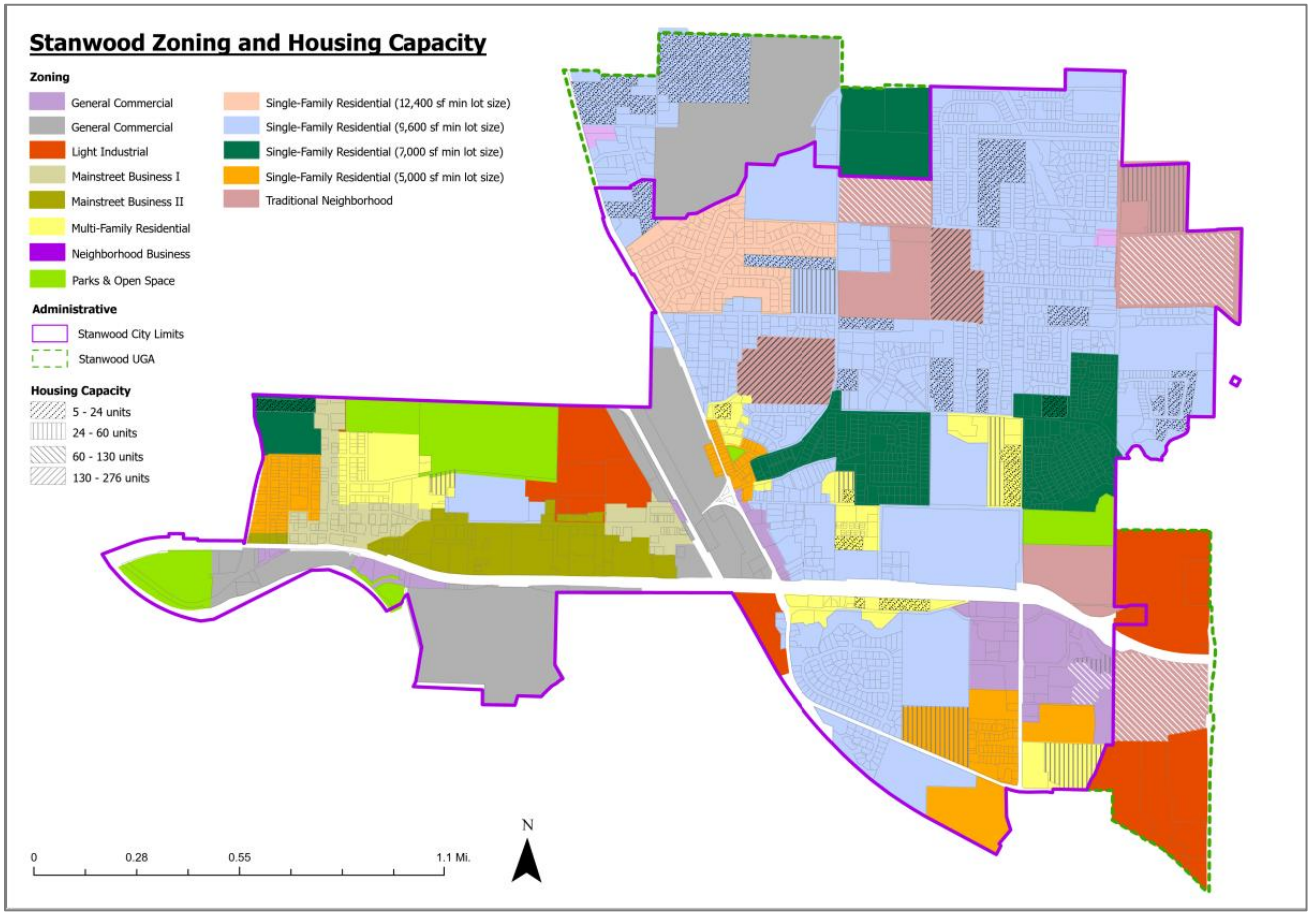
4. **Identify new land use and zoning alternatives for providing sufficient land capacity that's suitable for development**. As part of this step the consultant team (from FCS, LDC and Blueline) worked with City staff to prepare and evaluate three land use alternatives designed to enhance growth potential within City limits by at least another 273 jobs.

   This analysis also takes into account the direction obtained from local planning initiatives within the City as well as the vision set forth in the *Puget Sound Regional Council Policy VISION 2050*, which includes King, Pierce, Snohomish and Kitsap counties, and more than 80 cities and towns, state agencies, transit agencies, ports, and Tribal governments.

   VISION 2050 charts the course for the region's growth over the next 30 years. The plan seeks to enhance communities and equity for the region's residents, support a strong economy, expand housing choices, clean up Puget Sound, and provide a comprehensive regional transportation system. VISION 2050 supports continued growth in urban areas and preservation of rural areas and open space. The plan focuses a significant share of job and population growth near transit.

   Land Use alternatives that would help comply with state and regional requirements are identified and evaluated in the following sections.

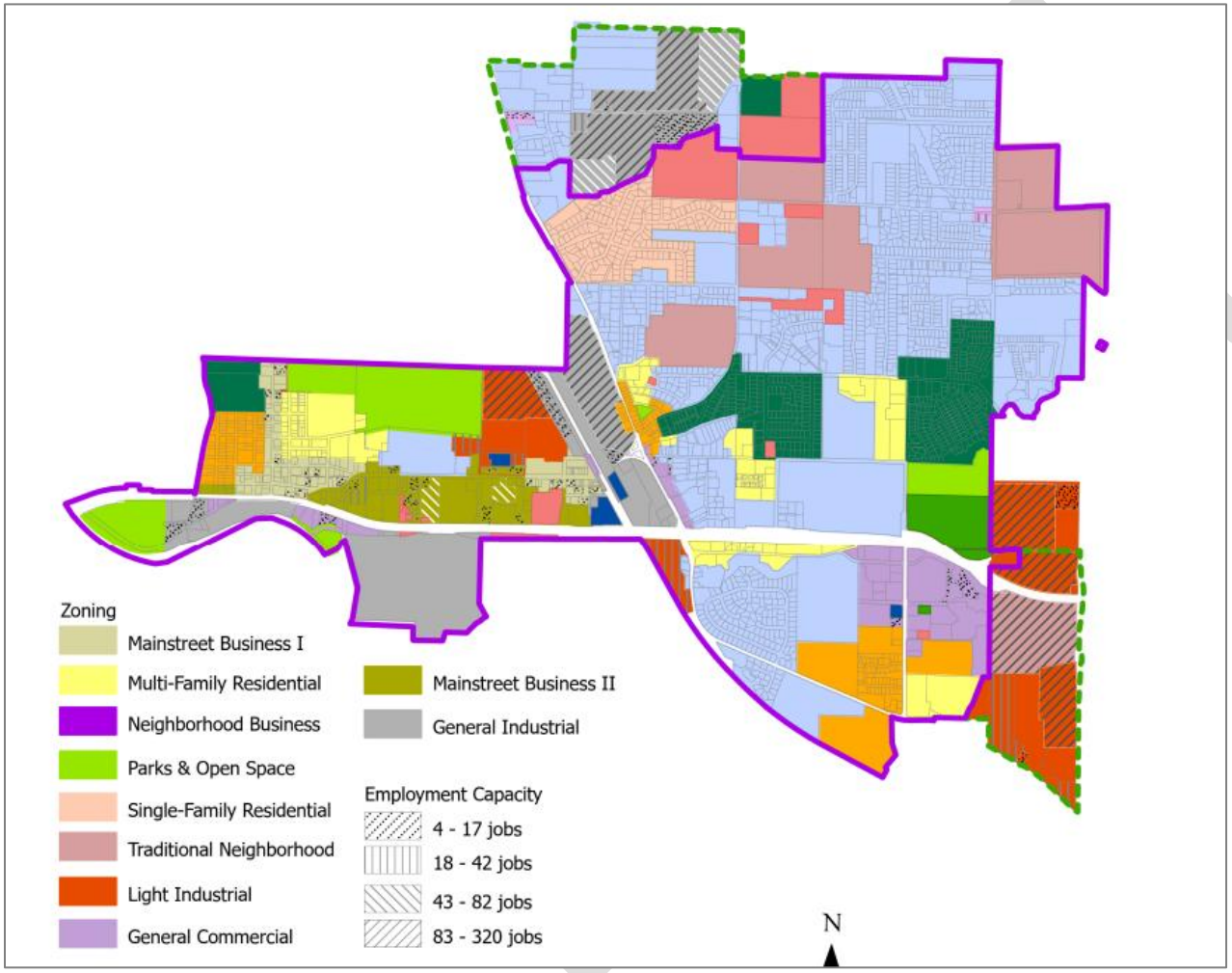
Exhibit 11: Housing Capacity



Based on current zoning and recent development activity, Stanwood is on track to exceed its 2044 capacity targets for population and housing.

The Twin City Mile Vision focuses on ped friendly connections between two key areas: Downtown and the East End with well-designed housing and mixed-use centers.

Exhibit 12: Employment Capacity



Based on findings by Snohomish County and the consultant team, under current zoning Stanwood is not likely to meet its 2044 capacity targets for employment. Most of the new job growth is expected to occur in the services & commercial retail/office sectors.

The Stanwood Comprehensive Plan, Downtown Master Plan, Economic Development Action Plan and Twin City Mile Project support revitalization of underutilized buildings/sites, preservation of legacy structures, and public investment and design incentives that result in community-generated spending and related business growth.

IV. LAND USE ALTERNATIVES ANALYSIS

The land use alternatives identified below are intended to enable the City of Stanwood to provide sufficient land capacity for new development over the next 20+ years (by year 2044). The recommended growth targets for Stanwood provide a context for complying with the PSRC VISION 2050 and the Snohomish County Tomorrow Regional Growth Strategy. The growth targets indicate the amount of growth each jurisdiction is expected to plan for in its comprehensive plan. The process for complying with these growth targets provides flexibility for jurisdictions in interpreting the regional growth strategies and must consider local input on the community vision, market conditions, and infrastructure investments.

As described in the prior section, based on current zoning and buildable lands analysis by Snohomish County and the consultant team, the City is likely to exceed its housing/population forecasts but fall short of the its employment forecasts. Hence, this section focuses on strategies designed to foster opportunities for business investment and related job creation. While there is potential to annex some of the unincorporated areas located within the Stanwood UGA, that approach is not being evaluated as a means to satisfy the expected employment growth target shortfall within the City.

While the number of home-based workers is not reflected in the long range employment targets, it is apparent that the number of people working from home (full or part time) is increasing. In the aftermath of the Covid-19 global pandemic we have observed an increase in the home-based workers with the advent of "Zoom Towns" that have a combination of reliable fast internet, attainable housing prices/rents, recreational amenities, good schools/parks and "small town feel." During the peak of the pandemic, the Seattle Metro Region emerged as one of the top four locations in the USA for telecommuting. As the northern gateway to the Region, the City of Stanwood can establish itself as a "Zoom Town" community with a mix of home based and local-serving businesses, supply chain providers to larger regional operations, and more attainably priced housing options.

The draft vision and goals of the Stanwood Economic Strategy, Twin City Mile Project and other local planning initiatives focus on community revitalization and planned multimodal facilities and park improvements will strengthen the attractiveness of Stanwood as a location for new families, retirees, commuters, and businesses.

Alt. 1 Combine LI and GI Zones into a Planned Industrial (PI) Zone

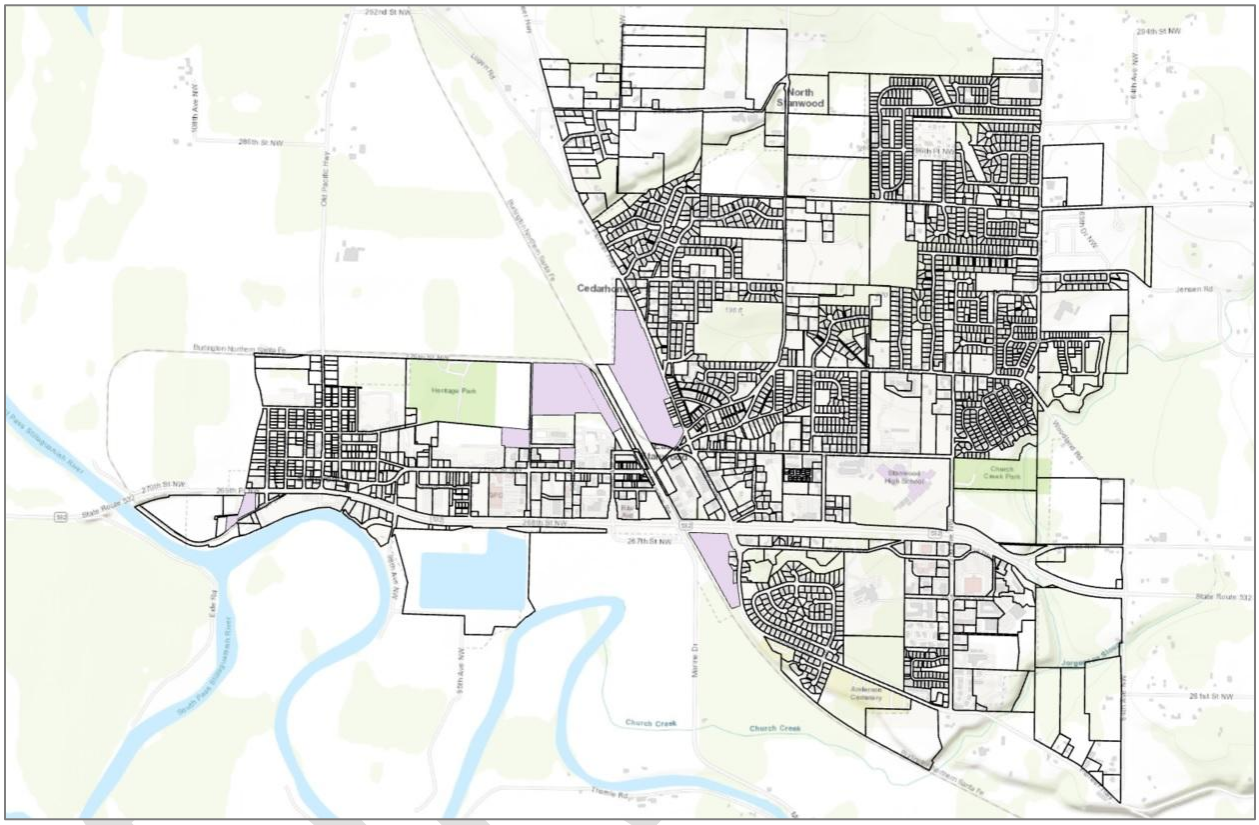
As noted in the prior sections, the amount of industrial job activity in the City has been flat or declining over the past several years. This land use alternative is intended to protect existing industrial operations while encouraging redevelopment of underutilized industrial buildings/sites. The PI zone would replace the LI and GI zones in most locations with a single PI (Planned Industrial Zone) category that permits most industrial activities to occur as well as commercial (retail and office) uses. The PI zone would remove the current 2,000 SF maximum for ancillary retail and allow industrial operations to include retail/wholesale showrooms and uses such as commercial kitchens, brewpubs, meetings/event space, offices, and entertainment/recreation.

An analysis was conducted of selected remaining GI and LI tax lots in the City that have a projected baseline job capacity of 10 or more net new jobs (see **Exhibit 13**). The capacity analysis excluded the pipeline projects (discussed in prior section) and identified nine (9) areas with a total of 41 acres

of gross buildable land area. The BLR assumes that these parcels/sites will increase in job capacity from 38 currently to 573 over the next 20 years.

With a change to PI, the capacity analysis assumes that the potential job density will increase with an average mix of employment going from nearly 100% industrial (manufacturing, distribution, wholesale trade, construction, utilities) to a new job mix of 80% industrial and 20% service/retail jobs.

Exhibit 13: Major GI and LI Tax Lots with Remaining Employment Capacity



The capacity analysis indicates that the overall amount of job capacity increase supported by a new user within the Town City Foods site and changes in LI/GI to PI would result in an increase in the overall employment capacity by 513 jobs. As shown in **Exhibit 14** the net new job capacity would primarily result from a new user within the Twin City Foods site (+150 jobs), a change in the LI zones to PI (+277 jobs), followed by a change in selected GI zones to PI (+86 jobs).

These estimates exclude the jobs expected within the identified pipeline projects on GI/LI zones, which are expected to support 76 jobs (see **Appendix D** for pipeline project assumptions).

Exhibit 14: Employment Capacity Analysis with PI Zone (Alt. 1)

Employment Capacity Analysis: LI to PI Zone Change

	Jobs per GBA	Assumed Job Mix with PI	Assumed Job Density per GBA	Existing Jobs	Potential Jobs	Net New Job Capacity	Increase from BLR
Warehousing/Storage	2.6	0.0%				0	
Makers	22	60.0%				0	
Service/Office	54	20.0%				0	
Retail	60	20.0%				0	
Total		100.0%	**36.0**	**24**	**630**	**606**	**277**

Employment Capacity Analysis: GI to PI Zone Change (excl. Twin City Foods Site)

	Jobs per GBA	Assumed Job Mix with PI	Assumed Job Density per GBA	Existing Jobs	Potential Jobs	Net New Job Capacity with PI	Increase from BLR
Warehousing/Storage	2.6	0.0%				0	
Makers	3	60.0%				0	
Service/Office	22	20.0%				0	
Retail	54	20.0%				0	
Total		100.0%	**16.8**	**4**	**334**	**330**	**86**

Alternative 1 Summary

Land Use Alternative	Jobs Added	Dwellings Added	Net Change in Job Capacity from BLR	Net Change in Dwelling Capacity from BLR
Alt. 1A: Twin City Foods Site (new user)	150		150	
Alt. 1B: LI to PI	278		277	
Alt. 1C: GI to PI (in designated areas)	86		86	
Subtotal	**514**	**0**	**513**	**0**

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

Alt. 2 New Downtown Mixed-Use Zone

Downtown Stanwood is the heart and soul of the community with roots that go back to the earliest days of settlement by Native American tribes and pioneers. The City is aiming to revitalize its downtown through visual and physical improvements to storefront buildings with stronger pedestrian linkages to surrounding neighborhoods. The Twin City Mile Project focuses on creating well-designed storefronts and pedestrian facilities.

An evaluation was conducted by the project consultant team of all remaining tax lots in the Downtown Area that have a BLR land use designation of either "vacant, part-vacant or redevelopable" to ascertain their existing and projected employment capacity.

Currently, there are approximately 59 tax lots with underutilized buildings and redevelopment potential within the Downtown area with a mix of MB1, MB2, and MR zone designations **(Exhibits 15 and 16).** According to the Snohomish County BLR, the remaining buildable lands in the Downtown areas (excluding the pipeline projects identified in the prior section) have the capacity to

accommodate another 37 households and 324 jobs. However, recent Downtown development activity in the pipeline is likely to displace businesses with new townhome construction and not result in any net new job growth.

A new Downtown Mixed Use Zone designation can be created to allow and encourage a mix of housing and employment as buildings are rehabilitated and sites are redeveloped. The new zone would retain the historic overlay designation for significant buildings and encourage façade and building revitalization with bonus density allowances allowing some additional building height for mixed-use developments. Potential redevelopment of underutilized sites near the train depot can also provide additional employment and housing capacity in Downtown.

Exhibit 15: Downtown Redevelopment Analysis Area

With the Mixed Use Zone designation and the related development incentives, the Downtown area would accommodate a mix of 2-3 story structures with ground floor commercial, upper-level offices and apartments and live/work buildings in mixed-use developments.

Exhibit 16: Downtown Capacity Under Current Zoning

Zone	Parcel Status	Parcels	Gross Buildable Acres	Existing Employment	Net New Employment Projected	Existing Housing Units	Net New Housing Units Projected
MB1	Partially-Used	8	2.0	10	2	11	0
	Redevelopable	21	4.7	49	91	12	0
	Vacant	3	0.5	0	9	0	0
	Total	**32**	**7.1**	**59**	**102**	**23**	**0**
MB2	Partially-Used	3	1.0	22	0	0	0
	Redevelopable	8	7.6	12	159	13	0
	Vacant	4	2.9	0	64	0	0
	Total	**15**	**11.5**	**34**	**223**	**13**	**0**
MR	Partially-Used	1	0.3	0	0	2	0
	Redevelopable	10	1.4	0	0	13	10
	Vacant	1	1.9	0	0	0	27
	Total	**12**	**3.6**	**0**	**0**	**15**	**37**
Grand Total		**59**	**22.2**	**93**	**324**	**51**	**37**

Source: Snohomish County BLR, 2021 adjusted to exclude pipeline projects.

The overall impact on development capacity attributed to the new Mixed Use zoning is expected to result in a net increase in housing from 53 existing dwellings to 291 dwellings, which is above the BLR assumptions by 254 dwellings.

The new Mixed-Use zone designation is expected to result in an increase of 287 net new jobs in Downtown, which is 37 fewer jobs than what the February 2022 BLR capacity had assumed for the remaining vacant, part vacant and redevelopment tax lots in Downtown (**Exhibit 17**).

Exhibit 17: Downtown Capacity Under Mixed-Use Zoning (Alt. 2)

Downtown Employment and Housing Density Assumptions with Mixed Use Zoning

Downtown Sites	Jobs or Dwellings per GBA	Assumed Mix with MXD	Assumed Job Density per GBA	Existing Jobs	Potential Jobs	Net New Job Capacity	Job Increase or Decrease from BLR	Net New Housing Capacity	Dwelling increase from BLR
Multifamily	**22**	70.0%	**0**					291	**254**
Service/Office	54	15.0%	8.1			97			
Retail	60	15.0%	9.0			108			
Total		100.0%	**17.1**	**93**	**380**	**287**	(37)		

Land Use Alternative	Jobs Added	Dwellings Added	Net Change in Job Capacity from BLR	Net Change in Dwelling Capacity from BLR
Alt. 2: Downtown Mixed Use Zone	287	291	(37)	254

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

Alt. 3 New GC Zone for Neighborhood Center

This alternative would address the current projected employment shortfall through a specific land use action to redesignate approximately 4 acres of buildable land within a TN zone to a GC zone designation within the City. As the City and surrounding areas such as Camano Island add residents, aggregate disposable income will increase. This additional consumer buying power would increase potential sales for existing and future retail and service businesses.

An analysis of retail sales and supportable commercial development was conducted to ascertain the amount of growth necessary to support a small neighborhood center with a small grocery store (such as a Trader Joes or Whole Foods 365), coffee shop, day care center and 1-2 restaurants. The results indicate that if 1,600 households are added to the City and surrounding communities over the next 20-25 years (Stanwood Housing Needs Assessment assumes 1,522 dwellings added to the City by 2044), it would create approximately $136.9 million in net new annual income and support $70.6 million in net new annual in-store retail sales. That level of demand would likely generate demand for approximately 148,600 SF of new development or redevelopment.

If the City could "capture" 60%-100% of this net new retail demand it would require between 3.4 and 6.2 acres of land area for the neighborhood center and support 202 to 372 jobs (**Exhibit 18**). While the market support for a new neighborhood shopping center would not occur for 15+ years, it will likely occur within the 15-20 year time frame based on the pace of housing development underway. Other factors such as transportation access, visibility and walkability are important considerations in the location of any commercial development.

Exhibit 18

Projected Stanwood/Camano Area: Net New In-Store Retail Demand

2022 to 2044 forecast:	
Proj. Net New Households by year 2044	1,600
Median Income (2022 est.)	$85,567
Proj. Net New Aggregated Income by 2044	$136,907,520
Proj. Net New Retail In-Store Retail Sales	$70,607,198

	Proj. Annual Retail Spending per Household	Proj. Additional Retail Demand	Supportable SF (@$475/SF)*	Supportable Jobs**	Land Need (gross buildable acres)**
Gasoline Stations/Automotive	$4,215	$6,744,052	14,198		
Food/Grocery	$6,603	$10,564,239	22,241		
General Merchandise	$28,078	$44,924,156	94,577		
Restaurants & Entertainment	$5,234	$8,374,751	17,631		
Total	$44,129	$70,607,198	148,600	372	6.2
Total, excluding gas stations/automotive	$39,914	$63,863,146	134,449	336	5.6
Projected Stanwood Capture Rate (@60%)			80,669	202	3.4

Source: Stanwood Housing Needs Assessment, 2022; ESRI Business Analyst (income and spending assumptions); excludes auto vehicle sales and non-store purchases (which are assumed to increase from 3% current to 10% of retail sales over time frame).

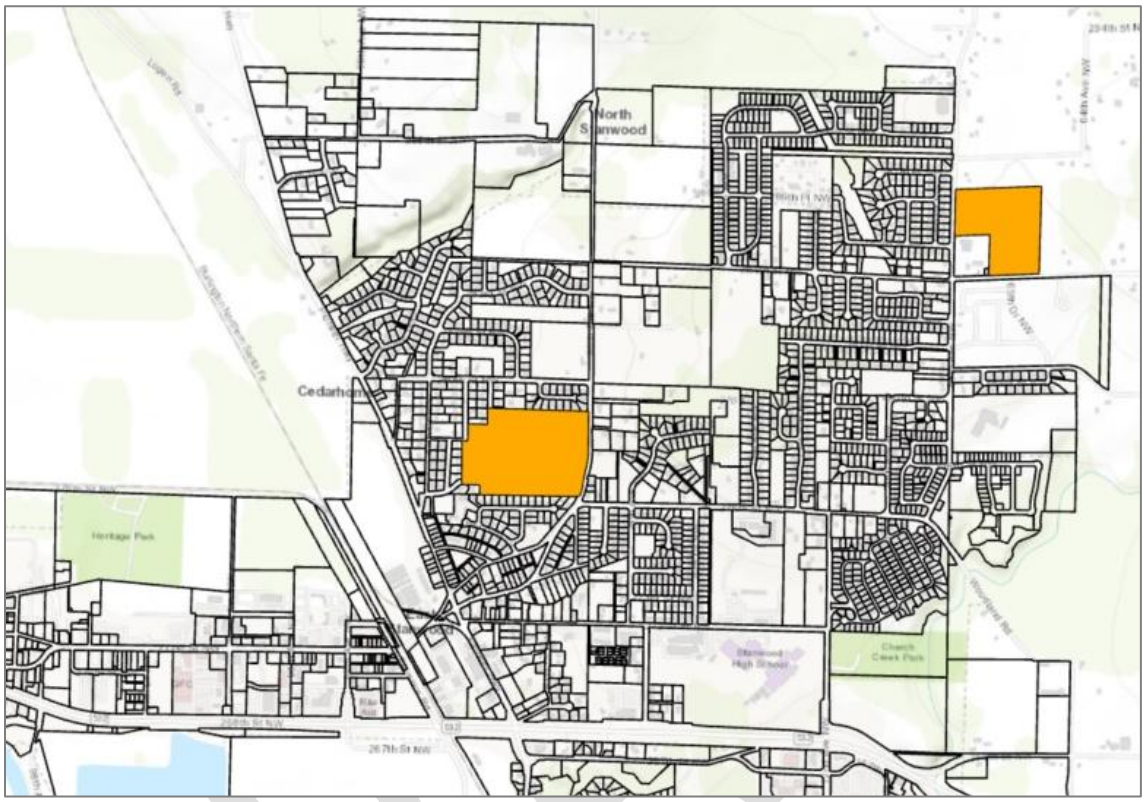
** Estimated gross annual average retail sales per establishment; source: IMPLAN model.*

*** Assumes 400 SF per job and 60 jobs per acre based on capacity analysis assumptions.*

For analysis purposes, the project consultant team identified a central location for the new neighborhood center. The capacity analysis identified two remaining large vacant TN-zoned sites the City that are not currently in the development pipeline. As shown in **Exhibit 19**, these two sites include 32.8 buildable acres with current capacity of 323 dwelling units per BLR assumptions. The

GC designation on 4 acres of land is expected to result in a net decrease in housing capacity by 22 units and a corresponding increase in employment capacity by 202 jobs.

Exhibit 19: Existing Large Vacant TN Parcels



Neighborhood Center Analysis (includes TN zones only)

Site Name	Status	Gross Buildable Acres	Existing Jobs	Proj. Net New Jobs	Proj. Net New Dus
Knudsen Site	Redevelopable	27.8	**0**	**0**	276
Josephine Sunset Homes	Redevelopable	5.0	**0**	**0**	47
Total		32.8	0	0	**323**

Source: Snohomish County BLR, 2021 (excludes pipeline developments).

Employment and Housing Capacity with GC Zone for Neighborhood Center

	Jobs or Dus per GBA	Assumed Mix with MXD	Job Increase from BLR	GBA Coverted from Res to Emp	DU Decrease from BLR	Updated Proj. Net New Dus
Singe-family	6	80.0%		**4.0**	(24)	**299**
Retail	60	20.0%	**202**			
Total		100.0%				

Land Use Alternative	Jobs Added	Dwellings Added	Net Change in Job Capacity from BLR	Net Change in Dwelling Capacity from BLR
Alt. 3: Planned GC site in TD*	202	0	**202**	(22)

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

V. EVALUATION OF THE ALTERNATIVES

The expected impact on future housing and employment capacity that would be attributed to the land use alternatives is shown in **Exhibit 20**. The City may opt to phase-in or combine these alternatives to achieve the recommended growth capacity targets.

Exhibit 20: Summary of Land Use Impacts

Land Use Alternative	Jobs Added	Dwellings Added	Net Change in Job Capacity from BLR	Net Change in Dwelling Capacity from BLR
Alt. 1A: Twin City Foods Site (new user)	150		150	
Alt. 1B: LI to PI	278		277	
Alt. 1C: GI to PI (in designated areas)	86		86	
Subtotal	**515**	**0**	**513**	**0**
Alt. 2: Downtown Mixed Use Zone	**287**	**291**	**(37)**	**254**
Alt. 3: Planned GC site in TD*	**202**	**0**	**202**	(22)
Grand Total	**1,004**	**291**	**678**	**232**

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

The process for selecting one or more of these alternatives will need to consider local input on the community vision, market conditions, and level of infrastructure investments needed and desired. In this regard, the project consultant team evaluated the potential fiscal and economic impacts of these land use alternatives.

A fiscal impact analysis was also conduced of each alternative to help quantify the relative changes in general fund contributions (revenues less expenditures) in comparison to the current long range BLR forecast using the remaining land capacity after the pipeline projects are removed from the buildable land inventory.

The fiscal impact analysis assumed buildout of the planned development capacity and evaluated potential changes to City's general fund after considering potential changes in property tax revenues, retail sales and use tax revenues, affordable housing sales and use tax revenues, and state pass through tax revenues (incudes gas tax, multimodal distributions, liquor profits/excise taxes, criminal justice programs, etc.).

Assumptions were also made regarding the net impact on the general fund that is generated by households (dwellings) vs. employment (**see Appendix E**).

Next, the project consultant team identified various evaluation criteria to help compare the relative impacts of the land use alternatives.

These criteria included :

- Jobs Added
- Housing Added
- Net Annual Fiscal Impact on General Fund
- Near-term Market Acceptance
- Citizen Support (based on feedback received so far)
- Housing Cost Impacts (production of a variety of housing)

The overall results depicted in **Exhibit 21 and Appendix E** indicate that there would likely be a significant increase in overall Real Market Value of real estate investment within the City for each of three land use alternatives. Positive impacts on the City's general fund are also expected with annual revenues expected to exceed expenditures in all of the scenarios evaluated.

Exhibit 21: Summary of Land Use and Fiscal Impacts

	Change over Existing Conditions*			
Land Use Alternative	Jobs Added	Dwellings Added	Annual Net Local Fiscal Impact on Gen. Fund*	Potential Net Increase in RMV
Alt 1: LI and GI to PI	514	**0**	$ 746,554	$ 69,904,000
Alt. 2: Downtown Mixed Use Zone	287	291	$ 999,504	$ 96,505,000
Alt. 3: Planned GC site in TD	202	299	$ 1,312,877	$ 20,580,000
Grand Total	**1,003**	**590**	**$ 3,058,934**	**$ 186,989,000**

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

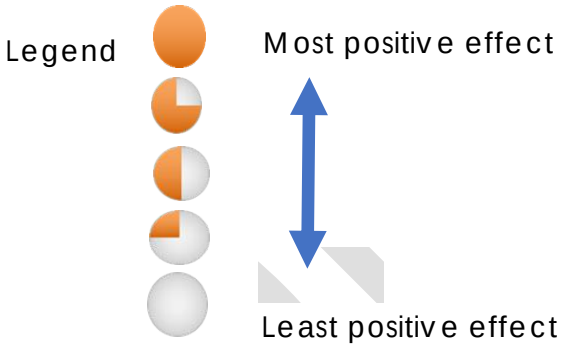
	Net Change compared with BLR Findings			
Land Use Alternative	Net Change in Job Capacity from BLR	Net Change in Dwelling Capacity from BLR	Annual Net Local Fiscal Impact on Gen. Fund*	Potential Net Increase in RMV
Alt. 1A: Twin City Foods Site (new user)	150		$ 30,375	$ 22,500,000
Alt. 1B: LI to PI	277		$ 402,326	$ 37,672,000
Alt. 1C: GI to PI (in designated areas)	86		$ 124,910	$ 11,696,000
Subtotal	**513**	**0**	**$ 557,611**	**$ 71,868,000**
Alt. 2: Downtown Mixed Use Zone	**(37)**	**254**	**$ (78,557)**	**$ 59,245,000**
Alt. 3: Planned GC site in TD*	**202**	(22)	**$ 1,312,877**	**$ 20,580,000**
Grand Total	**678**	**232**	**$ 1,791,930**	**$ 151,693,000**

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

The overall evaluation of the alternatives included assigning a value ranging from least positive to highest positive impact for each criterion. The results shown in **Exhibit 22** indicate that Alternatives 1 and 2 would yield the highest overall score relative to Alternative 3.

Exhibit 22: Evaluation of Land Use Alternatives

	Evaluation Criteria						
	Jobs Added	Housing Added	Net Fiscal Impact	Near Term Market Acceptance	Citizen Support	Housing Cost Impact	Total Relative SCORE
Alt. 1							
Alt. 2							
Alt. 3							



VI. OTHER CONSIDERATIONS AND NEXT STEPS

These draft findings and associated official Zone Map amendments (**Exhibit F**) will be discussed and may be refined based on input received during meetings with City staff, community stakeholders, and public officials (Planning Commission members and City Council members).

As the City considers changes to the official Zoning Map this is also an appropriate time to consider amendments to land use designations within areas outside the current city limits but inside the Stanwood UGA. Current land use zones and Comprehensive Plan designations should be updated to enhance consistency between City and County plan designations, particularly within the "eastern gateway" in locations likely to be considered for annexation. Recommended Zoning Map amendments would entail redesignating areas within the eastern gateway of the UGA in proximity to SR 532 from LI to TN to encourage a mix of housing and employment development in that location.

APPENDIX A: WAC 365-196-325

WAC 365-196-325

Providing sufficient land capacity suitable for development.

(1) Requirements.

(a) RCW **36.70A.115** requires counties and cities to ensure that, taken collectively, comprehensive plans and development regulations provide sufficient capacity of land suitable for development within their jurisdictions to accommodate their allocated housing and employment growth, including the accommodation of, as appropriate, the medical, governmental, educational, institutional, commercial, and industrial facilities related to such growth, as adopted in the applicable county-wide planning policies and consistent with the twenty-year population forecast from the office of financial management. To demonstrate this requirement is met, counties and cities must conduct an evaluation of land capacity sufficiency that is commonly referred to as a "land capacity analysis."

(b) Counties and cities must complete a land capacity analysis that demonstrates sufficient land for development or redevelopment to meet their adopted growth allocation targets during the review of urban growth areas required by RCW **36.70A.130** (3)(a). See WAC **365-196-310** for guidance in estimating and providing sufficient land capacity.

(c) Counties and cities subject to RCW **36.70A.215** must determine land capacity sufficiency as part of the buildable lands reporting required no later than one year prior to the deadline for periodic review of comprehensive plans and development regulations required by RCW **36.70A.130**, and adopt and implement measures that are reasonably likely to increase the consistency between land capacity and growth allocations. See WAC **365-196-315** for guidance.

(d) A complete land capacity analysis is not required to be undertaken for every amendment to a comprehensive plan or development regulation outside of the act's required periodic reviews. However, when considering amendments to the comprehensive plan or development regulations which increase or decrease allowed densities, counties and cities should estimate the degree of increase or decrease in development capacity on lands subject to the amendments, and estimate if the capacity change may affect its ability to provide sufficient capacity of land suitable for development. If so, the county or city should complete a land capacity analysis.

(2) Recommendations for meeting requirement.

(a) Determining land capacity sufficiency. The land capacity analysis is a comparison between the collective effects of all development regulations operating on development and the assumed densities established in the land use element. In order to achieve sufficiency, the development regulations must allow at least the low end of the range of assumed densities established in the land use element. This assures a city or county can meet its obligation to accommodate the growth allocated through the county-wide population allocation process.

(b) Appropriate area for analysis. The focus of the analysis is on the county or city's ability to meet its obligation to accommodate the growth allocated through the county-wide population or employment allocation process. Providing sufficient land capacity for development does not require a county or city to achieve or evaluate sufficiency for every parcel of a future land use designation provided the area as a whole ensures sufficient land capacity for development.

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(c) The land capacity analysis should evaluate what the development regulations allow, rather than what development has actually occurred. Many factors beyond the control of counties and cities will control the amount and pace of actual development, what density it is built at and what types and densities of development are financially viable for any set of economic conditions. Counties and cities need not ensure that particular types of development are financially feasible in the context of short term market conditions. Counties and cities should, however, consider available information on trends in local markets to inform its evaluation of sufficient land capacity for the twenty-year planning period.

(d) Development phasing. RCW **36.70A.115** does not create an obligation to ensure that all land in the urban growth area is available for development at the same time. When counties or cities establish mechanisms for development phasing, zoned densities in the short term may be established that are substantially lower than called for in the future land use designations. In these cases, a county or city ensures a sufficient land capacity suitable for development by implementing its development phasing policies to allow development to occur within the twenty-year planning period. Development phasing is described in greater detail in WAC **365-196-330**.

(e) The department recommends the following means of implementing the requirements of RCW **36.70A.115**.

(i) Periodic evaluation. Counties and cities ensure sufficient land capacity for development by comparing the achieved density of development that has been permitted in each zoning category to the assumed densities established in the land use element using existing permitting data. If existing permitting data shows that the densities approved are lower than assumed densities established in the land use element, counties and cities should review their development regulations to determine if regulatory barriers are preventing development at the densities as envisioned. This evaluation must occur as part of the urban growth area review required in RCW **36.70A.130** (3)(a) and as part of the buildable lands review and evaluation program conducted under RCW **36.70A.215**.

(ii) Flexible development standards. Counties and cities could ensure sufficient land capacity for development by establishing development regulations to allow development proposals that transfer development capacity from unbuildable portions of a development parcel to other portions of the development parcel so the underlying zoned density is still allowed. This may provide for flexibility in some dimensional standards provided development is consistent with state law and all impacts are mitigated.

(iii) Evaluation of development capacity impacts of proposed development regulation amendments. Counties and cities may also consider evaluation of whether proposed amendments to development regulations will have a significant impact on the ability of a county or city to provide sufficient capacity of land for development.

[Statutory Authority: RCW **36.70A.050** and **36.70A.190**. WSR 15-04-039, § 365-196-325, filed 1/27/15, effective 2/27/15; WSR 10-22-103, § 365-196-325, filed 11/2/10, effective 12/3/10; WSR 10-03-085, § 365-196-325, filed 1/19/10, effective 2/19/10.]

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APPENDIX B: SNOHOMISH COUNTY BLR MAPS FOR STANWOOD

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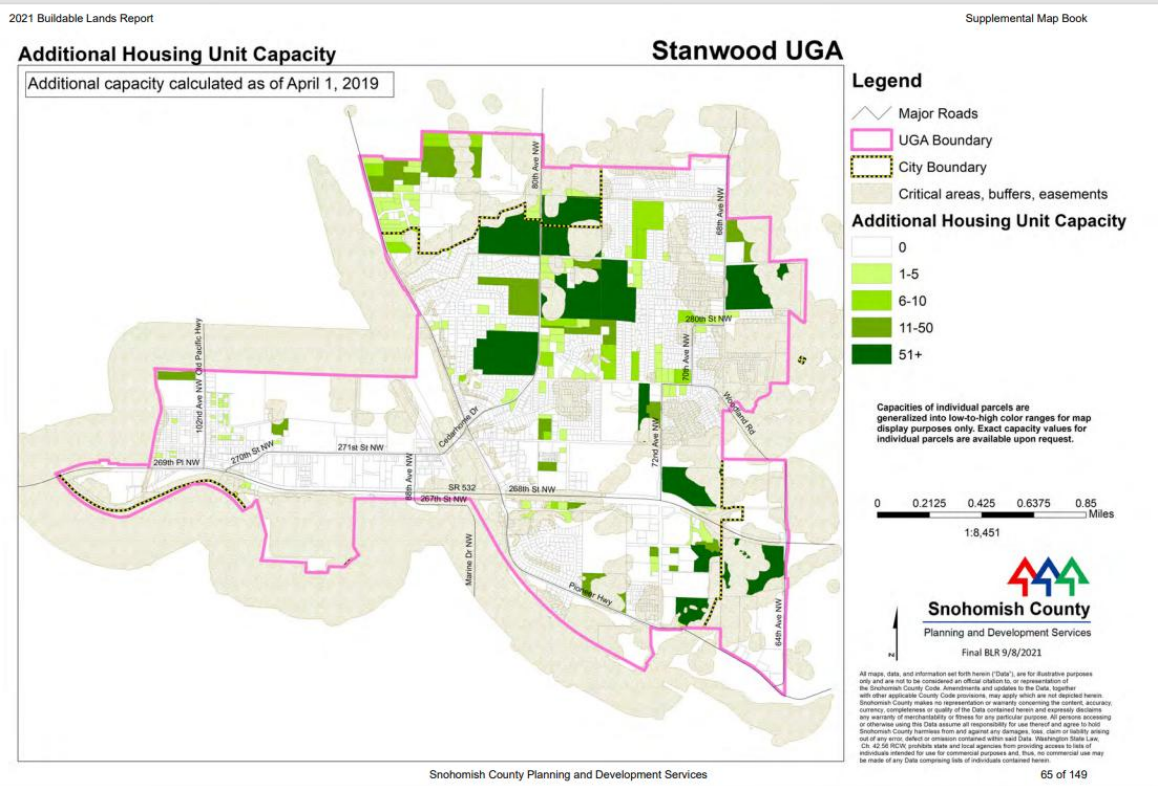
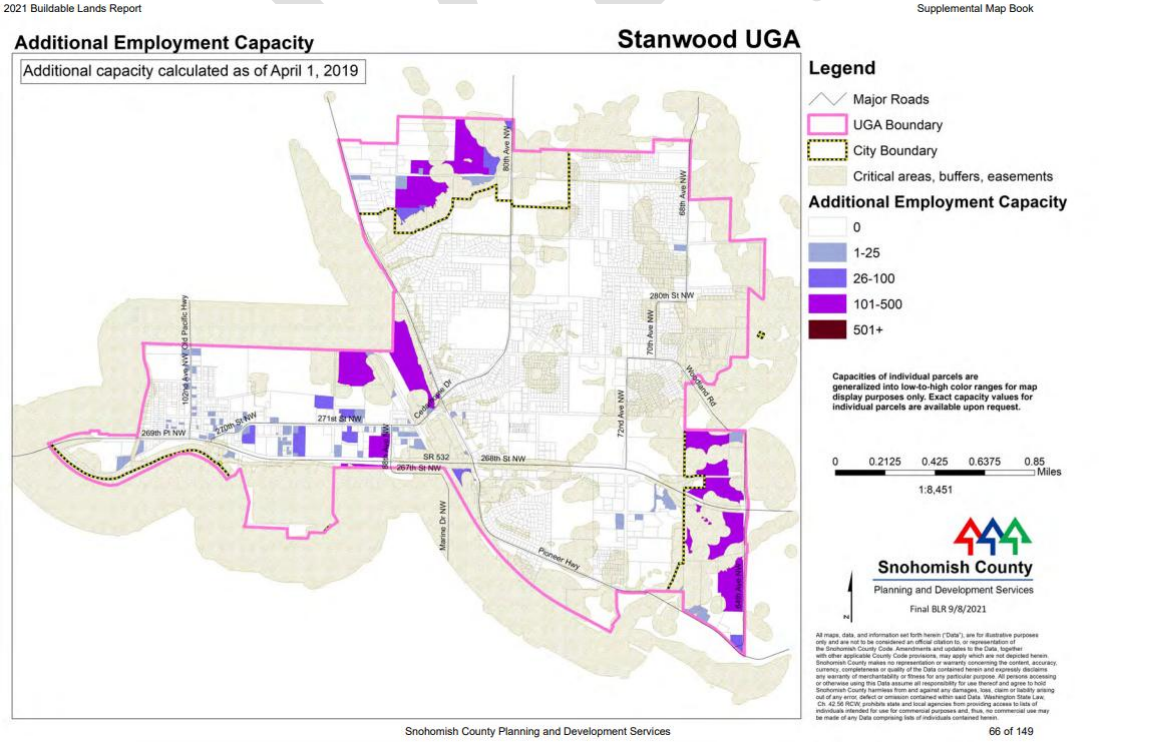
Snohomish County Buildable Lands Report, 2021

Stanwood Maps





APPENDIX C: COMMUNITY PROFILE

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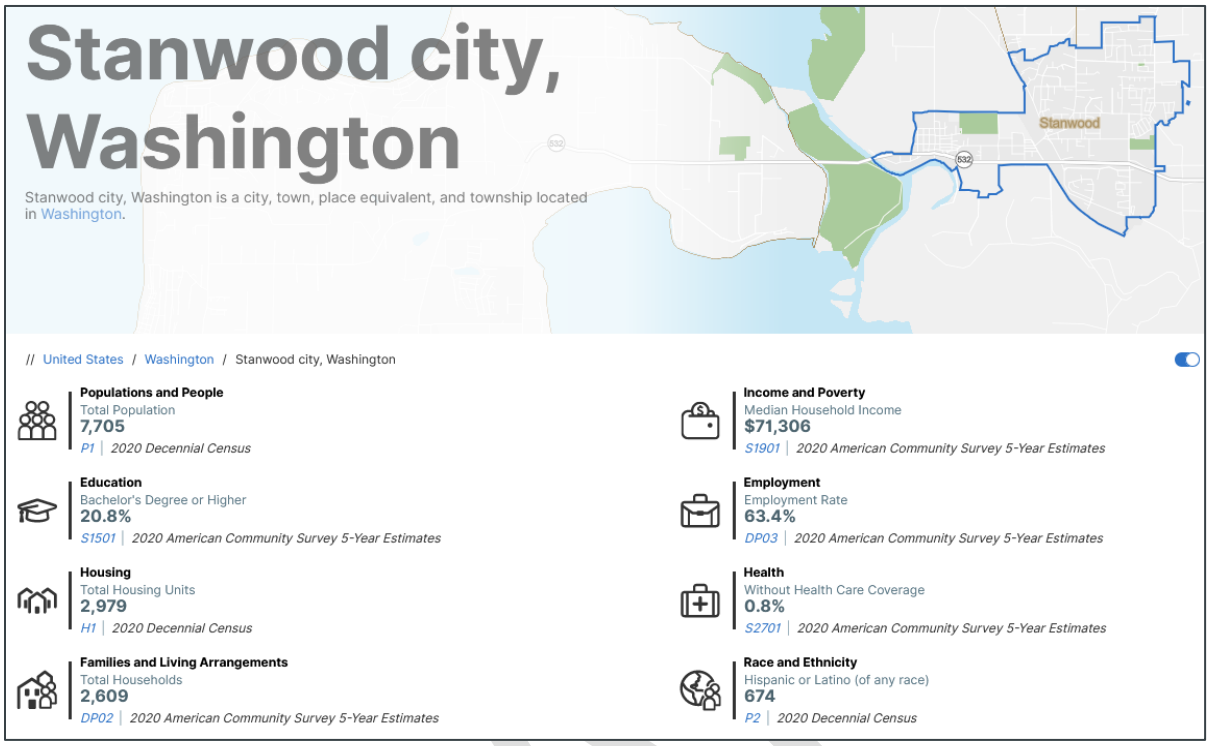
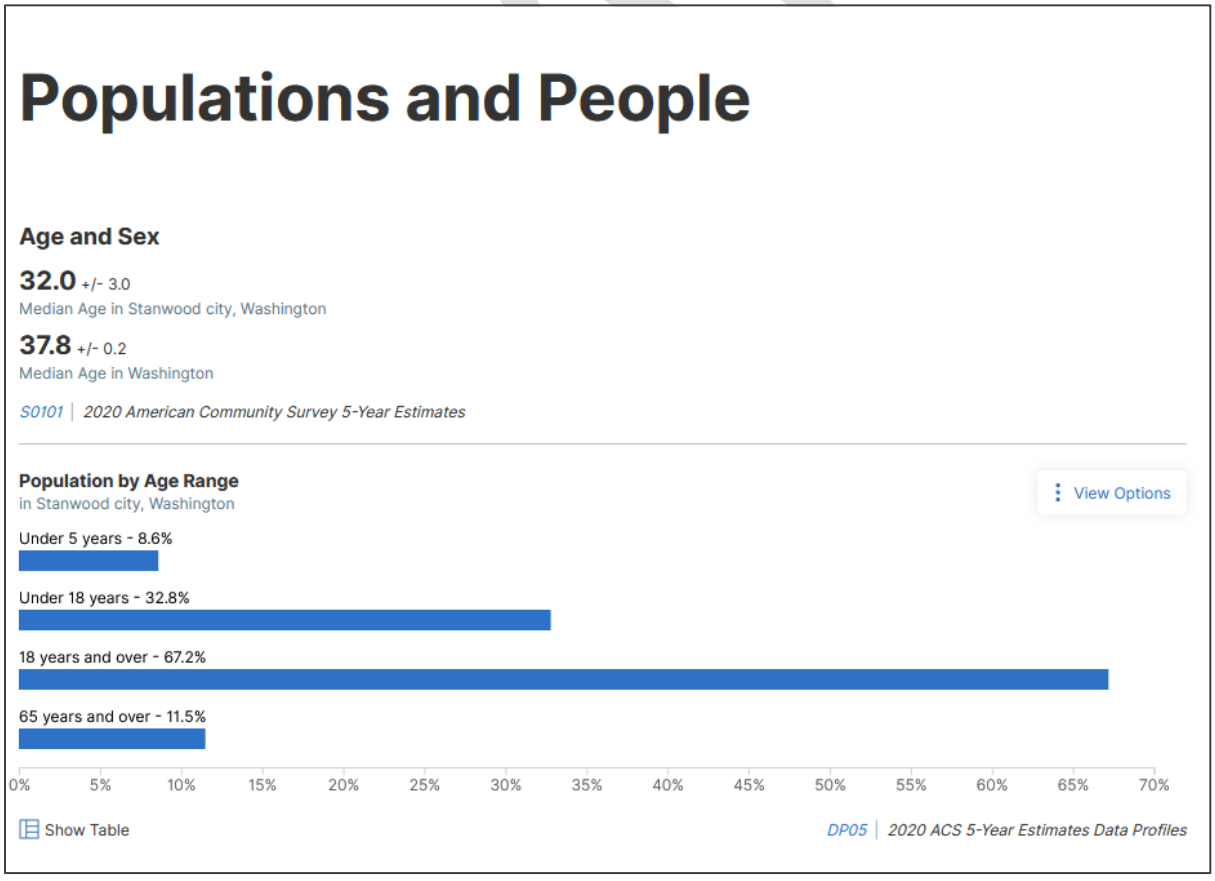
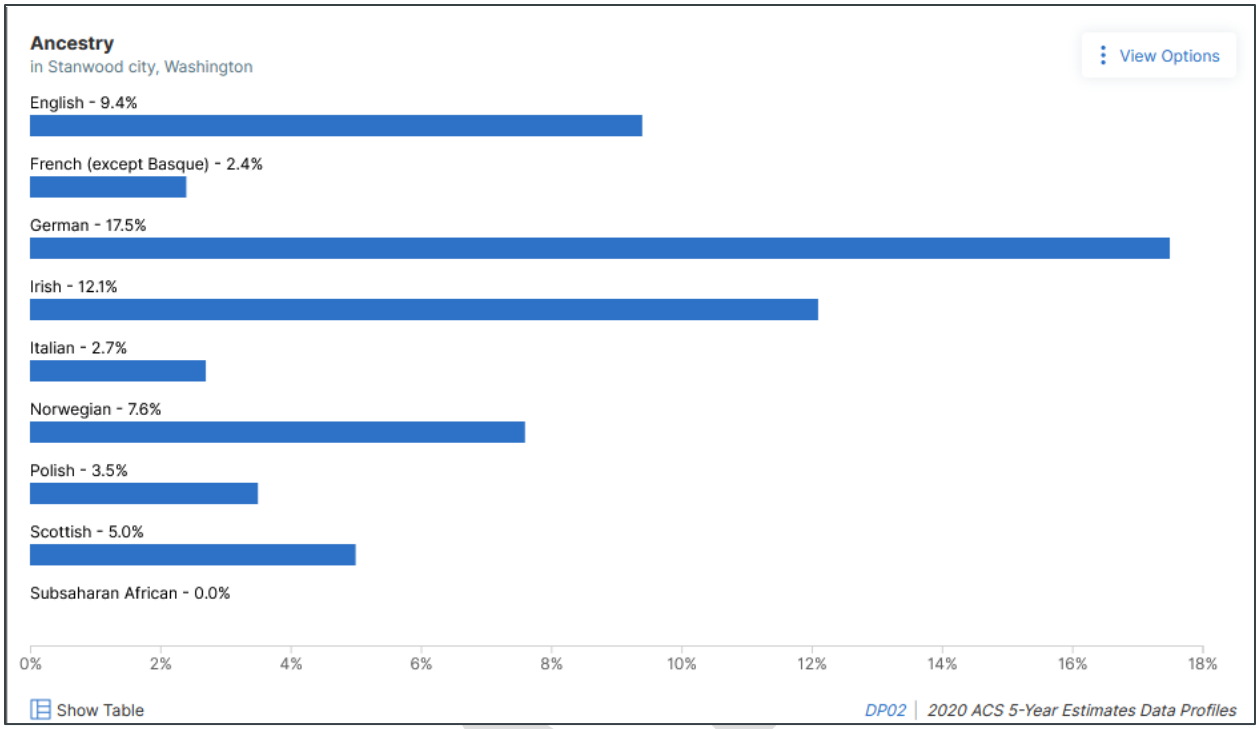

Stanwood city, Washington
Stanwood city, Washington is a city, town, place equivalent, and township located in Washington.
Stanwood
532
// United States / Washington / Stanwood city, Washington
Populations and People
Total Population
7,705
P1 | 2020 Decennial Census
Income and Poverty
Median Household Income
$71,306
S1901 | 2020 American Community Survey 5-Year Estimates
Education
Bachelor's Degree or Higher
20.8%
S1501 | 2020 American Community Survey 5-Year Estimates
Employment
Employment Rate
63.4%
DP03 | 2020 American Community Survey 5-Year Estimates
Housing
Total Housing Units
2,979
H1 | 2020 Decennial Census
Health
Without Health Care Coverage
0.8%
S2701 | 2020 American Community Survey 5-Year Estimates
Families and Living Arrangements
Total Households
2,609
DP02 | 2020 American Community Survey 5-Year Estimates
Race and Ethnicity
Hispanic or Latino (of any race)
674
P2 | 2020 Decennial Census


Populations and People
Age and Sex
32.0 +/- 3.0
Median Age in Stanwood city, Washington
37.8 +/- 0.2
Median Age in Washington
S0101 | 2020 American Community Survey 5-Year Estimates
Population by Age Range
in Stanwood city, Washington
View Options
Under 5 years - 8.6%
Under 18 years - 32.8%
18 years and over - 67.2%
65 years and over - 11.5%
0%
5%
10%
15%
20%
25%
30%
35%
40%
45%
50%
55%
60%
65%
70%
Show Table
DP05 | 2020 ACS 5-Year Estimates Data Profiles



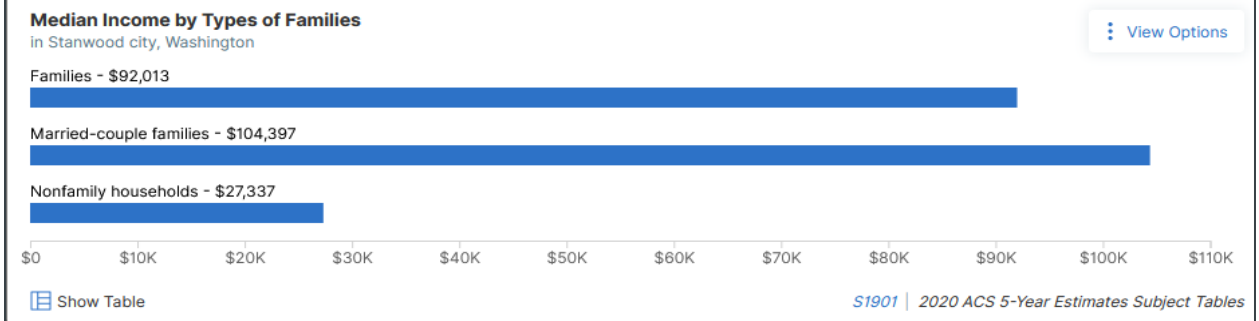
Income and Poverty

Income and Earnings

$71,306 +/- $16,199
Median Household Income in Stanwood city, Washington

$77,006 +/- $296
Median Household Income in Washington

S1901 | *2020 American Community Survey 5-Year Estimates*



Poverty

7.9% +/- 4.0%
Poverty, All people in Stanwood city, Washington

10.2% +/- 0.2%
Poverty, All people in Washington

S1701 | *2020 American Community Survey 5-Year Estimates*

Education

Educational Attainment

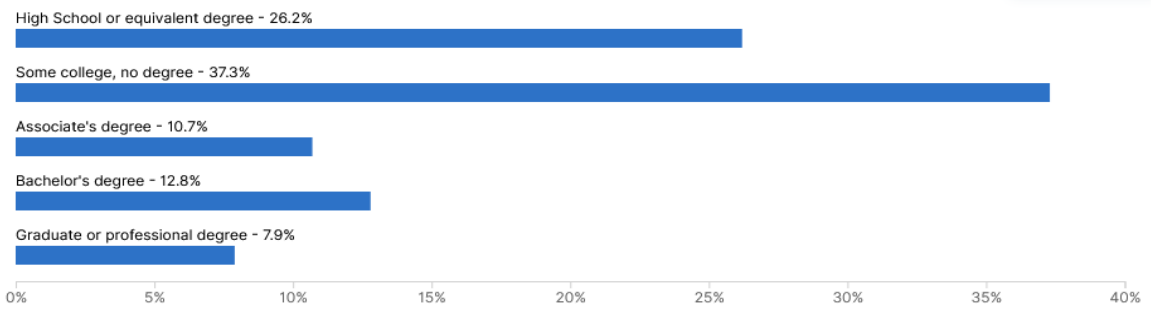
20.8% +/- 5.8%
Bachelor's Degree or Higher in Stanwood city, Washington

36.7% +/- 0.2%
Bachelor's Degree or Higher in Washington

S1501 | *2020 American Community Survey 5-Year Estimates*

Education Attainment (Population 25 Years and Older)
in Stanwood city, Washington

View Options



Show Table

DP02 | *2020 ACS 5-Year Estimates Data Profiles*

Employment

Class of Worker

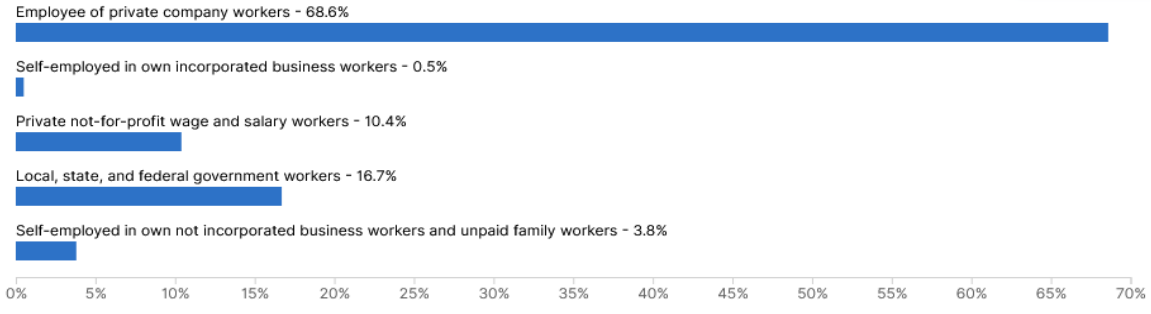
16.7% +/- 6.4%
Local, State, & Federal Government Workers in Stanwood city, Washington

15.6% +/- 0.2%
Local, State, & Federal Government Workers in Washington

S2406 | *2020 American Community Survey 5-Year Estimates*

Class of Worker
in Stanwood city, Washington

View Options



Show Table

S2406 | *2020 ACS 5-Year Estimates Subject Tables*

Employment and Labor Force Status

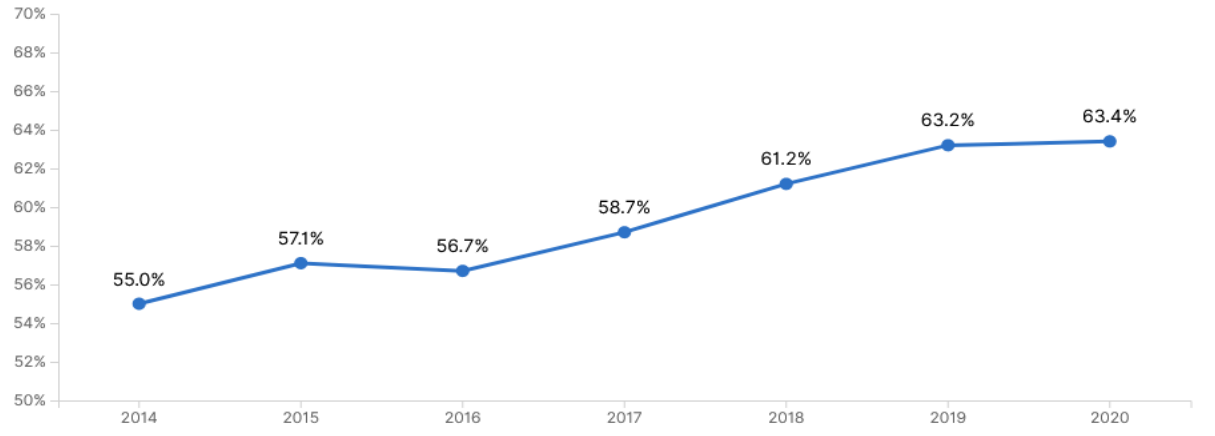
63.4% +/- 4.1%
Employment Rate in Stanwood city, Washington

60.6% +/- 0.1%
Employment Rate in Washington

DP03 | 2020 American Community Survey 5-Year Estimates

Employment Rate
in Stanwood city, Washington

View Options

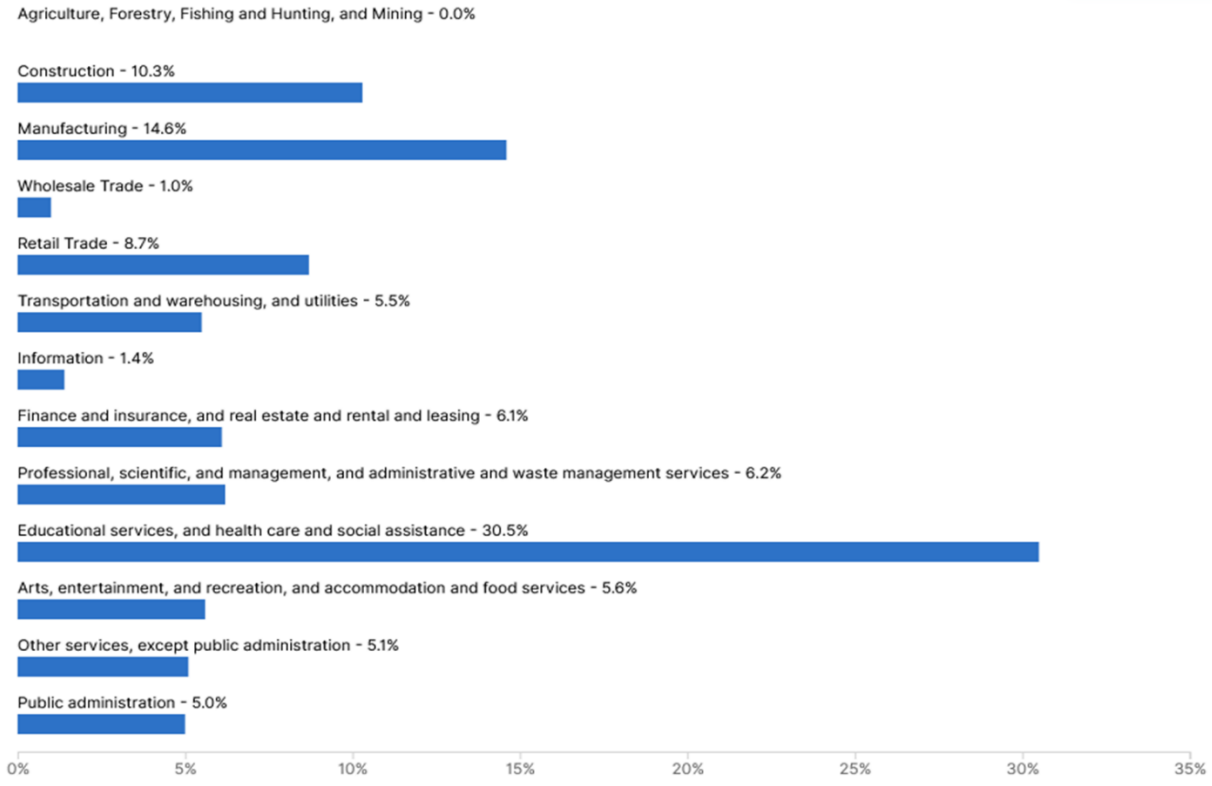


Show Table

DP03 | 2020 ACS 5-Year Estimates Data Profiles

Industry for the Civilian Employed Population 16 Years and Over
in Stanwood city, Washington

View Options



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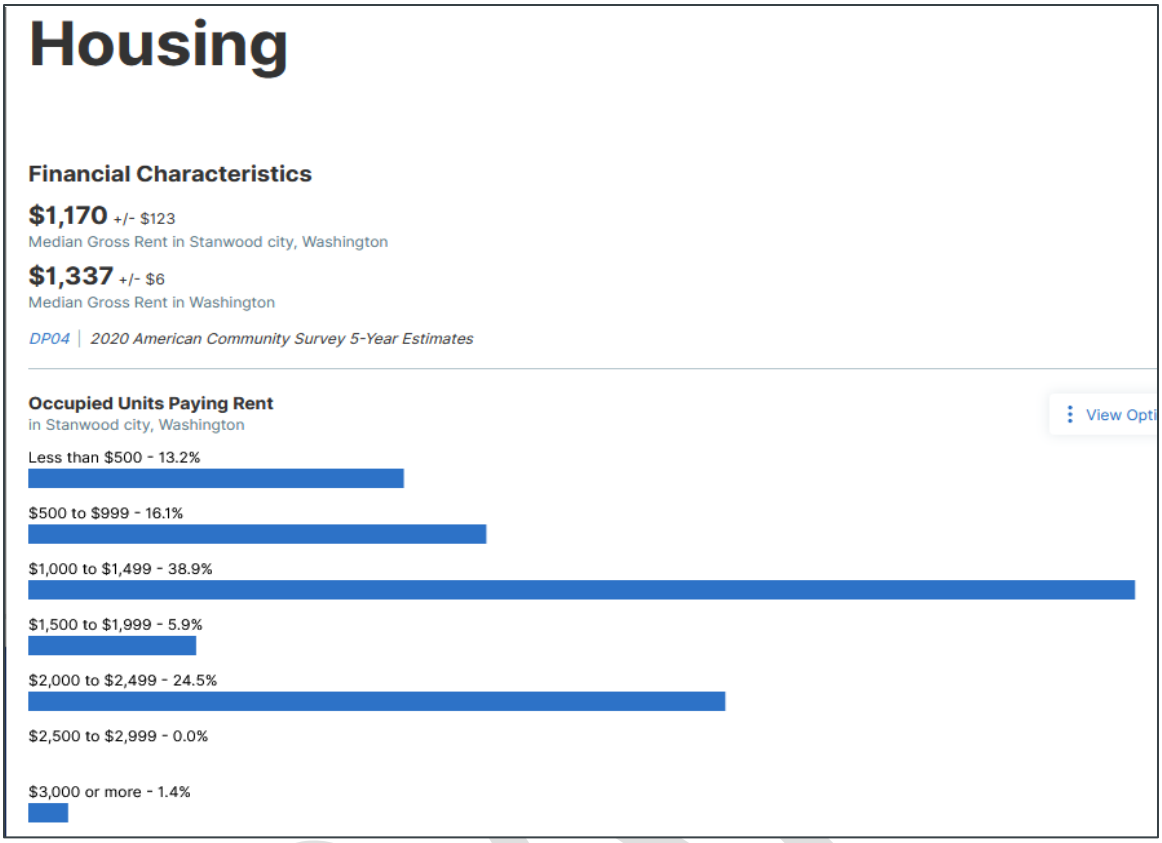
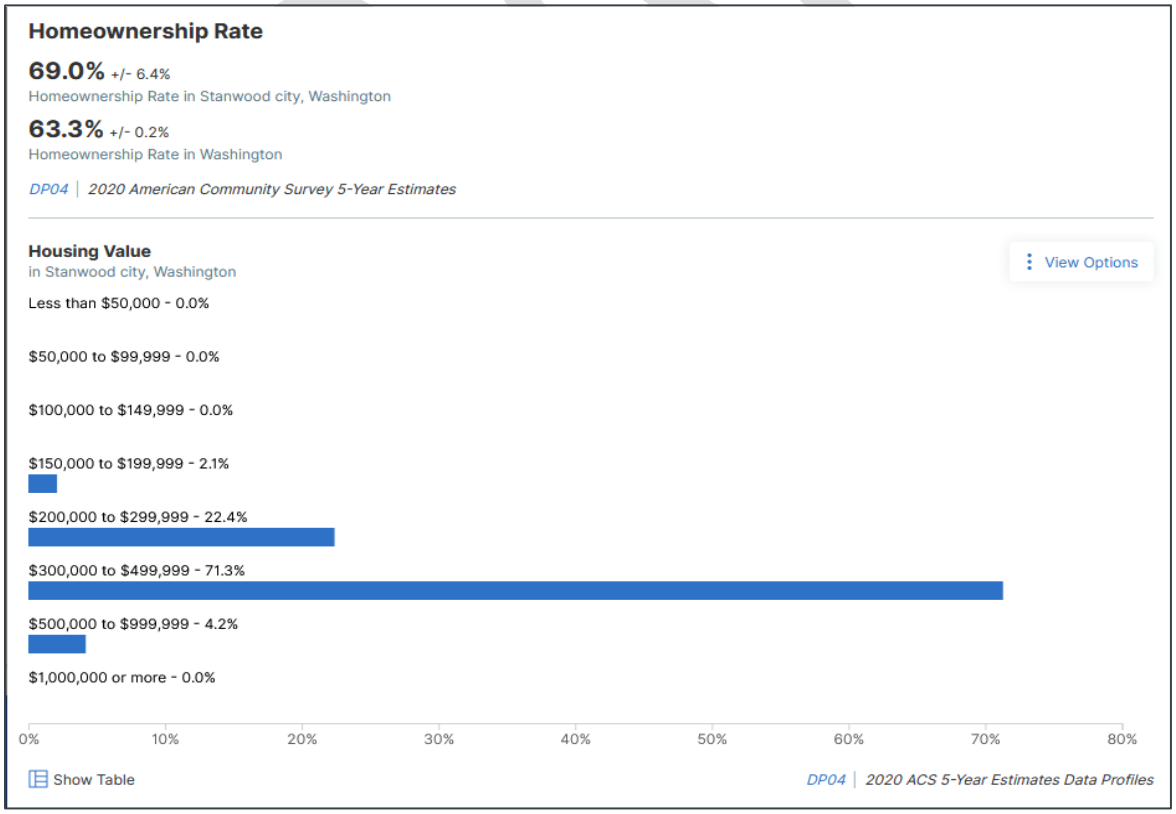
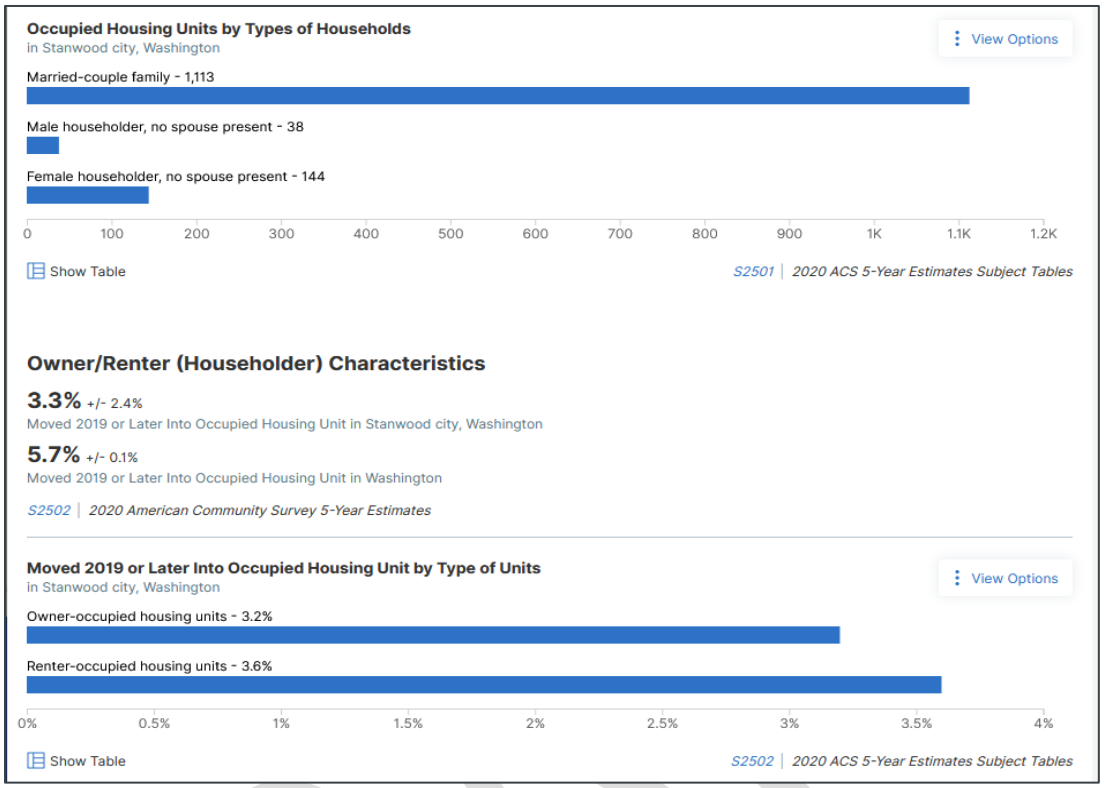
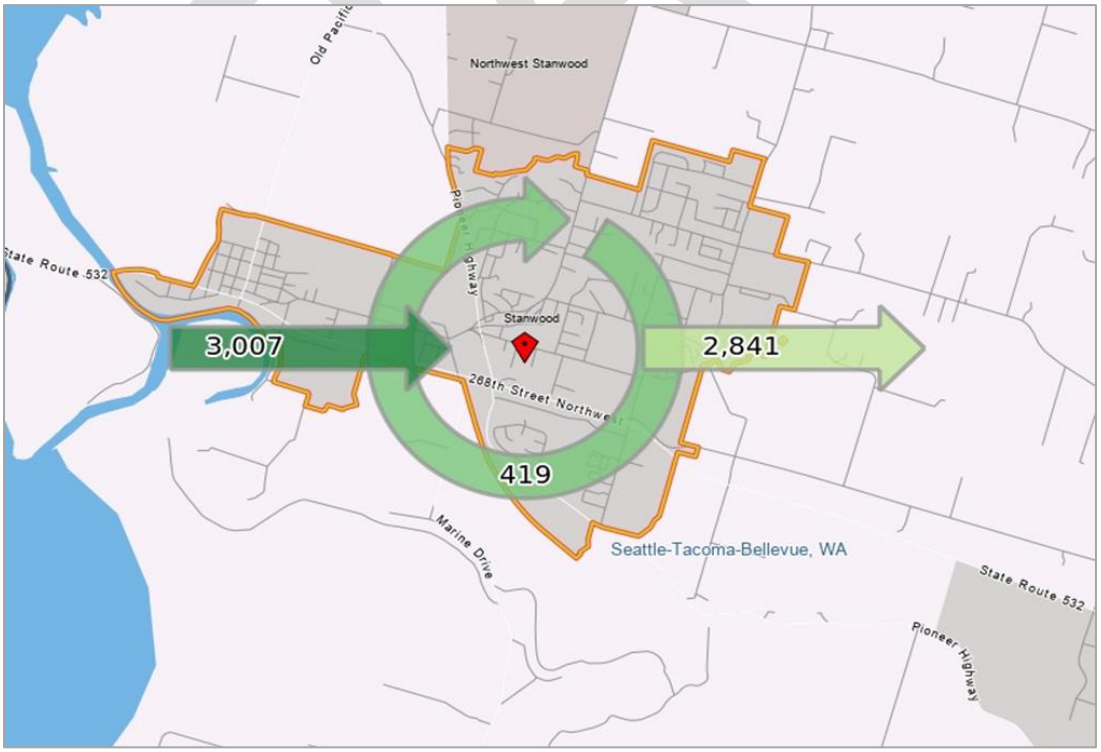
DP03 | 2020 ACS 5-Year Estimates Data Profiles


Housing
Financial Characteristics
$1,170 +/- $123
Median Gross Rent in Stanwood city, Washington
$1,337 +/- $6
Median Gross Rent in Washington
DP04 | 2020 American Community Survey 5-Year Estimates
Occupied Units Paying Rent
in Stanwood city, Washington
View Opti
Less than $500 - 13.2%
$500 to $999 - 16.1%
$1,000 to $1,499 - 38.9%
$1,500 to $1,999 - 5.9%
$2,000 to $2,499 - 24.5%
$2,500 to $2,999 - 0.0%
$3,000 or more - 1.4%


Homeownership Rate
69.0% +/- 6.4%
Homeownership Rate in Stanwood city, Washington
63.3% +/- 0.2%
Homeownership Rate in Washington
DP04 | 2020 American Community Survey 5-Year Estimates
Housing Value
in Stanwood city, Washington
View Options
Less than $50,000 - 0.0%
$50,000 to $99,999 - 0.0%
$100,000 to $149,999 - 0.0%
$150,000 to $199,999 - 2.1%
$200,000 to $299,999 - 22.4%
$300,000 to $499,999 - 71.3%
$500,000 to $999,999 - 4.2%
$1,000,000 or more - 0.0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
Show Table
DP04 | 2020 ACS 5-Year Estimates Data Profiles



Stanwood Resident Work Commuter Inflow/Outflow, 2018



APPENDIX D: PIPELINE CAPACITY ANALYSIS

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LDC | Surveying Engineering Planning

DATE: August 13, 2022

FROM: Samantha Adams – Associate Planner, LDC, Inc.
Matt Covert – Planner, LDC, Inc.

TO: Todd Chase, Principal/Economist, FCS Group
Tim Wood, FCS Group

SUBJECT: Land Capacity Analysis (Task 1.3.2)

Background

This memo provides a summary of the data analysis that LDC has performed in partial completion of Economic Analysis of Land Use Options (Phase 1) of the Stanwood Comprehensive Plan Update. The maps, matrices, and GIS shapefiles included in this deliverable form the basis for the development of economic analysis performed by the FCS Group.

These maps and associated documentation aim to depict the performance of development within the City of Stanwood's pipeline relative to the Buildable Lands Report (BLR) produced by Snohomish County. The intent is to identify how new development has impacted the anticipated employment and housing growth, projected by the BLR. The methodology and results of this process are described below.

Methodology

To achieve an accurate assessment of the capacity Stanwood has in terms employment and housing, it was imperative to incorporate development that has been issued since the BLR was published. The City of Stanwood provided permitting data from the year 2018 to 2022 which will be referred to as the 'pipeline data' or 'pipeline development' throughout this document.

The first step in this process was joining the BLR parcel data set from Snohomish County with the pipeline data from the City of Stanwood. With these two data sets merged as one, we identified which parcels reduce the amount of employment and housing growth the City has to accommodate.

We summed the amount of employment and housing capacity from the BLR data, and we summed the total pipeline developments as total jobs and housing units. We subtracted the pipeline data from the original BLR capacity to achieve an updated look at where the City still needs to accommodate projected growth. As a result, we found the City of Stanwood has overachieved on housing projection by 165 units. In other words, the parcels identified in the BLR for housing growth have been developed at a higher density than anticipated. Conversely, we found the City has underachieved on employment projection by 22 jobs. The FCS Group, LDC, Inc., and the Blueline Group have been strategizing on regulatory and zoning changes the City of Stanwood could implement to ensure the City has ample space to absorb the projected employment growth.

Sincerely,

LDC, Inc.

Matt Covert, AICP
Planner

HQ: 20210 142nd Avenue NE, Woodinville, WA 98072 • Kent: 1851 Central Place South, Suite 101, Kent, WA 98030

Service ABOVE the Standard ph: 425.806.1869 • fx: 425.482.2893 • www.LDCcorp.com

APPENDIX D PIPELINE CAPACITY ANALYSIS

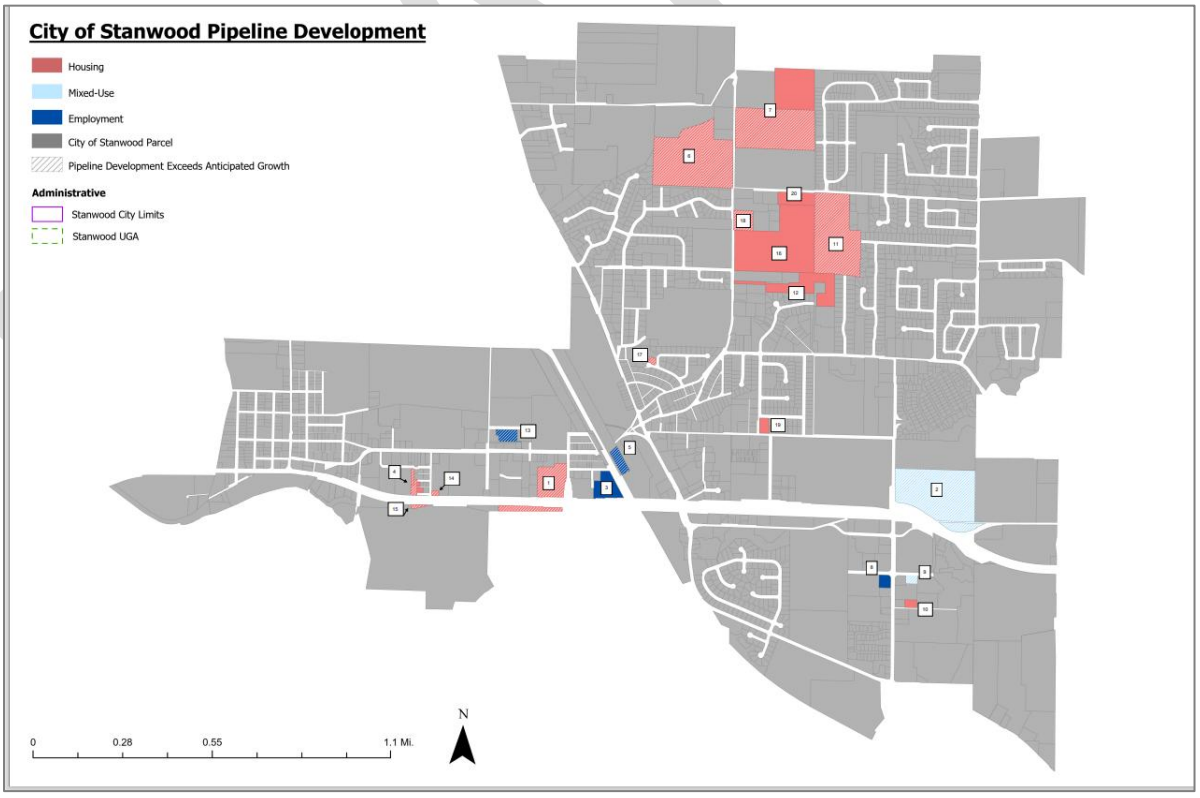
City of Stanwood, Predevelopment Pipeline Analysis, April 2022

Map #	Project Name	Use	Description	Status	Parcel (s)	Housing (dwellings) BLR Housing Capacity*	Housing (dwellings) Housing Units Expected**	Employment (jobs) Approx. Net rentable SF Expected**	Employment (jobs) 2022 BLR Job Capacity Estimate*	Employment (jobs) Approx. Job Capacity Expected**
1	Viking Village	Townhomes	90-unit townhome	pre-application	32041900304000, 32041900303400	0	90	0	105	0
2	Creekside/Vine St	Mixed Use	400+ unit mixed use/multi family	pre-application	32042000302000, 32042000302100, 32042900200300	130	400	26,800 sf	0	67
3	McDay Holdings	Industrial	potential mini storage	pre-application	32041900307900, 32041900303700, 32041900310000, 32041900310100	0	0	69,600 sf	25	5
4	Liberty Properties	Townhomes	6-unit townhome	pending construction	32032400414900, 32032400415000	0	6	0	7	0
5	Wolfkill	Industrial	office and warehousing	pending construction	3.20419E+13	0	0	21,968 sf	0	30
6	Chandler's Reserve	Subdivision	91-lot subdivision	pending final plat	32041800400800, 32041800401100, 32041800401700	80	91	0		
7	Kottsick	Subdivision	127-lot subdivision	pending annexation	32041800401300, 32041800401600	53	127	0		
8	Affordable Pet Care	Commercial	vet clinic	pending construction	3.20429E+13	50	0	5,771 sf	11	17
9	Grandview Lot 2	Mixed Use	36-unit mixed use multi family	pending construction	3.20429E+13	36	36	6,612 sf	6	17
10	Grandview Lot 16	Multi-Family	34-unit multi family	pending construction	3.20429E+13	34	34	0		
11	Bakerview	Subdivision	114-unit subdivision	pending preliminary plat	3.2042E+13	199	114	0		
12	Summerset Division II	Subdivision	22-lot subdivision	pending preliminary plat	32041900105000, 32042000205700	25	22	0		
13	Inland Steel	Industrial	office and warehousing	in land use review	3.20419E+13	0	0	14,401 sf	30	41
14	Brunner	Townhomes	3 or 4 unit townhome	pre-application	3.20324E+13	0	3	0	5	0
15	Sequim Land	Townhomes	7-unit townhome	in land use review	32032400412200, 32032400413600	0	7	0	11	0
16	Schonberg	Subdisivion	TN zoned subdivision	pre-application	32041900100600, 32041900106400	163	163	0		
17	Buddy Shelters	Townhomes	4-unit townhome	pending construction	6.812E+11	1	4	0		
18	Hammond	Shortplat	6-unit shortplat	pending final plat	3.20419E+13	1	6	0		
19	Brandt	Shortplat	4-unit shortplat	pending final plat	3.20419E+13	4	4	0		
20	Faulkner	Subdivision	17-lot subdivision	pre-application	3.20419E+13	21	17	0		
					Total	797	1124	145152	199	**177**
					Single-family Dwellings	546	544			
					Other Dwellings	251	580			
					Difference between Target and Actual		**327**			**(22)**
						SFD units	(2)			jobs
						Other units	329			

Source notes:

* capacity estimate based on Final 2021 Buildable Land Report.

** expected development based on planning applications approved or in process as of April 15, 2022.



APPENDIX E: FISCAL IMPACT ANALYSIS

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City of Stanwood Municipal Expenditures and Revenues (excluding enterprise funds and proprietary sources)

Expenditures (excl. enterprise funds)	2018	2019	2020	2021	Change: 2019-2021
General Government	$ 740,651	$ 839,478	$ 1,166,491	$ 979,962	$ 140,484
Public Safety	$ 3,898,710	$ 3,903,029	$ 2,228,981	$ 2,300,886	$ (1,602,143)
Transportation	$ 388,370	$ 407,708	$ 417,663	$ 538,089	$ 130,381
Natural and Economic Environment	$ 790,345	$ 872,479	$ 965,460	$ 1,049,775	$ 177,296
Social Services	$ 2,182	$ 1,864	$ 10,009	$ 26,143	$ 24,279
Culture and Recreation	$ 260,553	$ 284,632	$ 317,700	$ 395,354	$ 110,722
Grand Total	**$ 6,080,811**	**$ 6,309,190**	**$ 5,106,304**	**$ 5,290,209**	**$ (1,018,981)**

Revenues (excl. enterprise funds & proprietary sources)	2018	2019	2020	2021	Change: 2019-2021
Taxes Total	$ 6,694,247	$ 7,722,320	$ 6,798,693	$ 7,201,148	$ (521,172)
Property Tax	$ 3,110,796	$ 3,428,450	$ 1,824,653	$ 1,827,923	$ (1,600,527)
Retail Sales and Use Taxes Total	$ 2,038,163	$ 2,646,659	$ 3,088,924	$ 3,074,719	$ 428,060
Local Retail Sales and Use Tax	$ 1,547,103	$ 2,032,251	$ 2,386,219	$ 2,340,998	$ 308,747
Public Transportation Systems Sales and Use Tax	$ 363,467	$ 478,192	$ 561,210	$ 550,753	$ 72,561
Affordable and Supportive Housing Sales and Use Tax			$ 5,562	$ 19,261	$ 19,261
Hotel/Motel Sales and Use Tax			$ 94	$ 209	$ 209
Brokered Natural Gas Sales and Use Tax	$ 2,297	$ 3,537	$ 931		$ (3,537)
Criminal Justice Sales and Use Tax	$ 125,296	$ 132,679	$ 134,908	$ 163,498	$ 30,819
Business and Occupation Taxes	$ 1,084,646	$ 1,101,093	$ 1,121,888	$ 1,187,067	$ 85,974
Other Taxes	$ 460,642	$ 546,118	$ 763,228	$ 1,111,439	$ 565,321
Licenses and Permits	$ 554,494	$ 538,188	$ 552,282	$ 530,116	$ (8,072)
Intergovernmental Revenues	$ 1,413,484	$ 1,033,826	$ 3,300,938	$ 2,278,116	$ 1,244,290
Charges for Goods and Services	$ 762,531	$ 1,055,940	$ 1,151,645	$ 971,834	$ (84,106)
Fines and Penalties	$ 12,993	$ 15,349	$ 14,749	$ 16,469	$ 1,120
Miscellaneous Revenues	$ 153,740	$ 193,461	$ 268,444	$ 153,418	$ (40,043)
Grand Total	**$ 9,591,488**	**$ 10,559,084**	**$ 12,086,751**	**$ 11,151,101**	**$ 592,017**
Population	6,835	7,000	7,228	7,980	980
Households (est.)	2,513	2,574	2,657	2,934	360
Employment (est.)		3,426	3,460	3,495	69

Source: Washington Dept. of Revenue, U.S. Census, Washington Office of Financial Management

Expenditures per Household	2018	2019	2020	2021	Average
General Government	$ 295	$ 326	$ 439	$ 334	$ 348
Public Safety	$ 1,551	$ 1,517	$ 839	$ 784	$ 1,173
Transportation	$ 155	$ 158	$ 157	$ 183	$ 163
Natural and Economic Environment	$ 315	$ 339	$ 363	$ 358	$ 344
Social Services	$ 1	$ 1	$ 4	$ 9	$ 4
Culture and Recreation	$ 104	$ 111	$ 120	$ 135	$ 117
Grand Total	**$ 2,420**	**$ 2,452**	**$ 1,922**	**$ 1,803**	**$ 2,149**

Revenues per Household					Average
Property Tax	$ 1,238	$ 1,332	$ 687	$ 623	$ 970
Retail Sales and Use Taxes Total	n/a	n/a	n/a	n/a	n/a
Business and Occupation Taxes	n/a	n/a	n/a	n/a	n/a
Other Taxes	$ 183	$ 212	$ 287	$ 379	$ 265
Licenses and Permits	$ 221	$ 209	$ 208	$ 181	$ 205
Intergovernmental Revenues	n/a	n/a	n/a	n/a	n/a
Charges for Goods and Services	$ 303	$ 410	$ 433	$ 331	$ 370
Fines and Penalties	$ 5	$ 6	$ 6	$ 6	$ 6
Miscellaneous Revenues	$ 61	$ 75	$ 101	$ 52	$ 72
Grand Total	**$ 2,012**	**$ 2,245**	**$ 1,722**	**$ 1,572**	**$ 1,888**

Net Avg. Annual General Fund Impact per Household (excl. Pass through rev.)					$ (262)
Sales and Use Tax Revenue Analysis	**2018**	**2019**	**2020**	**2021**	**Average**
Sales and Use Tax Revenue	$ 1,547,103	$ 2,032,251	$ 2,386,219	$ 2,340,998	$ 2,076,643
Current Local Sales and Use Tax Rate	2.8%	2.8%	2.8%	2.8%	
Local Taxable Retail Sales	$ 55,253,670	$ 72,580,393	$ 85,222,107	$ 83,607,071	$ 74,165,810
Retail Employment		326	329	333	329
Gross Taxable Sales per Retail Employee		$ 222,639	$ 258,829	$ 251,410	**$ 244,293**
Sales and Use Tax Revenue per Retail Job (est.)					**$ 6,307**
Affordable Housing Sales & Use Tax Rev per Retail Job			$ 17	$ 58	**$ 37**
REET Revenue Per Change in Prior year AV				$ 0.51	**$ 0.51**
State Pass-Through Inter. Gov. Revenue per HH					**$ 99**

Estimated Local Assessed Valuation	**2018**	**2019**	**2020**	**2021**	**Average**
Property Tax Revenue	$ 3,110,796	$ 3,428,450	$ 1,824,653	$ 1,827,923	$ 2,547,956
City Property Tax Rate per $1,000 AV	$ 1.50	$ 1.50	$ 1.50	$ 1.50	**$ 1.50**
Estimated Taxable Assessed Valuation	$ 2,073,864,207	$ 2,285,633,333	$ 1,216,435,333	$ 1,218,615,333	$ 1,698,637,052

Source: Washington Dept. of Revenue, U.S. Census, Washington Office of Financial Management

Estimated Per Capita Distributions for Each City/Town

	2019	2020	2021	2022 Revised	2023 Forecast	2024 Forecast
Gas Tax (MVFT)	$19.62	$17.23	$17.30	$17.65	**$18.20**	**$18.11**
Multi-Modal Distribution	1.38	1.36	1.33	1.32	**1.30**	**1.28**
Increased MVFT	1.21	1.19	1.16	1.15	**1.14**	**1.12**
Liquor Profits	8.15	8.03	7.83	7.77	**7.65**	**7.52**
Liquor Excise	5.47	6.34	7.08	7.12	**6.86**	**6.83**
Criminal Justice–Special Programs	1.07	1.11	1.15	1.21	**1.27**	**1.32**
Criminal Justice–Population[1]	$0.30	$0.31	$0.33	$0.36	**$0.36**	**$0.38**

1. Minimum distribution of $1,000 per city/town, regardless of population.

Summary of Fiscal Impacts by Land Use Alternative (annual at buildout)

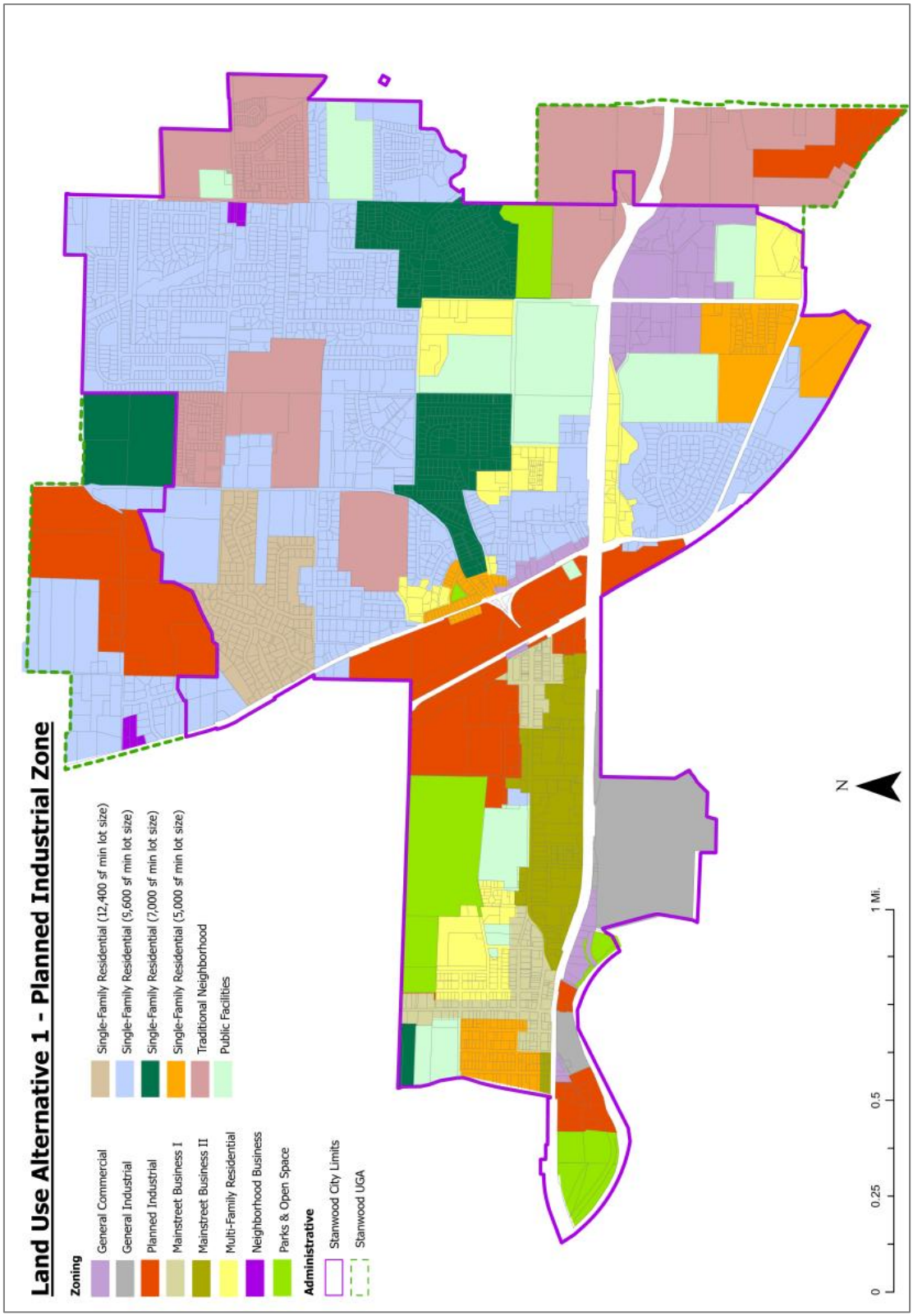
Land Use Alternative	Annual Net Local Fiscal Impact on Gen. Fund*	Potential Net Increase in RMV	Potential Change in City Prop. Tax Revenue	Potential Change Retail Sales & Use Tax Rev.	Affordable Housing Sales & Use Tax Rev.	State Pass Through Tax Rev.	Total Tax Rev.	Net Change in Gen. Gov. Expenditures
			$ -	$ -	$ -	$ -	$ -	$ -
Alt. 1A: Twin City Foods Site (new user)	$ 30,375	$ 22,500,000	$ 30,375	$ -	$ -	$ -	$ 30,375	$ -
Alt. 1B: LI to PI	$ 402,326	$ 37,672,000	$ 50,857	$ 349,396	$ 2,072	$ -	$ 402,326	$ -
Alt. 1C: GI to PI (in designated areas)	$ 124,910	$ 11,696,000	$ 15,790	$ 108,477	$ 643	$ -	$ 124,910	$ -
Subtotal	**$ 557,611**	**$ 71,868,000**	$ -	$ -	$ -	$ -	$ -	$ -
Alt. 2: Downtown Mixed Use Zone	**$ (78,557)**	**$ 59,245,000**	$ 79,981	$ (116,676)	$ (692)	$ 25,259	$ (12,128)	$ (66,429)
			$ -	$ -	$ -	$ -	$ -	$ -
Alt. 3: Planned GC site in TD*	**$ 1,312,877**	**$ 20,580,000**	$ 27,783	$ 1,273,972	$ 7,556	$ (2,188)	$ 1,307,123	$ 5,754

* analysis of annual impact at buildout (year 20) excluding pipeline projects.

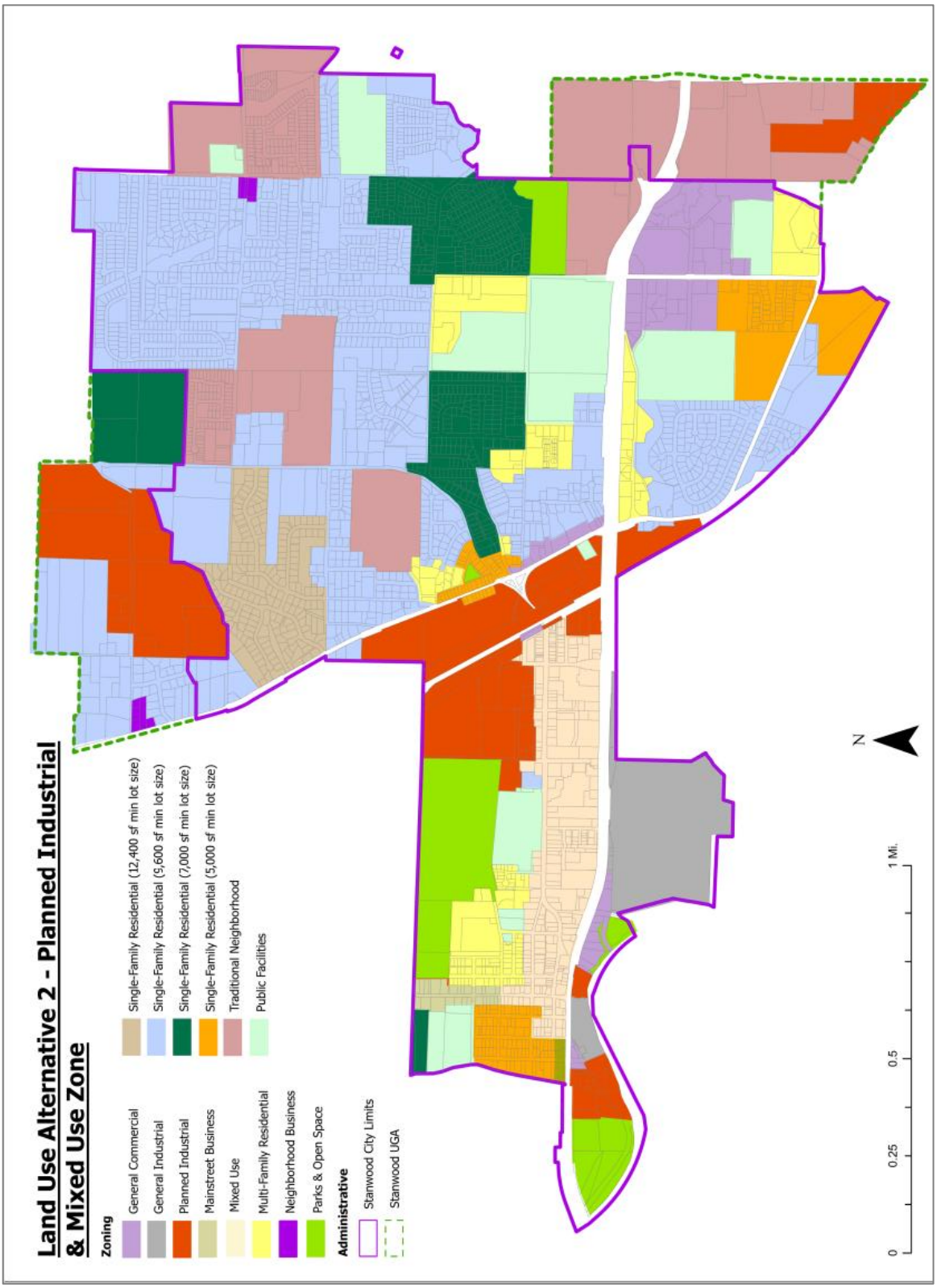
APPENDIX F: DRAFT ZONE MAP AMENDMENT ALTERNATIVES

DRAFT

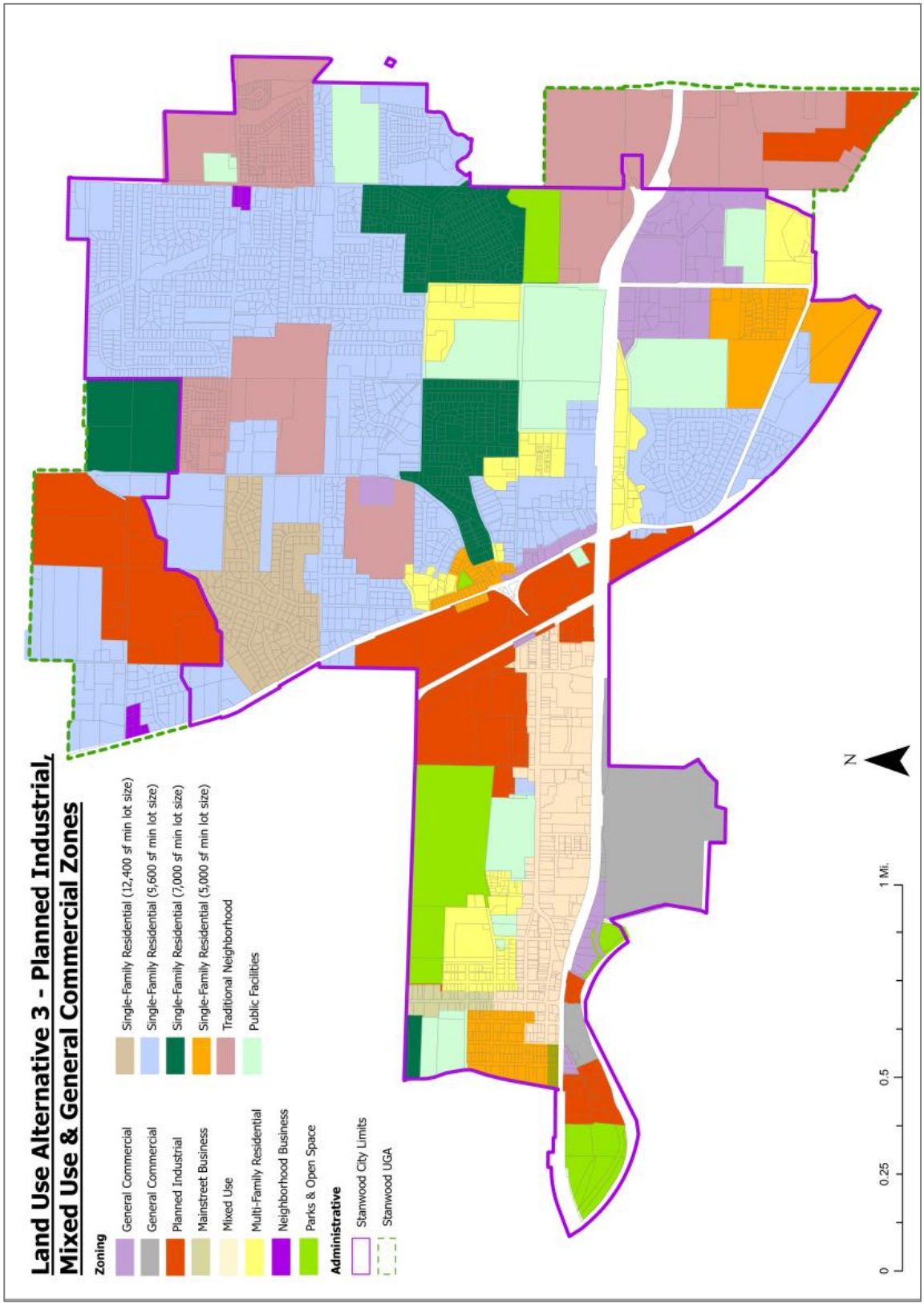
Alternative 1. New Planned Industrial (PD) Zone



Alternative 2. PD Zone (Alt. 1) & New Downtown Mixed-Use Zone



Alternative 3. Alts. 1 & 2 plus new GC-zoned area



10 Year Pop / Emp Growth Distribution

City Population Growth of 1,782
UGA Population Growth of 385

- Candleview Heights
- Collins
- Jasper Junction
- Jerry & John
- Lenz
- Lindberg
- Lindstrom
- Maple Court
- Mineral Pointe
- Ramaley
- Stach Property
- Potential Population Growth
- Sundance Estates
- Valley View Estates
- YMCA / Josephine
- City Limits
- Proposed UGA
- Parcels

N

0 0.25 0.5 Miles

This map and map data are provided "as-is" and are general growth patterns. This map does not reflect legal surveys or legal descriptions. The City of Stanwood explicitly disclaims any representations and warranties as to the accuracy, timeliness, or completeness of this map and data. This map and data are created from city, county, state and federal sources. The source data may contain errors. This map and data should not be used for navigational, tracking, or any other purpose requiring exacting measurement of distance or direction. In no event will the City of Stanwood or its employees be liable for any losses or damages that might arise from the use of the maps and data. The City of Stanwood shall assume no liability for any decisions made or actions taken or not taken by the user of this map and data.

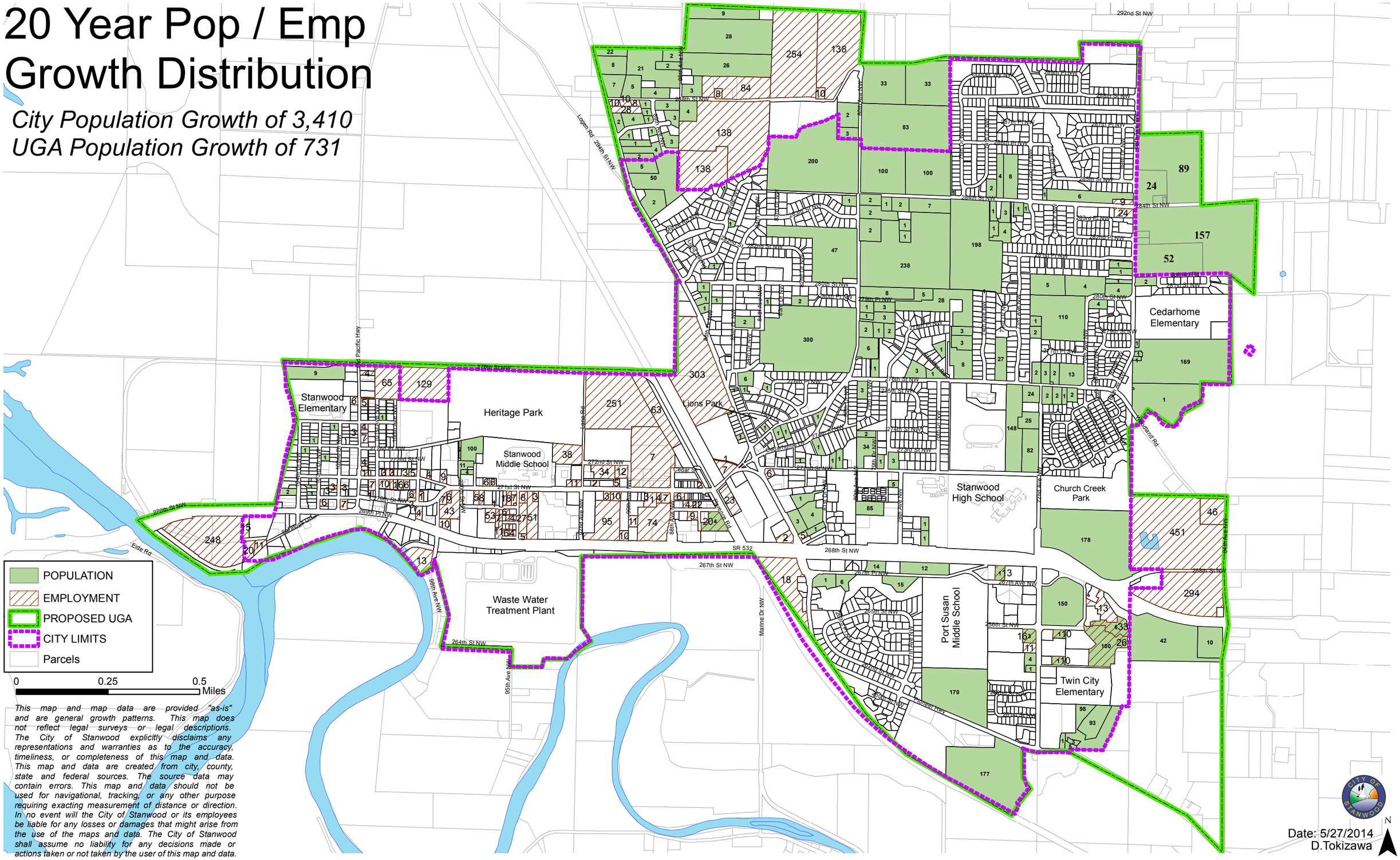
93 pop
185 pop
50 pop
140 pop
100 pop
4 pop
150 pop
244 pop
9 pop
41 pop
110 pop
225 pop
169 pop
14 pop
95 emp
4 pop
451 emp
26 emp
100 pop
52 pop
100 pop
200 pop
177 pop

Stanwood Elementary
Heritage Park
Lions Park
Stanwood Middle School
Waste Water Treatment Plant
Cedarhome Elementary
Stanwood High School
Church Creek Park
Port Susan Middle School
Twin City Elementary

D.Tokizawa
Date: 5/23/2014

20 Year Pop / Emp Growth Distribution

City Population Growth of 3,410
UGA Population Growth of 731



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Appendix F

ADS Flow Monitoring Report

Stanwood, WA

Final Report Submitted for **Stanwood, WA**
October 12, 2022

ADS ENVIRONMENTAL SERVICES

October 12, 2022

Kenny Gomez
RH2 Engineering
22722 29th Drive SE, Suite 210
Bothell, WA 98021

SUBJECT: Stanwood, WA

Dear Kenny,

ADS is pleased to submit the report for Stanwood, WA completed on behalf of RH2 Engineering. The metering was conducted at four (4) locations. The study was conducted during the period of Tuesday, 25 January 2022 to Thursday, 04 August 2022.

The report contains depth, velocity, and quantity hydrographs as well as daily long tables for the metering period. An Excel file containing depth, quantity, and velocity entities for the monitoring location in 5-minute format is included.

In addition, we would be happy to further explain any details about the report that may seem unclear. Should you have any questions or comments, you may contact the Project Manager, Mike Piña at MPina@idexcorp.com.

It has been our pleasure to be of service to you in the performance of this project. Thank you for choosing ADS products and services to meet your flow monitoring needs.

Sincerely,
ADS ENVIRONMENTAL SERVICES

Shawn Hoglan
Senior Data Analyst

Stanwood, WA

Prepared For:

Kenny Gomez
RH2 Engineering
22722 29th Drive SE, Suite 210
Bothell, WA 98021

Prepared By:

ADS ENVIRONMENTAL SERVICES®

ST_MH13

Site Commentary

SITE INFORMATION

Pipe	Elliptical (12 in H x 12 in W)
Silt	0.00 (in)

OBSERVATIONS

Average flow depth, velocity, and quantity data observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	**DFINAL (in)**	**VFINAL (ft/s)**	**QFINAL (MGD - Total MG)**
Average	3.06	3.34	0.321
Minimum	0.15	0.34	0.007
Maximum	9.57	12.44	2.200
Min Time	03/29/2022 2:55:00 PM	04/09/2022 11:15:00 AM	07/14/2022 2:40:00 AM
Max Time	03/28/2022 3:35:00 PM	04/11/2022 8:20:00 AM	04/10/2022 12:05:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions and data on the graphical reports are based on the none average.

DATA UPTIME

Data uptime observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022** is provided in the following table:

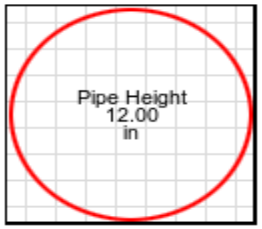
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100

Hydrograph Report

ST_MH13

Flow Monitor

ST_MH13



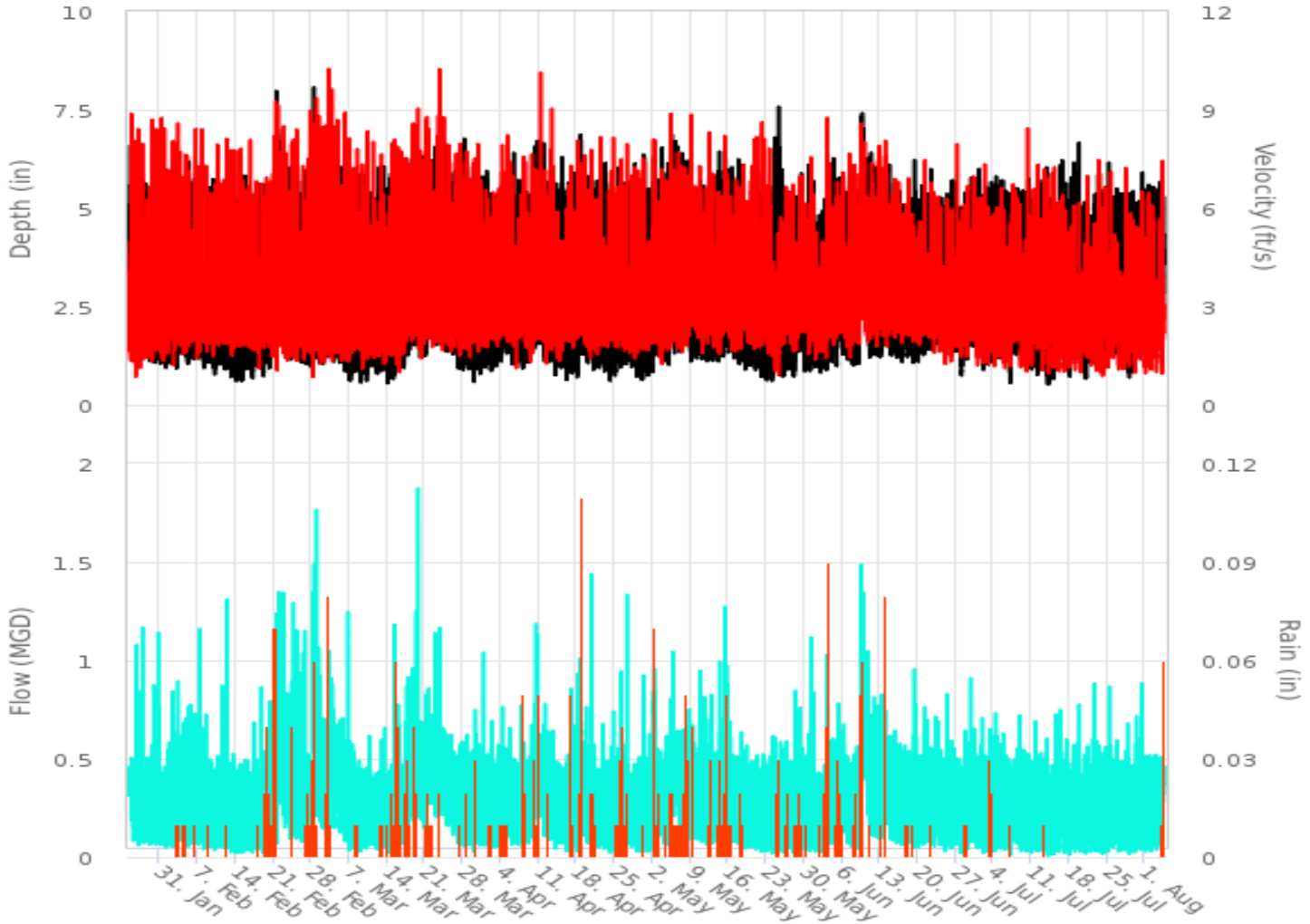
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL
- QFINAL
- Rain
- VFINAL

ADS ENVIRONMENTAL SERVICES



Scattergraph Report

ST_MH13

Flow Monitor

ST_MH13

Pipe Height
12.00
in

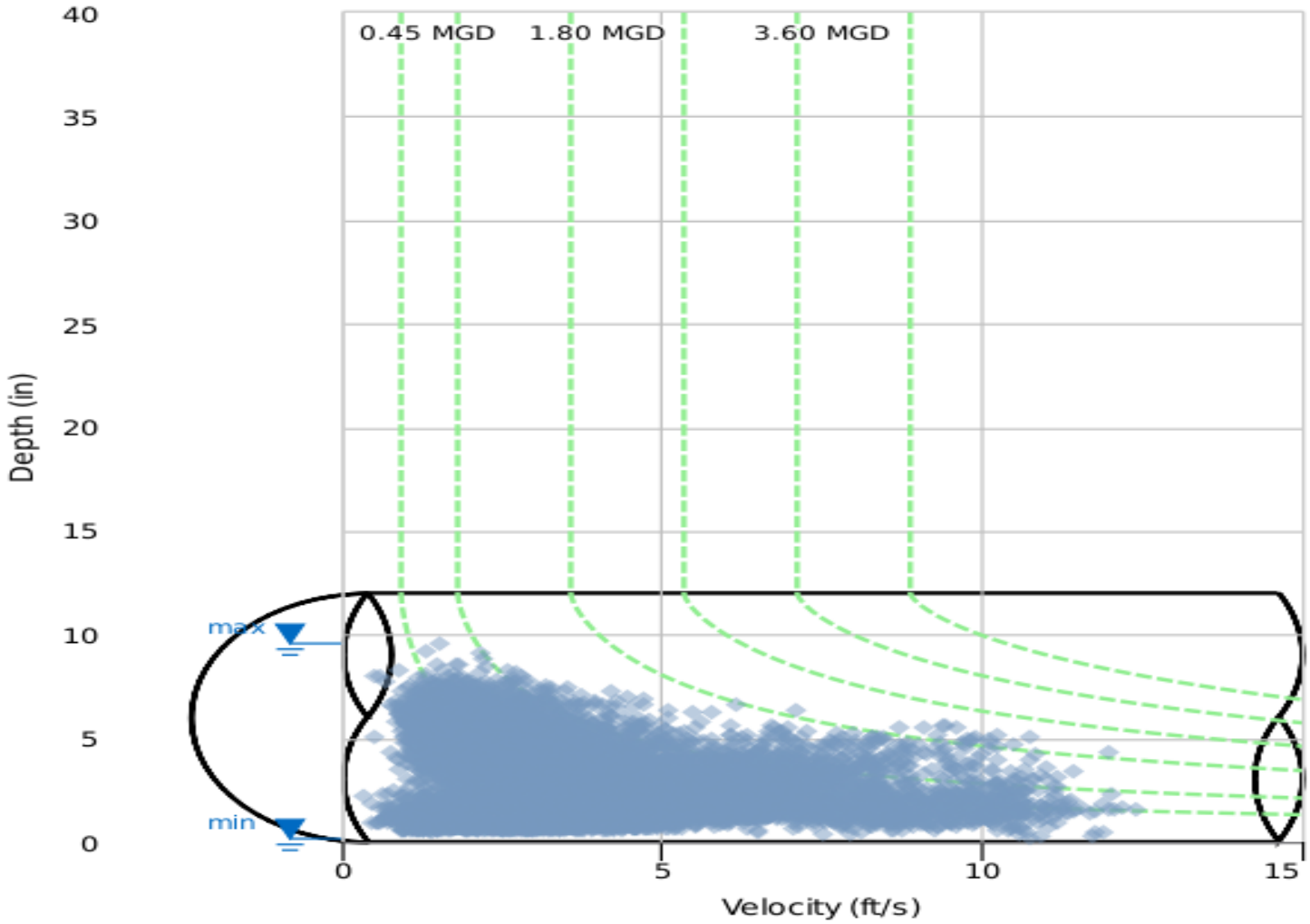
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL - VFINAL
- Iso-Q™
- Min-Max Depth

ADS ENVIRONMENTAL SERVICES



Daily Tabular Report

01/25/2022 00:00 - 08/04/2022 22:55
ST_MH13Pipe: Elliptical (12 in H x 12 in W), Silt0.00 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/25/2022	22:55	0.74	15:10	6.70	3.71	18:35	1.05	22:50	9.09	3.46	23:00	0.105	17:45	0.677	0.368	0.189	-
01/26/2022	13:10	0.88	19:50	7.07	3.06	13:10	0.46	08:15	9.03	3.39	13:10	0.008	18:20	1.340	0.296	0.296	-
01/27/2022	02:35	0.98	18:30	6.68	2.95	09:10	0.66	00:05	8.87	3.28	09:10	0.018	19:15	1.452	0.291	0.291	-
01/28/2022	05:25	1.12	09:45	6.39	2.87	13:50	0.96	18:55	9.01	3.30	03:20	0.061	11:10	0.713	0.271	0.271	-
01/29/2022	04:55	1.08	10:45	6.61	2.79	11:10	0.75	15:50	8.97	3.18	11:10	0.025	21:05	1.560	0.261	0.261	-
01/30/2022	02:20	1.06	09:40	6.63	2.91	09:45	1.12	12:15	9.02	3.48	06:20	0.063	17:10	1.550	0.306	0.306	-
01/31/2022	21:10	0.87	08:35	6.54	2.85	13:50	0.97	09:00	9.59	3.38	03:10	0.054	21:15	0.606	0.272	0.272	-
02/01/2022	06:45	0.87	09:50	6.41	2.84	07:05	1.04	17:35	8.90	3.39	03:10	0.048	10:55	1.168	0.282	0.282	-
02/02/2022	13:35	0.88	10:00	7.43	2.76	13:35	0.55	14:55	9.17	3.20	13:35	0.009	10:00	1.158	0.269	0.269	-
02/03/2022	03:30	0.87	16:30	6.91	2.94	18:10	1.17	19:15	8.91	3.48	03:30	0.040	09:00	1.658	0.313	0.313	0.16
02/04/2022	04:00	1.27	20:45	6.65	2.97	20:45	0.73	18:50	7.72	3.49	04:10	0.076	10:50	0.872	0.311	0.311	0.05
02/05/2022	04:55	1.01	11:00	7.52	2.92	11:05	1.06	10:00	8.21	3.34	05:00	0.052	15:25	1.715	0.296	0.296	-
02/06/2022	06:00	1.15	20:10	6.91	3.02	02:40	0.99	20:45	8.91	3.26	06:00	0.061	12:20	1.271	0.296	0.296	0.01
02/07/2022	20:30	1.10	08:25	7.54	2.95	15:45	1.02	20:35	8.77	3.09	15:45	0.047	10:15	1.521	0.280	0.280	-
02/08/2022	04:25	0.92	19:40	6.35	2.79	19:10	1.04	07:20	8.63	3.03	19:10	0.026	07:25	1.422	0.263	0.263	-
02/09/2022	03:40	1.03	15:55	6.63	2.80	17:05	1.16	10:35	8.62	2.97	03:40	0.052	07:45	0.567	0.245	0.245	0.01
02/10/2022	03:35	0.74	10:40	6.77	2.74	12:15	1.04	09:25	8.93	3.04	03:35	0.031	11:25	0.587	0.245	0.245	-
02/11/2022	02:50	1.00	20:30	6.81	2.79	21:20	1.16	07:10	8.66	3.00	03:00	0.046	11:50	1.290	0.254	0.254	-
02/12/2022	05:05	0.87	09:55	6.79	2.80	09:55	1.27	07:50	8.49	3.00	05:00	0.041	11:30	1.589	0.260	0.260	0.01
02/13/2022	03:45	0.67	12:05	7.47	2.84	09:05	1.16	17:05	8.51	3.01	03:45	0.021	12:50	0.621	0.253	0.253	-
02/14/2022	02:50	0.55	19:05	6.21	2.70	11:55	1.15	08:55	8.54	2.94	02:50	0.016	12:50	0.646	0.235	0.235	-
02/15/2022	02:30	0.58	20:00	6.35	2.62	15:20	1.40	08:50	8.59	2.98	01:45	0.019	20:45	0.683	0.232	0.232	-
02/16/2022	02:15	0.89	18:15	6.15	2.65	13:45	1.16	07:30	8.75	2.93	03:30	0.029	07:35	0.627	0.230	0.230	-
02/17/2022	04:10	0.63	08:20	6.77	2.58	06:30	1.06	20:55	8.71	2.89	03:35	0.018	09:55	1.355	0.225	0.225	0.02
02/18/2022	02:35	0.95	20:30	6.09	2.56	13:15	0.73	19:40	8.75	2.87	13:15	0.019	19:40	1.218	0.224	0.224	-
02/19/2022	03:05	0.72	10:30	6.63	2.59	08:30	0.52	17:35	9.01	2.97	08:30	0.009	12:05	0.795	0.240	0.240	0.18
02/20/2022	05:55	0.87	16:05	6.45	2.81	18:00	0.70	09:00	9.23	3.15	18:00	0.016	09:05	1.483	0.271	0.271	0.09
02/21/2022	07:55	1.22	13:50	8.80	4.13	17:05	0.88	12:40	9.87	4.67	17:05	0.042	10:25	2.181	0.635	0.635	1.19
02/22/2022	06:10	1.04	18:30	7.32	3.70	17:40	1.04	14:35	9.58	4.50	06:10	0.182	19:05	1.983	0.512	0.512	-
02/23/2022	08:00	0.82	07:30	7.26	3.40	14:05	0.85	07:55	9.51	3.74	03:00	0.129	13:20	1.483	0.368	0.368	-
02/24/2022	02:25	1.08	20:05	6.52	3.27	11:00	1.21	08:40	9.41	3.47	12:05	0.049	08:40	1.602	0.342	0.342	0.10
02/25/2022	10:55	0.96	16:15	6.48	3.14	13:50	0.86	10:55	9.66	3.51	19:25	0.057	06:15	1.490	0.328	0.328	-
02/26/2022	05:35	1.04	13:45	6.85	3.11	14:20	1.03	10:35	9.46	3.37	05:55	0.073	19:50	1.476	0.314	0.314	0.01
02/27/2022	18:05	0.92	15:00	7.13	3.15	23:05	0.99	09:00	9.43	3.37	23:05	0.026	09:10	0.732	0.303	0.303	0.06
02/28/2022	04:20	0.86	10:40	9.08	3.98	07:20	0.64	10:35	10.25	4.34	07:25	0.014	22:20	1.961	0.591	0.591	0.80
03/01/2022	16:10	0.55	20:25	7.58	3.69	20:55	1.08	16:10	10.41	4.95	16:10	0.087	12:00	1.691	0.519	0.519	0.01
03/02/2022	04:10	0.82	08:45	7.01	3.55	17:55	0.98	22:40	11.46	4.24	19:45	0.034	22:55	0.961	0.413	0.413	0.26
03/03/2022	05:20	1.07	20:05	7.23	3.89	20:10	1.15	03:25	11.98	5.10	09:55	0.038	16:30	1.188	0.569	0.569	0.23
03/04/2022	00:10	0.94	08:35	6.57	3.44	11:00	0.92	17:35	11.92	4.69	23:40	0.049	19:25	0.987	0.439	0.439	-
03/05/2022	05:25	0.99	12:35	6.87	3.25	16:35	0.88	21:10	10.60	4.35	16:35	0.043	21:15	1.186	0.391	0.391	-
03/06/2022	23:50	0.70	10:25	6.63	3.09	21:50	0.99	23:45	11.06	4.06	14:15	0.031	18:50	1.842	0.336	0.336	-
03/07/2022	08:25	0.31	20:10	6.70	2.94	05:20	1.10	20:30	10.99	3.63	03:40	0.030	14:50	0.943	0.298	0.298	-
03/08/2022	11:15	0.64	13:10	6.58	2.93	13:15	0.95	11:15	10.61	3.57	03:05	0.055	20:00	0.610	0.289	0.289	0.09
03/09/2022	00:45	0.38	10:40	6.56	2.81	14:35	0.86	08:45	11.92	3.47	14:35	0.022	09:40	0.595	0.268	0.268	-
03/10/2022	04:40	0.38	20:50	6.39	2.83	15:30	1.18	21:30	10.91	3.50	03:15	0.040	16:15	0.994	0.274	0.274	-
03/11/2022	10:10	0.88	16:40	6.28	2.72	23:00	0.96	19:20	12.19	3.43	03:40	0.059	19:20	0.529	0.256	0.256	-
03/12/2022	05:20	0.75	13:15	7.98	2.74	13:15	0.56	23:45	10.57	3.33	05:00	0.036	23:50	1.030	0.256	0.256	0.01
03/13/2022	21:05	0.76	10:55	6.86	2.83	21:05	0.86	08:25	11.27	3.20	21:05	0.011	12:25	1.113	0.252	0.252	0.05
03/14/2022	06:50	0.26	20:00	6.63	2.85	13:20	0.86	17:40	11.77	3.23	01:45	0.021	19:00	0.585	0.254	0.254	0.14
03/15/2022	02:15	0.61	09:35	7.42	3.08	07:10	1.03	19:40	10.81	3.89	02:55	0.030	09:15	1.368	0.354	0.354	0.37
03/16/2022	13:05	0.94	15:00	6.88	3.17	07:40	0.62	13:00	10.61	3.75	07:40	0.013	00:15	1.137	0.337	0.337	0.03
03/17/2022	02:45	0.89	18:30	7.25	3.41	17:35	1.32	00:15	10.46	4.10	01:50	0.063	18:25	1.468	0.431	0.431	0.37
03/18/2022	23:45	1.23	12:00	7.22	3.49	06:45	1.28	04:25	11.02	4.24	03:20	0.160	19:15	1.590	0.443	0.443	0.17
03/19/2022	06:00	1.22	11:30	7.85	3.92	18:45	1.51	05:55	11.11	4.65	01:35	0.180	17:20	2.174	0.580	0.580	0.24
03/20/2022	03:35	1.00	10:25	7.28	3.60	08:25	1.24	12:05	11.16	4.15	23:50	0.136	16:05	0.838	0.430	0.430	0.01
03/21/2022	01:25	1.17	07:15	7.93	3.76	16:20	1.25	09:00	10.72	4.51	01:10	0.129	17:10	1.511	0.522	0.522	0.27
03/22/2022	23:25	1.63	08:35	7.52	3.88	07:15	1.26	15:10	9.60	4.40	07:15	0.061	20:10	2.067	0.536	0.536	0.12
03/23/2022	14:15	1.26	15:20	7.76	3.76	19:00	0.99	15:10	11.79	4.58	02:40	0.190	18:15	2.121	0.530	0.530	0.18
03/24/2022	06:15	1.47	19:05	7.62	3.54	07:10	1.20	06:10	11.16	4.46	20:40	0.052	08:05	0.752	0.474	0.474	-
03/25/2022	04:45	1.24	09:40	6.86	3.27	17:00	1.16	14:20	10.69	4.23	02:10	0.149	14:25	0.865	0.408	0.408	-
03/26/2022	13:55	1.09	11:15	7.42	3.18	14:25	1.05	18:50	10.36	3.82	10:05	0.064	08:20	0.652	0.358	0.358	-
03/27/2022	03:15	0.88	08:05	6.78	3.13	08:45	0.88	13:35	10.94	3.67	21:45	0.027	09:20	0.883	0.339	0.339	0.01
03/28/2022	15:20	0.63	15:35	9.57	3.13	13:40	1.15	09:55	10.93	3.66	01:25	0.052	19:40	0.887	0.347	0.347	0.15
03/29/2022	14:55	0.15	19:40	6.68	2.96	17:20	1.08	08:55	10.90	3.56	14:55	0.013	09:00	0.784	0.298	0.298	-
03/30/2022	04:40	0.46	11:05	7.17	3.21	08:35	1.11	04:40	10.72	3.73	01:45	0.027	05:40	0.919	0.351	0.351	0.21
03/31/2022	04:05	0.63	19:15	6.53	3.09	18:30	1.12	08:10	10.16	3.51	14:00	0.035	20:05	2.000	0.324	0.324	-
04/01/2022	02:55	0.92	17:40	6.80	2.97	10:50	1.37	19:20	10.21	3.48	02:55	0.052	19:25	0.846	0.310	0.310	0.05
04/02/2022	05:10	0.82	09:55	7.72	2.90	11:25	1.22	14:30	9.08	3.24	05:10	0.043	09:15	0.993	0.291	0.291	-
04/03/2022	02:30	0.96	12:15	6.22	2.87	09:20	1.61	08:15	9.26	3.25	02:30	0.047	12:10	0.949	0.291	0.291	0.03

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
04/04/2022	01:30	1.05	06:25	7.63	3.04	08:15	1.28	06:40	10.35	3.74	01:30	0.061	06:00	0.944	0.350	0.350	0.15
04/05/2022	23:50	1.20	09:10	6.53	3.01	17:45	1.26	06:20	10.55	3.50	23:55	0.079	15:25	1.161	0.309	0.309	0.01
04/06/2022	03:40	1.00	09:00	9.24	2.88	19:25	0.43	06:50	9.22	3.26	19:25	0.021	10:00	0.589	0.286	0.286	-
04/07/2022	12:05	0.92	10:00	6.23	2.79	12:05	0.69	18:15	10.36	3.25	12:05	0.012	18:20	0.901	0.279	0.279	-
04/08/2022	01:25	0.90	12:55	6.89	3.01	18:55	1.13	11:05	9.99	3.70	00:35	0.045	02:30	0.663	0.329	0.329	0.27
04/09/2022	05:35	1.03	10:55	6.37	2.92	11:15	0.34	16:15	9.94	3.29	11:15	0.022	16:20	1.011	0.292	0.292	0.04
04/10/2022	00:15	1.18	08:35	8.15	3.65	10:40	1.41	12:05	10.78	4.23	00:00	0.126	12:05	2.200	0.486	0.486	0.49
04/11/2022	22:50	1.48	08:40	7.93	3.58	08:40	1.19	08:20	12.44	4.09	22:50	0.171	20:30	0.893	0.443	0.443	-
04/12/2022	02:50	1.03	10:45	6.62	3.31	10:45	0.88	08:55	9.67	3.65	02:30	0.101	04:35	0.990	0.354	0.354	0.03
04/13/2022	23:40	0.96	15:05	7.12	3.16	08:30	0.90	05:00	10.53	3.55	21:45	0.028	16:35	1.285	0.326	0.326	-
04/14/2022	02:25	0.72	18:40	6.65	2.90	18:55	0.72	13:55	10.27	3.45	18:55	0.025	09:40	0.610	0.289	0.289	-
04/15/2022	20:55	0.70	07:35	7.29	2.91	07:00	0.74	20:55	7.12	3.30	07:00	0.018	19:20	0.539	0.288	0.288	-
04/16/2022	04:15	0.58	09:00	6.59	2.90	11:05	1.29	07:55	9.30	3.44	04:15	0.025	22:15	0.935	0.298	0.298	0.12
04/17/2022	04:00	0.75	09:00	6.68	2.89	07:20	1.23	09:45	10.49	3.47	04:00	0.037	20:20	0.972	0.304	0.304	0.01
04/18/2022	02:10	0.67	18:35	7.54	3.08	17:55	1.40	07:25	11.56	3.65	01:55	0.027	07:30	1.481	0.363	0.363	0.45
04/19/2022	07:00	1.02	07:10	6.84	3.21	16:50	1.38	11:50	10.41	3.67	01:55	0.101	18:30	0.934	0.358	0.358	-
04/20/2022	03:00	0.98	11:15	6.24	3.08	13:05	1.03	15:45	10.12	3.32	02:30	0.065	15:45	1.901	0.308	0.308	0.07
04/21/2022	02:10	0.82	18:15	6.62	3.01	20:00	1.04	15:10	10.24	3.16	09:35	0.034	05:35	0.701	0.287	0.287	0.05
04/22/2022	02:45	0.93	10:50	6.43	2.84	14:35	1.30	10:15	10.09	3.18	02:45	0.047	19:20	0.885	0.272	0.272	-
04/23/2022	03:25	0.82	08:45	6.53	2.73	14:45	0.58	22:00	7.10	3.12	14:45	0.025	05:50	0.637	0.260	0.260	-
04/24/2022	04:30	0.58	09:20	6.38	2.80	05:25	1.01	08:15	10.17	3.17	04:30	0.023	18:30	1.120	0.278	0.278	-
04/25/2022	02:00	0.71	08:20	7.96	2.81	08:20	0.47	15:40	8.79	3.17	02:35	0.026	15:35	0.886	0.268	0.268	0.16
04/26/2022	02:00	0.87	08:35	7.49	2.92	20:10	1.04	05:30	10.05	3.07	02:00	0.039	05:35	1.468	0.278	0.278	0.07
04/27/2022	01:25	1.01	18:10	6.41	2.95	20:20	1.15	07:00	11.02	2.97	01:25	0.048	07:05	1.905	0.273	0.273	0.12
04/28/2022	03:35	0.91	19:00	6.55	2.88	23:45	0.98	11:55	10.31	3.08	23:45	0.022	12:05	0.557	0.262	0.262	-
04/29/2022	03:20	0.69	07:05	6.47	2.73	07:00	1.37	08:05	10.56	3.08	02:30	0.023	14:55	0.739	0.252	0.252	-
04/30/2022	02:20	0.61	08:15	7.17	2.72	06:30	1.14	05:30	10.41	3.20	04:00	0.019	09:10	1.916	0.268	0.268	0.10
05/01/2022	03:30	0.70	10:35	6.80	2.80	16:05	0.93	09:35	6.00	3.02	03:25	0.023	10:35	0.809	0.262	0.262	-
05/02/2022	00:35	0.78	07:20	8.48	3.49	21:50	1.48	05:35	11.16	3.85	00:35	0.033	07:55	1.015	0.437	0.437	0.58
05/03/2022	02:40	1.17	18:50	6.95	3.29	18:05	0.92	09:50	10.95	3.37	23:50	0.093	09:55	0.638	0.327	0.327	0.07
05/04/2022	01:45	1.00	17:30	7.60	3.12	18:15	1.11	16:25	10.17	3.39	01:55	0.063	16:25	1.216	0.317	0.317	0.01
05/05/2022	01:10	0.98	14:20	8.10	3.72	05:55	1.38	20:55	10.37	3.97	01:10	0.057	17:30	1.401	0.477	0.477	0.56
05/06/2022	01:25	1.06	17:45	7.58	3.75	06:05	1.36	15:10	10.70	4.14	01:35	0.189	05:35	0.746	0.469	0.469	0.14
05/07/2022	03:15	1.29	18:10	8.13	3.49	18:10	1.28	07:55	10.69	4.22	03:15	0.133	21:05	0.938	0.438	0.438	0.26
05/08/2022	23:40	1.30	19:35	7.31	3.53	20:10	1.54	17:10	10.37	3.97	08:15	0.107	21:00	0.958	0.432	0.432	0.08
05/09/2022	01:35	1.09	18:20	6.46	3.17	18:20	1.16	05:15	10.61	3.93	01:50	0.083	09:25	1.134	0.387	0.387	0.09
05/10/2022	05:55	1.11	08:40	6.58	3.13	07:10	1.21	16:50	10.30	3.51	02:20	0.085	21:35	1.622	0.339	0.339	-
05/11/2022	02:40	1.12	14:40	6.64	2.99	14:40	1.31	14:45	9.80	3.32	02:00	0.069	14:45	1.273	0.309	0.309	-
05/12/2022	02:25	1.08	17:25	6.65	3.07	05:45	1.42	15:40	10.30	3.43	00:35	0.063	19:50	1.144	0.333	0.333	0.21
05/13/2022	03:45	1.10	19:30	6.64	3.02	10:40	1.06	05:00	9.12	3.20	02:05	0.067	10:00	0.627	0.295	0.295	-
05/14/2022	05:00	1.07	13:10	6.87	3.06	09:15	1.38	06:40	10.44	3.29	05:00	0.069	10:10	1.707	0.317	0.317	0.07
05/15/2022	01:55	1.17	13:30	7.45	3.42	06:35	1.22	14:10	10.46	3.75	02:05	0.070	10:50	2.195	0.435	0.435	0.42
05/16/2022	03:20	1.28	07:05	6.74	3.25	08:10	1.19	06:15	10.68	3.65	23:50	0.097	06:15	0.830	0.361	0.361	0.03
05/17/2022	02:50	1.14	18:50	6.94	3.14	13:00	1.40	08:40	10.45	3.33	02:35	0.072	08:40	0.851	0.315	0.315	-
05/18/2022	01:40	1.02	11:50	6.86	3.05	09:15	1.45	18:05	10.12	3.18	01:00	0.061	11:45	0.903	0.305	0.305	0.08
05/19/2022	03:25	0.86	18:25	6.35	2.89	14:50	1.61	10:20	12.03	3.12	03:25	0.043	10:20	0.819	0.275	0.275	-
05/20/2022	05:20	0.59	18:40	6.41	2.85	18:35	0.95	20:10	10.76	3.03	00:50	0.043	18:45	0.565	0.257	0.257	-
05/21/2022	01:30	0.82	18:45	6.56	2.80	18:45	0.87	07:05	10.41	3.07	02:55	0.037	09:20	0.619	0.258	0.258	-
05/22/2022	03:00	0.69	09:40	7.22	2.81	19:25	1.17	06:15	10.48	3.20	03:00	0.024	08:50	0.577	0.272	0.272	-
05/23/2022	03:15	0.60	19:20	6.22	2.74	20:05	1.31	15:30	9.86	3.12	03:15	0.027	21:25	0.949	0.260	0.260	-
05/24/2022	02:10	0.59	17:50	7.50	3.43	00:10	0.50	07:55	5.32	2.58	02:10	0.014	07:55	0.740	0.294	0.294	0.01
05/25/2022	23:55	0.94	07:15	8.31	3.02	07:20	0.64	05:40	10.31	2.95	21:15	0.023	16:15	0.769	0.272	0.272	0.15
05/26/2022	02:00	0.68	11:20	6.28	2.93	06:50	1.39	14:15	9.64	2.96	01:50	0.022	07:40	0.923	0.278	0.278	0.12
05/27/2022	02:20	0.86	06:10	6.56	2.78	19:15	1.45	22:50	9.82	3.10	02:20	0.041	07:05	0.609	0.262	0.262	-
05/28/2022	02:50	0.69	21:40	5.96	2.64	11:50	1.22	09:40	8.63	2.91	02:50	0.018	09:40	1.269	0.245	0.245	0.12
05/29/2022	02:45	1.32	11:30	6.56	3.06	18:15	1.38	17:00	10.03	3.41	22:10	0.053	08:20	0.913	0.329	0.329	0.17
05/30/2022	02:25	0.84	19:15	6.46	2.93	19:20	1.29	20:15	8.92	2.96	02:10	0.038	20:15	0.852	0.283	0.283	0.02
05/31/2022	01:50	0.84	19:50	6.27	2.76	16:05	1.34	20:30	10.68	2.97	01:50	0.026	06:30	1.693	0.264	0.264	-
06/01/2022	02:15	0.93	07:25	5.83	2.69	02:15	1.23	08:15	10.11	2.85	02:15	0.023	07:25	0.494	0.243	0.243	0.02
06/02/2022	04:10	0.65	18:35	6.31	2.71	14:45	0.73	10:10	8.82	2.85	01:35	0.021	17:00	0.525	0.243	0.243	0.03
06/03/2022	03:25	0.82	07:25	6.84	3.04	02:00	1.23	07:05	11.20	3.50	02:00	0.022	06:35	1.118	0.362	0.362	0.45
06/04/2022	04:15	1.06	10:45	6.51	2.78	20:15	1.38	13:25	8.13	3.32	04:15	0.059	08:30	0.734	0.286	0.286	0.06
06/05/2022	01:20	0.95	15:15	7.37	3.32	20:00	1.30	07:55	11.01	3.90	01:15	0.044	07:55	1.121	0.408	0.408	0.32
06/06/2022	03:45	1.20	07:45	7.36	3.15	21:00	1.06	08:35	11.31	3.60	03:25	0.104	08:40	1.287	0.344	0.344	0.01
06/07/2022	03:30	1.13	19:25	6.81	3.05	06:00	1.22	15:40	10.24	3.16	03:30	0.065	08:30	0.632	0.294	0.294	0.01
06/08/2022	03:15	0.98	19:00	6.16	2.85	18:55	1.15	07:05	10.61	3.01	02:25	0.042	07:10	0.747	0.271	0.271	0.02
06/09/2022	02:10	1.01	15:50	8.28	3.80	06:00	1.39	14:50	12.01	4.19	02:10	0.035	14:50	1.963	0.610	0.610	1.13
06/10/2022	23:25	1.18	06:45	7.12	3.98	23:25	1.00	04:15	11.26	4.15	23:25	0.026	18:00	1.569	0.552	0.552	0.02
06/11/2022	03:25	1.14	09:35	7.20	3.43	11:55	1.21	07:20	11.47	4.11	03:25	0.103	21:35	1.308	0.428	0.428	0.03
06/12/2022	12:05	0.95	08:45	6.95	3.25	08:40	1.31	08:00	11.04	3.79	02:55	0.091	16:45	0.926	0.383	0.383	-
06/13/2022	00:05	1.17	17:45	5.93	3.19	11:50	1.59	14:35	10.43	3.82	02:25	0.084	10:05	1.228	0.387	0.387	0.34
06/14/2022	00:00	1.16	18:30	7.04	3.31	07:20	1.19	19:40	10.39	3.80	23:55	0.103	00:20	0.722	0.391	0.391	-
06/15/2022	03:35	1.24	16:20	6.50	3.15	15:10	1.74	19:00	10.00	3.36	01:40	0.083	07:55	0.989	0.341	0.341	-
06/16/2022	03:20	1.18	06:05	6.07	3.15	19:45	1.89	10:45	9.30	3.12	01:30	0.067	18:25	0.848	0.322	0.322	-

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
06/17/2022	02:40	1.07	19:55	5.78	3.05	03:25	0.69	09:40	10.16	3.08	03:25	0.030	15:40	0.937	0.306	0.306	0.03
06/18/2022	02:10	1.18	10:05	5.82	2.98	18:45	1.38	06:45	9.60	3.14	02:10	0.062	11:00	0.771	0.302	0.302	0.03
06/19/2022	03:30	1.04	09:35	7.36	3.16	13:05	1.54	08:50	9.59	3.05	03:30	0.043	13:10	1.548	0.328	0.328	-
06/20/2022	02:50	1.08	20:20	6.55	3.15	17:05	0.60	09:25	9.76	2.99	17:05	0.041	17:10	0.764	0.313	0.313	-
06/21/2022	01:00	1.26	12:10	6.70	3.14	23:10	1.65	09:00	10.70	3.12	01:00	0.054	19:50	1.047	0.327	0.327	-
06/22/2022	01:55	1.37	10:00	6.50	3.24	11:50	1.51	13:05	9.65	3.04	02:05	0.070	19:05	0.631	0.332	0.332	0.02
06/23/2022	02:40	1.30	16:25	6.71	3.23	08:30	1.14	08:10	8.94	3.01	02:05	0.046	08:10	1.327	0.327	0.327	-
06/24/2022	03:30	1.39	06:40	6.32	3.18	23:25	1.23	07:50	8.17	2.91	02:15	0.057	07:50	0.595	0.312	0.312	-
06/25/2022	03:35	1.05	21:35	6.48	3.02	03:35	1.14	14:30	8.56	2.90	03:35	0.025	08:40	1.276	0.300	0.300	-
06/26/2022	03:05	1.24	11:15	6.58	3.08	01:50	0.81	08:35	8.01	2.83	03:05	0.035	08:35	0.688	0.296	0.296	-
06/27/2022	09:10	1.01	08:00	6.30	2.82	16:00	1.12	06:50	9.86	3.02	16:00	0.045	06:50	0.720	0.268	0.268	-
06/28/2022	02:10	0.73	19:10	6.48	2.75	02:30	1.24	20:40	10.18	2.90	02:10	0.016	20:45	0.821	0.260	0.260	0.02
06/29/2022	02:30	1.13	21:15	6.26	3.12	03:20	1.09	07:20	9.87	2.92	02:05	0.030	19:25	1.699	0.313	0.313	-
06/30/2022	03:05	1.38	18:55	6.12	3.20	19:50	1.37	11:00	10.18	2.99	02:25	0.070	11:05	0.915	0.317	0.317	-
07/01/2022	15:30	0.92	08:15	6.47	2.99	01:55	0.95	15:30	9.54	2.78	02:35	0.038	15:35	0.941	0.276	0.276	-
07/02/2022	04:15	0.88	19:50	7.22	2.79	19:50	0.92	21:15	8.28	2.76	03:15	0.020	14:50	0.632	0.258	0.258	-
07/03/2022	02:15	0.97	15:00	6.25	3.13	02:00	1.09	08:40	10.46	2.81	02:00	0.023	08:45	0.716	0.308	0.308	0.16
07/04/2022	03:55	1.14	10:25	7.04	3.17	03:55	1.16	09:40	10.39	2.83	03:55	0.028	09:45	0.972	0.315	0.315	-
07/05/2022	02:25	1.14	11:05	6.40	3.14	02:30	1.25	18:30	9.46	2.81	02:30	0.031	18:25	1.144	0.300	0.300	-
07/06/2022	23:35	0.38	18:20	5.97	2.99	02:35	1.01	05:55	8.02	2.82	11:05	0.026	05:55	1.136	0.285	0.285	-
07/07/2022	08:45	0.51	19:30	6.21	2.68	01:15	1.00	08:40	10.21	2.82	00:55	0.009	21:10	0.597	0.245	0.245	0.01
07/08/2022	17:55	1.09	16:20	6.01	2.99	12:25	1.62	07:25	9.79	3.00	04:05	0.053	20:20	0.991	0.286	0.286	-
07/09/2022	02:00	1.15	14:15	6.16	3.05	00:50	1.00	13:25	9.31	2.78	01:45	0.028	13:30	0.695	0.292	0.292	-
07/10/2022	02:25	1.14	11:00	6.27	3.01	03:20	0.99	18:10	10.12	2.80	02:50	0.027	11:25	0.637	0.288	0.288	-
07/11/2022	02:05	0.85	20:55	6.04	2.89	00:35	1.03	19:10	9.40	2.80	02:25	0.019	19:15	1.011	0.274	0.274	-
07/12/2022	02:20	0.75	14:15	6.66	2.89	22:10	1.33	23:55	8.66	2.97	02:20	0.028	10:20	0.564	0.277	0.277	-
07/13/2022	23:05	0.73	18:30	6.22	2.96	01:05	1.01	08:35	9.85	2.74	23:00	0.024	20:30	1.157	0.269	0.269	0.01
07/14/2022	03:00	0.50	20:00	5.76	2.40	02:20	0.91	19:45	10.59	2.70	02:30	0.007	06:55	0.652	0.205	0.205	-
07/15/2022	02:10	0.64	19:25	6.22	2.74	02:00	0.96	06:30	10.06	2.67	02:00	0.010	11:50	1.111	0.242	0.242	-
07/16/2022	03:35	1.13	07:45	7.07	3.00	03:30	0.96	07:35	9.67	2.74	03:30	0.023	07:40	1.386	0.283	0.283	-
07/17/2022	02:35	1.05	09:50	6.67	2.89	01:55	0.84	08:20	8.38	2.76	02:35	0.021	11:25	0.911	0.276	0.276	-
07/18/2022	02:05	0.71	20:30	6.81	2.86	02:45	0.89	19:20	8.37	2.68	02:05	0.014	20:40	0.696	0.258	0.258	-
07/19/2022	01:55	1.10	19:35	7.16	3.11	01:45	0.98	20:20	10.25	2.70	01:45	0.023	20:20	0.958	0.288	0.288	-
07/20/2022	02:30	0.95	18:40	6.19	2.75	01:55	0.91	21:15	9.48	2.59	02:30	0.020	18:45	0.636	0.233	0.233	-
07/21/2022	01:55	0.63	21:20	5.51	2.52	06:00	1.19	08:20	9.72	2.85	01:55	0.014	08:20	0.985	0.229	0.229	-
07/22/2022	01:15	0.97	08:55	6.04	2.86	01:50	1.03	16:10	9.88	2.80	01:15	0.020	16:10	1.963	0.274	0.274	-
07/23/2022	02:25	1.26	07:00	6.74	2.78	00:40	0.92	09:30	10.05	2.67	01:05	0.029	09:00	0.620	0.244	0.244	-
07/24/2022	03:50	0.96	19:55	6.05	2.83	02:35	0.79	09:35	10.09	2.60	02:50	0.015	16:40	0.916	0.259	0.259	-
07/25/2022	01:50	1.08	07:30	6.81	3.14	01:10	0.98	16:50	9.35	2.72	01:10	0.024	09:15	1.332	0.295	0.295	-
07/26/2022	23:25	1.24	19:40	5.97	3.08	01:50	1.31	09:10	9.85	2.74	01:50	0.044	18:30	0.842	0.284	0.284	-
07/27/2022	02:30	1.15	16:25	6.67	2.97	02:30	0.95	10:50	4.28	2.63	02:30	0.024	10:05	0.624	0.267	0.267	-
07/28/2022	01:05	1.22	19:55	6.91	3.07	01:50	0.94	09:45	10.21	2.73	01:05	0.030	18:00	0.866	0.288	0.288	-
07/29/2022	02:10	0.68	07:40	6.18	2.69	01:55	0.96	09:10	10.26	2.76	01:55	0.012	16:40	0.760	0.239	0.239	-
07/30/2022	04:30	1.07	13:25	6.10	3.03	03:05	0.94	09:45	8.38	2.79	04:30	0.021	09:50	0.943	0.296	0.296	-
07/31/2022	03:10	1.18	12:45	6.71	3.14	13:50	1.10	09:30	9.83	2.85	03:05	0.035	09:35	1.070	0.307	0.307	-
08/01/2022	01:40	1.24	08:20	6.18	3.26	01:35	0.93	10:50	9.61	2.69	01:35	0.026	19:25	0.588	0.309	0.309	-
08/02/2022	02:05	1.26	10:35	6.31	3.26	02:25	0.89	08:20	8.98	2.59	02:00	0.027	18:15	0.568	0.300	0.300	-
08/03/2022	02:25	1.36	18:50	6.50	3.14	02:20	0.92	19:30	9.29	2.54	02:20	0.032	04:00	0.759	0.278	0.278	0.02
08/04/2022	05:00	1.18	07:25	5.94	2.70	01:30	0.80	05:00	9.42	2.43	02:00	0.032	09:25	0.558	0.221	0.092	0.20

01/25/2022 00:00 - 08/04/2022 22:55

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			61.329	13.96
Average	3.06	3.34	0.321	

ST_MH19SE470

Site Commentary

SITE INFORMATION

Pipe	Elliptical (15 in H x 15 in W)
Silt	0.00 (in)

OBSERVATIONS

Average flow depth, velocity, and quantity data observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	**DFINAL (in)**	**VFINAL (ft/s)**	**QFINAL (MGD - Total MG)**
Average	2.71	6.27	0.646
Minimum	1.45	1.88	0.105
Maximum	4.54	8.38	1.552
Min Time	03/13/2022 2:45:00 AM	08/03/2022 2:50:00 AM	08/03/2022 2:50:00 AM
Max Time	06/09/2022 5:45:00 PM	03/21/2022 4:55:00 AM	06/09/2022 5:45:00 PM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions and data on the graphical reports are based on the none average.

DATA UPTIME

Data uptime observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022** is provided in the following table:

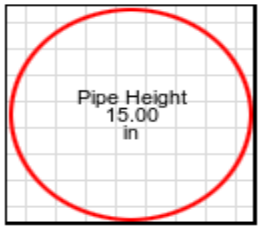
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	100
QFINAL (MGD - Total MG)	100

Hydrograph Report

ST_MH19SE470

Flow Monitor

ST_MH19SE470



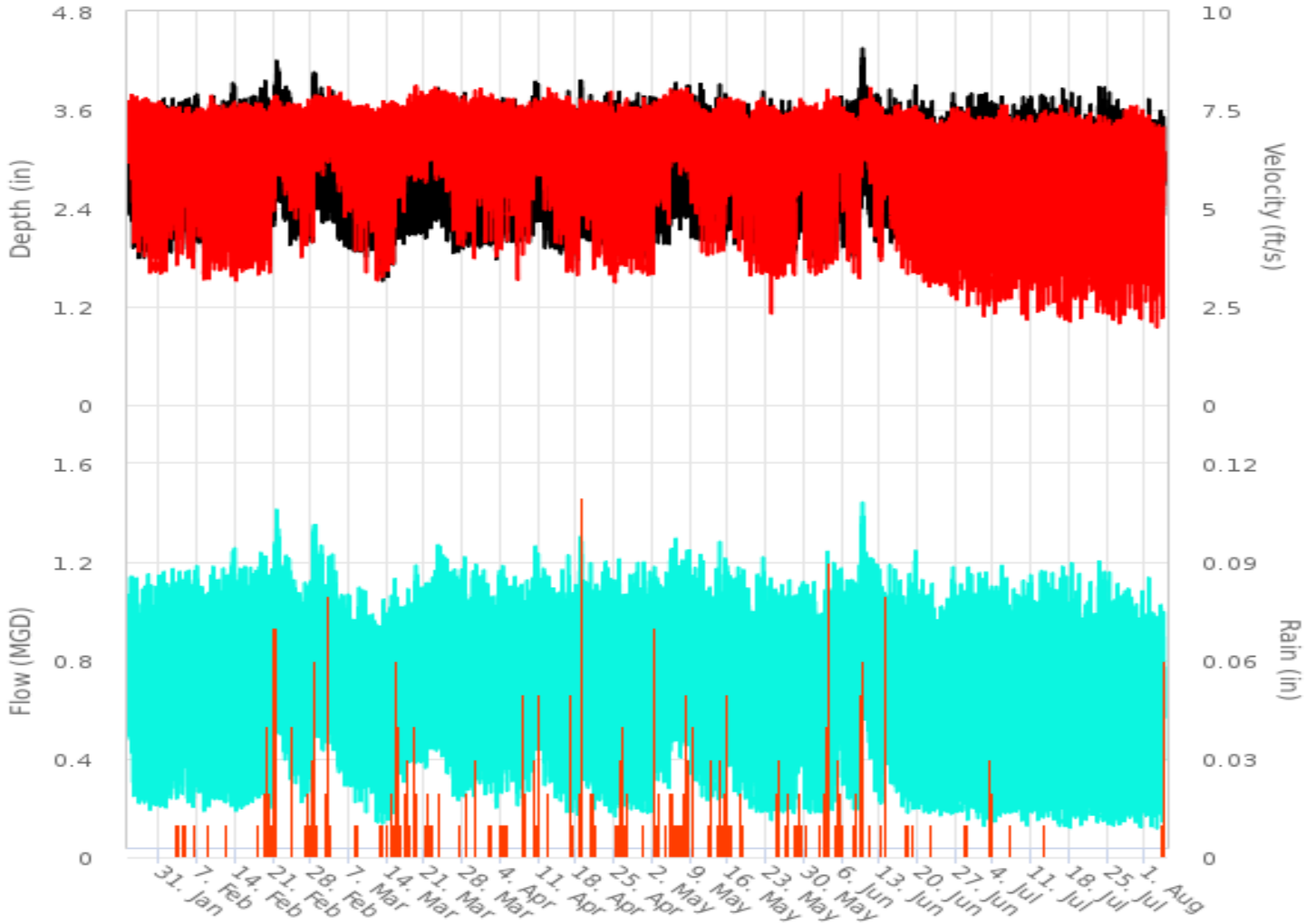
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL
- QFINAL
- Rain
- VFINAL

ADS ENVIRONMENTAL SERVICES

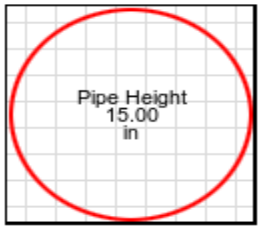


Scattergraph Report

ST_MH19SE470

Flow Monitor

ST_MH19SE470



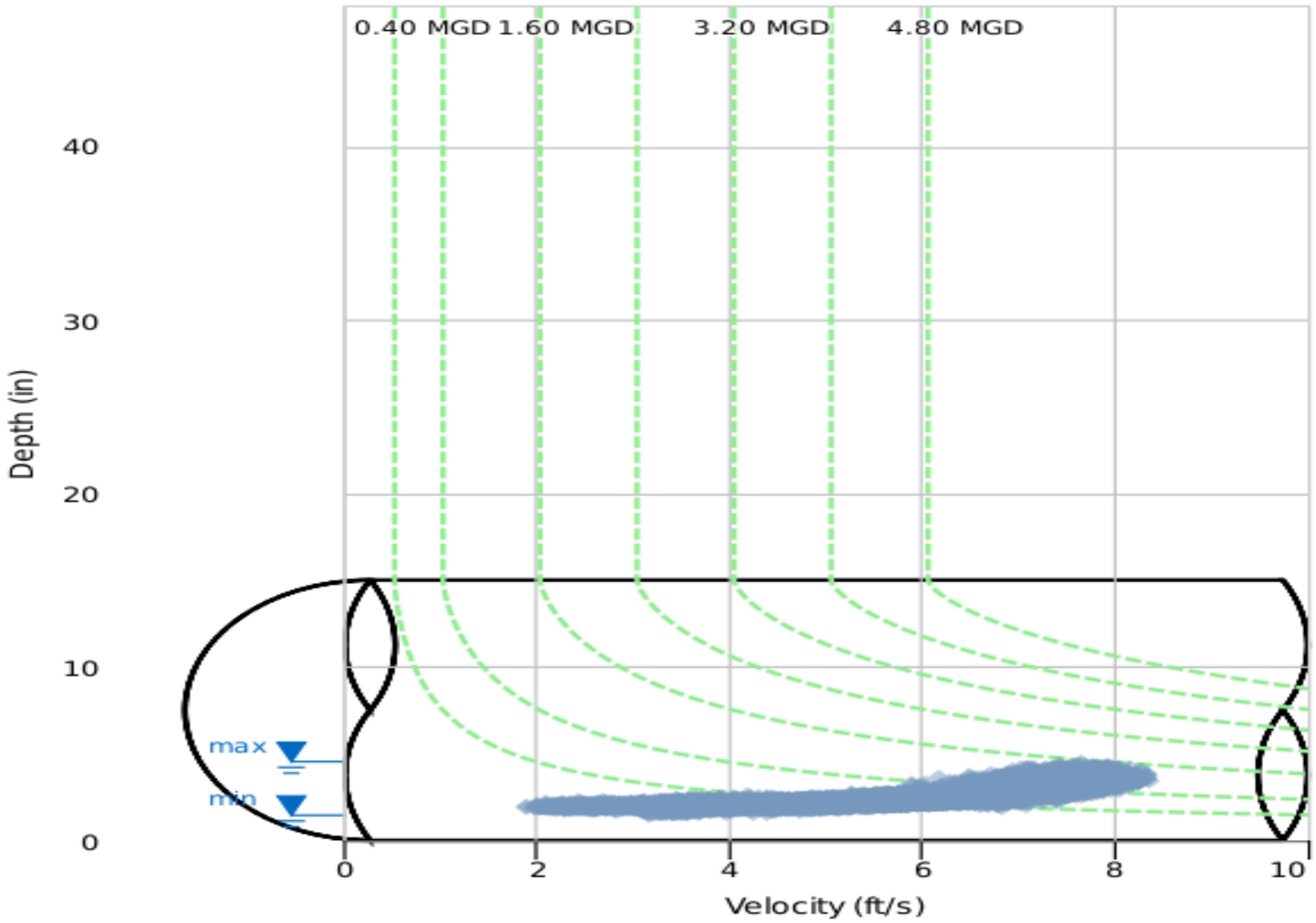
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL - VFINAL
- Iso-Q™
- Min-Max Depth

ADS ENVIRONMENTAL SERVICES



Daily Tabular Report

01/25/2022 00:00 - 08/04/2022 22:55
ST_MH19SE470Pipe: Elliptical (15 in H x 15 in W), Silt0.00 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/25/2022	23:30	2.14	20:05	3.84	2.85	23:25	5.66	19:30	8.24	6.96	23:30	0.393	20:10	1.277	0.748	0.447	-
01/26/2022	02:10	1.90	17:35	3.79	2.67	04:25	3.81	18:30	7.99	6.69	04:25	0.231	17:35	1.245	0.663	0.663	-
01/27/2022	01:55	1.74	18:30	3.75	2.57	04:05	3.66	09:55	7.99	6.58	03:55	0.211	18:30	1.225	0.623	0.623	-
01/28/2022	02:20	1.76	21:35	3.85	2.58	03:55	3.71	09:45	7.97	6.48	03:50	0.213	21:35	1.232	0.619	0.619	-
01/29/2022	06:25	1.78	14:25	3.81	2.63	04:25	3.34	10:50	7.97	6.36	04:25	0.190	14:30	1.244	0.631	0.631	-
01/30/2022	06:05	1.80	19:40	3.94	2.74	04:45	3.22	19:40	8.05	6.31	06:15	0.204	19:40	1.340	0.666	0.666	-
01/31/2022	05:20	1.81	19:50	3.99	2.69	03:20	3.26	16:05	7.98	6.19	02:15	0.197	19:50	1.308	0.632	0.632	-
02/01/2022	03:25	1.78	06:55	3.94	2.73	03:20	3.36	04:25	8.01	6.21	03:30	0.187	04:25	1.329	0.644	0.644	-
02/02/2022	02:35	1.81	19:25	4.17	2.72	04:10	3.84	16:10	7.93	6.27	02:35	0.214	19:25	1.328	0.645	0.645	-
02/03/2022	02:35	1.94	16:30	4.20	2.82	03:30	3.23	16:30	7.99	6.36	02:10	0.206	16:30	1.451	0.683	0.683	0.16
02/04/2022	04:25	2.07	11:20	4.01	2.71	04:05	3.66	20:50	7.73	6.27	04:05	0.245	11:20	1.302	0.636	0.636	0.05
02/05/2022	02:50	1.84	12:25	4.12	2.66	05:10	3.58	06:45	8.05	6.24	05:05	0.212	12:25	1.362	0.624	0.624	-
02/06/2022	03:50	1.81	11:00	4.04	2.71	03:50	3.22	12:25	7.90	6.20	03:50	0.175	11:00	1.337	0.643	0.643	0.01
02/07/2022	03:35	1.93	17:35	3.94	2.66	03:40	3.93	18:25	7.88	6.31	03:40	0.247	17:35	1.265	0.626	0.626	-
02/08/2022	04:15	1.82	20:25	3.85	2.62	04:10	3.09	20:30	7.98	6.14	02:50	0.173	20:25	1.253	0.603	0.603	-
02/09/2022	01:45	2.02	15:55	4.02	2.70	02:10	3.12	12:05	8.10	6.23	02:10	0.200	15:55	1.330	0.638	0.638	0.01
02/10/2022	00:15	2.01	10:40	3.98	2.75	02:05	3.30	10:40	7.95	6.20	02:05	0.229	10:40	1.342	0.648	0.648	-
02/11/2022	03:15	2.11	17:45	4.10	2.73	03:00	3.32	17:50	7.93	6.15	03:00	0.232	20:30	1.376	0.638	0.638	-
02/12/2022	05:05	1.96	09:55	4.01	2.75	03:35	3.31	21:05	7.90	6.21	03:50	0.207	09:55	1.326	0.654	0.654	0.01
02/13/2022	03:20	1.93	12:05	4.07	2.78	05:05	3.18	12:05	7.94	6.25	05:00	0.197	12:05	1.379	0.672	0.672	-
02/14/2022	01:45	1.86	19:50	3.90	2.73	02:20	3.09	19:05	7.77	6.15	02:10	0.185	19:50	1.250	0.642	0.642	-
02/15/2022	01:45	1.85	20:00	3.83	2.71	02:25	3.29	06:40	8.11	6.10	02:25	0.195	06:40	1.247	0.632	0.632	-
02/16/2022	04:10	1.93	18:15	3.88	2.75	03:30	3.22	06:40	7.83	6.15	03:30	0.203	14:15	1.260	0.649	0.649	-
02/17/2022	01:50	2.02	08:20	4.15	2.77	02:00	3.25	20:15	7.90	6.11	01:55	0.217	08:20	1.339	0.652	0.652	0.02
02/18/2022	01:00	2.08	13:30	3.97	2.85	04:15	3.23	14:30	7.97	6.06	03:45	0.233	13:35	1.311	0.672	0.672	-
02/19/2022	03:45	2.24	10:30	4.23	2.97	03:40	3.20	06:35	7.86	6.08	03:40	0.240	10:30	1.413	0.715	0.715	0.18
02/20/2022	05:55	1.87	16:05	4.02	2.79	05:35	3.24	19:20	8.07	6.31	05:35	0.188	17:40	1.325	0.678	0.678	0.09
02/21/2022	00:40	2.16	18:10	4.34	3.22	00:15	4.65	07:05	8.06	7.04	00:15	0.343	18:10	1.513	0.906	0.906	1.19
02/22/2022	23:55	2.41	11:00	4.08	3.07	03:35	5.72	06:25	8.09	6.78	23:55	0.484	11:00	1.335	0.808	0.808	-
02/23/2022	02:45	2.24	17:45	3.97	2.93	02:45	5.32	05:55	8.05	6.72	02:45	0.395	16:00	1.322	0.758	0.758	-
02/24/2022	01:15	1.89	20:05	3.72	2.76	03:05	4.86	04:45	7.97	6.72	01:15	0.300	20:05	1.193	0.696	0.696	0.10
02/25/2022	02:50	2.00	18:00	3.75	2.69	02:55	4.54	03:25	7.92	6.53	02:55	0.291	18:00	1.207	0.652	0.652	-
02/26/2022	02:20	1.92	13:40	3.86	2.69	03:50	3.61	19:45	7.82	6.35	03:50	0.215	19:45	1.220	0.641	0.641	0.01
02/27/2022	03:05	1.93	15:00	3.94	2.76	03:05	3.89	08:25	7.85	6.52	03:05	0.232	15:00	1.280	0.679	0.679	0.06
02/28/2022	03:50	1.93	10:40	4.31	3.11	03:40	3.76	11:35	8.04	6.96	03:40	0.230	10:40	1.473	0.863	0.863	0.80
03/01/2022	02:55	2.36	20:25	4.04	2.98	04:10	5.83	05:35	8.16	7.05	04:10	0.482	20:20	1.317	0.803	0.803	0.01
03/02/2022	02:25	2.21	17:55	3.81	2.88	03:55	5.72	05:25	8.13	7.03	03:50	0.426	17:55	1.250	0.765	0.765	0.26
03/03/2022	02:35	2.23	20:05	3.97	3.06	02:20	6.09	05:05	8.33	7.26	02:35	0.455	18:35	1.336	0.859	0.859	0.23
03/04/2022	21:45	2.13	08:35	3.92	2.77	02:50	5.86	11:35	8.01	6.99	02:50	0.428	08:35	1.271	0.719	0.719	-
03/05/2022	04:20	2.00	11:50	3.64	2.64	02:55	5.32	08:10	8.19	6.88	04:30	0.337	14:55	1.139	0.664	0.664	-
03/06/2022	05:05	1.90	20:20	3.67	2.63	04:20	4.40	05:30	8.20	6.70	04:20	0.268	20:20	1.187	0.654	0.654	-
03/07/2022	01:40	1.88	14:40	3.57	2.56	05:05	4.68	14:40	8.08	6.63	02:55	0.283	14:40	1.167	0.619	0.619	-
03/08/2022	02:05	1.86	19:50	3.64	2.56	02:05	3.74	13:10	7.90	6.48	02:05	0.212	19:50	1.151	0.607	0.607	0.09
03/09/2022	02:35	1.85	10:40	3.77	2.51	02:25	3.71	13:30	7.93	6.36	02:50	0.217	10:40	1.229	0.581	0.581	-
03/10/2022	02:45	1.76	20:50	3.59	2.51	02:50	3.26	16:10	7.78	6.33	02:50	0.178	23:20	1.119	0.580	0.580	-
03/11/2022	06:00	1.85	12:00	3.58	2.47	01:15	3.89	12:05	7.83	6.31	03:25	0.235	12:05	1.116	0.561	0.561	-
03/12/2022	02:55	1.55	09:15	3.59	2.48	03:35	3.09	08:25	7.64	6.11	05:15	0.136	14:15	1.108	0.560	0.560	0.01
03/13/2022	02:45	1.45	19:25	3.81	2.52	02:35	3.18	07:55	8.22	6.23	02:45	0.125	08:00	1.226	0.589	0.589	0.05
03/14/2022	01:05	1.55	18:40	3.62	2.49	02:05	3.31	17:05	7.95	6.37	02:05	0.147	18:40	1.155	0.583	0.583	0.14
03/15/2022	01:40	1.66	18:25	3.71	2.62	01:40	3.53	09:35	7.90	6.49	01:40	0.170	09:35	1.195	0.635	0.635	0.37
03/16/2022	01:25	2.01	08:05	4.02	2.65	03:00	5.17	19:35	7.88	6.69	03:00	0.329	08:05	1.252	0.650	0.650	0.03
03/17/2022	01:45	1.96	17:40	3.77	2.72	02:40	4.72	18:30	8.10	6.83	02:40	0.291	18:30	1.264	0.692	0.692	0.37
03/18/2022	03:20	2.05	16:10	3.63	2.70	02:00	5.77	03:45	8.04	6.94	03:20	0.378	16:10	1.176	0.688	0.688	0.17
03/19/2022	01:35	2.06	13:30	3.86	2.87	03:40	5.58	05:35	8.23	7.15	03:40	0.370	08:15	1.290	0.778	0.778	0.24
03/20/2022	04:00	2.07	09:45	3.73	2.76	03:55	5.71	07:30	8.33	7.01	03:55	0.381	08:20	1.202	0.721	0.721	0.01
03/21/2022	01:25	2.01	09:30	3.86	2.79	00:20	5.56	04:55	8.38	7.15	01:25	0.354	09:30	1.272	0.746	0.746	0.27
03/22/2022	00:45	2.13	21:55	3.68	2.83	23:10	5.98	21:55	8.35	7.30	01:15	0.432	21:55	1.258	0.772	0.772	0.12
03/23/2022	23:35	2.15	09:15	4.05	2.96	01:50	5.65	20:00	8.29	7.20	01:50	0.426	09:15	1.364	0.819	0.819	0.18
03/24/2022	22:35	2.08	20:30	3.95	2.84	23:50	5.66	17:35	8.34	7.05	22:35	0.394	20:30	1.358	0.756	0.756	-
03/25/2022	03:25	1.96	09:40	3.83	2.73	03:15	5.30	05:15	8.16	6.84	03:20	0.331	15:30	1.270	0.700	0.700	-
03/26/2022	04:10	1.83	11:15	3.94	2.76	03:50	4.38	16:55	8.22	6.72	04:15	0.244	16:55	1.315	0.701	0.701	-
03/27/2022	02:40	1.85	17:15	4.10	2.77	02:40	3.88	06:00	8.06	6.57	02:40	0.218	17:15	1.309	0.695	0.695	0.01
03/28/2022	00:30	1.90	06:45	4.07	2.71	01:15	3.74	03:30	8.18	6.45	01:15	0.231	06:45	1.375	0.659	0.659	0.15
03/29/2022	23:05	1.90	20:25	3.84	2.67	03:05	4.15	20:25	8.11	6.53	00:05	0.254	20:25	1.301	0.650	0.650	-
03/30/2022	03:15	1.94	08:35	3.92	2.77	02:05	3.61	17:20	8.23	6.79	02:05	0.238	17:20	1.290	0.710	0.710	0.21
03/31/2022	00:35	1.91	20:00	3.79	2.69	02:00	4.73	04:10	8.19	6.78	02:00	0.283	19:15	1.254	0.679	0.679	-
04/01/2022	00:25	1.93	17:40	3.82	2.63	03:00	3.84	04:45	8.04	6.72	02:50	0.245	17:40	1.264	0.651	0.651	0.05
04/02/2022	01:10	1.90	09:55	3.93	2.63	03:35	4.04	07:10	8.15	6.63	03:20	0.254	09:55	1.294	0.647	0.647	-
04/03/2022	02:40	1.75	12:15	3.87	2.66	03:35	3.59	10:50	8.01	6.44	02:40	0.195	12:15	1.272	0.650	0.650	0.03

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
04/04/2022	03:15	1.94	14:55	3.93	2.74	03:05	3.78	16:45	8.07	6.60	03:05	0.249	17:35	1.280	0.682	0.682	0.15
04/05/2022	02:20	1.97	18:35	3.75	2.69	02:35	3.90	06:40	8.22	6.60	02:35	0.254	18:35	1.274	0.665	0.665	0.01
04/06/2022	23:40	1.92	09:55	3.97	2.68	23:30	4.28	06:25	8.19	6.29	23:30	0.262	06:25	1.231	0.631	0.631	-
04/07/2022	00:40	1.94	19:00	3.85	2.68	02:35	3.08	10:55	7.80	6.21	02:25	0.207	19:00	1.247	0.625	0.625	-
04/08/2022	02:00	1.91	12:55	3.90	2.77	00:25	3.59	05:55	8.09	6.55	00:25	0.228	16:25	1.280	0.681	0.681	0.27
04/09/2022	05:20	1.93	07:55	3.84	2.73	02:10	3.83	05:45	7.87	6.39	05:20	0.248	07:55	1.228	0.658	0.658	0.04
04/10/2022	00:00	1.91	08:35	4.09	3.04	00:00	4.98	07:50	8.01	6.87	00:00	0.292	08:35	1.351	0.811	0.811	0.49
04/11/2022	22:50	2.18	07:25	4.01	2.95	22:50	5.68	19:15	8.05	6.85	22:50	0.404	19:15	1.347	0.772	0.772	-
04/12/2022	02:55	1.89	16:50	3.68	2.77	02:50	4.93	16:00	8.25	6.89	02:55	0.291	16:50	1.234	0.718	0.718	0.03
04/13/2022	02:55	1.90	19:30	3.74	2.70	02:40	4.83	06:25	8.15	6.82	02:40	0.292	15:10	1.240	0.687	0.687	-
04/14/2022	01:15	1.86	20:10	3.75	2.63	03:00	3.97	03:10	8.24	6.58	03:00	0.231	10:30	1.217	0.647	0.647	-
04/15/2022	01:20	1.82	07:35	3.93	2.62	03:20	3.80	04:50	8.06	6.56	03:20	0.216	07:35	1.275	0.639	0.639	-
04/16/2022	03:10	1.71	09:30	3.89	2.68	04:20	3.30	11:05	8.15	6.45	03:10	0.181	11:55	1.298	0.660	0.660	0.12
04/17/2022	03:50	1.79	19:40	4.12	2.71	03:55	3.30	06:30	7.98	6.33	03:55	0.181	19:40	1.377	0.655	0.655	0.01
04/18/2022	02:25	1.75	18:35	4.15	2.75	02:15	3.19	18:35	8.16	6.30	02:15	0.169	18:35	1.458	0.669	0.669	0.45
04/19/2022	02:00	2.03	07:10	3.90	2.76	02:55	4.78	07:10	7.96	6.63	02:55	0.308	07:10	1.306	0.688	0.688	-
04/20/2022	23:45	1.95	13:00	3.95	2.69	00:50	4.20	05:50	7.99	6.59	03:05	0.257	13:00	1.262	0.662	0.662	0.07
04/21/2022	01:40	1.84	20:25	3.83	2.68	02:05	3.32	15:40	8.07	6.44	02:05	0.190	15:35	1.262	0.650	0.650	0.05
04/22/2022	04:15	1.90	20:00	3.95	2.64	02:45	3.62	20:00	7.97	6.47	02:20	0.222	20:00	1.328	0.634	0.634	-
04/23/2022	03:30	1.87	16:15	4.11	2.64	03:30	3.22	05:50	8.10	6.21	03:30	0.184	16:15	1.306	0.621	0.621	-
04/24/2022	03:50	1.77	18:50	3.91	2.69	03:35	3.25	07:05	8.05	6.20	04:30	0.176	18:55	1.262	0.638	0.638	-
04/25/2022	02:10	1.76	17:45	3.91	2.66	02:05	3.03	04:25	7.82	5.98	02:05	0.159	17:45	1.275	0.608	0.608	0.16
04/26/2022	00:45	1.90	15:30	3.81	2.66	01:05	3.50	21:30	7.96	6.33	03:00	0.210	15:30	1.244	0.632	0.632	0.07
04/27/2022	01:10	1.86	18:10	3.92	2.69	01:10	3.29	05:25	8.00	6.30	01:10	0.187	18:10	1.271	0.642	0.642	0.12
04/28/2022	04:10	1.84	20:25	3.96	2.65	01:25	3.30	19:45	7.76	6.18	01:25	0.187	19:50	1.241	0.618	0.618	-
04/29/2022	02:55	1.82	07:05	4.04	2.59	02:30	3.41	06:10	8.13	6.13	02:45	0.190	07:05	1.319	0.594	0.594	-
04/30/2022	02:15	1.77	09:45	4.02	2.63	04:00	3.23	07:30	8.10	6.25	04:00	0.174	09:45	1.322	0.624	0.624	0.10
05/01/2022	01:30	1.73	19:20	3.99	2.67	03:25	3.21	09:10	7.97	6.11	03:25	0.174	09:10	1.337	0.627	0.627	-
05/02/2022	00:25	1.81	07:20	4.18	2.91	01:30	3.16	09:10	7.88	6.61	00:30	0.178	07:20	1.422	0.746	0.746	0.58
05/03/2022	00:40	1.95	19:35	3.80	2.74	00:40	4.88	16:00	8.13	6.80	00:40	0.297	12:35	1.236	0.699	0.699	0.07
05/04/2022	01:05	1.96	08:35	3.84	2.69	01:45	4.81	05:45	8.12	6.75	01:45	0.293	08:35	1.260	0.679	0.679	0.01
05/05/2022	01:10	1.95	18:15	4.01	2.93	01:00	4.27	03:45	8.25	7.06	01:00	0.262	18:15	1.359	0.797	0.797	0.56
05/06/2022	02:45	2.25	06:45	3.98	2.90	02:50	6.09	11:25	8.20	7.16	02:50	0.458	06:50	1.312	0.789	0.789	0.14
05/07/2022	04:05	2.13	16:35	4.17	2.90	04:05	5.77	06:45	8.21	7.09	04:05	0.398	16:35	1.450	0.782	0.782	0.26
05/08/2022	23:35	2.21	19:35	4.29	2.98	23:10	5.67	06:20	8.35	6.98	23:35	0.430	19:35	1.486	0.801	0.801	0.08
05/09/2022	02:00	2.01	18:25	4.05	2.87	01:45	5.02	12:45	8.12	6.66	02:05	0.333	18:25	1.346	0.728	0.728	0.09
05/10/2022	02:10	2.01	08:40	4.01	2.78	02:20	4.39	08:40	7.80	6.49	02:20	0.280	08:40	1.328	0.682	0.682	-
05/11/2022	00:40	1.99	14:40	3.98	2.72	02:10	3.81	14:40	7.79	6.32	02:10	0.241	14:40	1.312	0.650	0.650	-
05/12/2022	02:45	1.89	17:25	4.03	2.78	02:20	3.75	17:25	7.84	6.34	02:20	0.225	17:25	1.342	0.672	0.672	0.21
05/13/2022	02:20	1.98	19:30	4.03	2.68	02:00	3.64	05:25	8.05	6.44	02:00	0.228	19:30	1.360	0.645	0.645	-
05/14/2022	01:35	1.88	09:15	3.99	2.68	01:30	3.52	08:00	8.08	6.55	01:30	0.203	09:15	1.342	0.661	0.661	0.07
05/15/2022	02:05	1.87	10:40	4.14	2.86	00:40	3.68	06:45	8.14	6.61	01:05	0.215	10:40	1.392	0.735	0.735	0.42
05/16/2022	23:50	2.03	07:05	3.96	2.82	02:55	5.22	05:35	7.99	6.68	23:50	0.342	07:05	1.335	0.714	0.714	0.03
05/17/2022	01:40	1.95	20:15	3.94	2.75	02:30	3.90	05:30	8.05	6.63	02:30	0.250	20:15	1.325	0.688	0.688	-
05/18/2022	00:05	2.00	16:50	3.86	2.75	01:10	3.81	05:50	7.88	6.43	01:10	0.244	16:50	1.268	0.670	0.670	0.08
05/19/2022	01:30	2.01	14:00	3.97	2.73	03:20	3.51	04:05	7.96	6.18	03:20	0.223	18:20	1.284	0.640	0.640	-
05/20/2022	01:00	1.91	15:55	3.76	2.62	00:45	3.21	15:55	7.87	6.35	01:00	0.189	15:55	1.226	0.618	0.618	-
05/21/2022	01:55	1.78	10:05	4.01	2.63	03:40	3.32	06:05	7.96	6.30	03:40	0.180	18:45	1.322	0.626	0.626	-
05/22/2022	02:25	1.74	08:50	4.09	2.70	04:30	3.26	07:05	8.29	6.21	01:45	0.180	07:05	1.440	0.646	0.646	-
05/23/2022	02:40	1.75	19:15	3.79	2.62	22:30	2.10	22:50	7.71	6.12	22:30	0.137	16:00	1.188	0.603	0.603	-
05/24/2022	04:00	1.80	18:45	3.98	2.62	01:40	3.25	16:00	7.91	5.97	04:05	0.182	16:00	1.282	0.592	0.592	0.01
05/25/2022	00:25	1.74	09:10	4.09	2.66	00:00	3.13	09:10	7.83	6.08	00:05	0.171	09:10	1.372	0.609	0.609	0.15
05/26/2022	01:35	1.82	11:20	3.82	2.69	02:00	3.11	06:05	7.69	6.05	01:35	0.177	11:20	1.191	0.618	0.618	0.12
05/27/2022	01:45	1.77	06:10	3.80	2.61	02:30	3.39	06:10	7.96	6.06	02:30	0.183	06:10	1.257	0.593	0.593	-
05/28/2022	01:50	1.76	11:50	3.79	2.58	01:45	3.17	05:20	7.80	6.12	01:45	0.168	21:40	1.204	0.592	0.592	0.12
05/29/2022	23:30	1.98	11:35	3.80	2.72	23:30	4.93	06:00	7.95	6.70	23:30	0.305	19:45	1.194	0.677	0.677	0.17
05/30/2022	02:55	1.76	15:15	3.78	2.68	04:20	3.60	05:45	7.84	6.32	02:45	0.196	14:20	1.192	0.643	0.643	0.02
05/31/2022	01:40	1.75	19:50	3.80	2.58	01:50	3.28	05:40	7.91	6.24	01:40	0.174	19:50	1.222	0.601	0.601	-
06/01/2022	01:10	1.75	07:25	3.73	2.58	01:25	3.24	05:35	7.99	6.14	02:10	0.172	07:25	1.220	0.589	0.589	0.02
06/02/2022	01:35	1.73	18:35	3.73	2.55	01:20	3.29	08:25	7.97	6.26	01:20	0.176	13:55	1.209	0.595	0.595	0.03
06/03/2022	02:10	1.71	07:25	3.94	2.67	00:55	3.21	07:25	8.27	6.54	00:55	0.165	07:25	1.373	0.664	0.664	0.45
06/04/2022	04:10	1.77	09:15	3.83	2.64	02:50	3.48	07:50	7.98	6.34	02:50	0.184	11:40	1.238	0.632	0.632	0.06
06/05/2022	01:30	1.81	15:15	4.02	2.90	01:00	3.59	06:50	8.21	6.73	01:25	0.208	15:15	1.324	0.750	0.750	0.32
06/06/2022	03:35	1.90	07:45	4.05	2.80	23:45	4.67	07:45	7.80	6.51	01:40	0.287	07:45	1.346	0.691	0.691	0.01
06/07/2022	03:35	2.02	06:00	4.11	2.72	03:25	3.57	06:00	7.89	6.30	03:25	0.234	06:00	1.394	0.646	0.646	0.01
06/08/2022	01:30	1.74	18:55	4.14	2.70	02:35	3.20	05:30	7.57	5.93	02:35	0.178	18:55	1.263	0.609	0.609	0.02
06/09/2022	00:40	1.89	17:45	4.54	3.14	03:00	3.11	17:05	7.80	6.42	03:50	0.191	17:45	1.552	0.825	0.825	1.13
06/10/2022	23:55	2.29	06:40	4.03	3.08	23:55	5.90	00:10	8.25	7.02	23:55	0.450	17:10	1.360	0.837	0.837	0.02
06/11/2022	03:25	2.15	09:25	4.07	2.89	23:50	5.56	04:05	8.22	6.87	03:25	0.392	09:25	1.379	0.760	0.760	0.03
06/12/2022	23:50	1.94	19:40	4.08	2.88	03:20	4.02	07:15	7.91	6.58	03:20	0.250	19:40	1.354	0.729	0.729	-
06/13/2022	02:35	1.90	17:45	3.93	2.83	01:10	3.53	05:05	7.80	6.32	02:40	0.211	17:45	1.236	0.685	0.685	0.34
06/14/2022	23:55	2.01	19:55	4.24	2.84	23:40	4.73	05:40	7.72	6.54	23:50	0.307	19:55	1.370	0.704	0.704	-
06/15/2022	01:20	1.97	16:20	4.00	2.75	03:15	4.11	17:15	7.85	6.48	03:15	0.282	16:20	1.310	0.667	0.667	-
06/16/2022	03:25	1.96	17:15	4.07	2.71	01:35	3.87	16:25	8.04	6.43	01:35	0.257	17:15	1.313	0.654	0.654	-

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
06/17/2022	02:30	1.86	19:15	3.76	2.68	02:30	3.38	17:30	7.67	6.23	02:30	0.191	19:15	1.185	0.626	0.626	0.03
06/18/2022	02:40	1.79	10:50	3.86	2.69	02:00	3.17	06:55	7.78	6.10	02:00	0.172	10:45	1.226	0.626	0.626	0.03
06/19/2022	01:25	1.79	09:35	4.13	2.75	03:25	3.28	13:05	7.88	6.08	01:30	0.177	09:35	1.364	0.646	0.646	-
06/20/2022	02:10	1.82	08:55	3.84	2.71	04:05	3.26	06:15	7.76	5.97	02:10	0.179	08:55	1.209	0.616	0.616	-
06/21/2022	03:15	1.81	15:05	3.87	2.69	01:50	3.05	17:05	7.63	5.77	01:50	0.174	19:00	1.197	0.594	0.594	-
06/22/2022	01:20	1.83	10:00	4.00	2.69	01:40	2.95	15:05	7.60	5.78	01:45	0.165	10:00	1.280	0.593	0.593	0.02
06/23/2022	02:15	1.83	09:25	3.92	2.70	04:20	3.06	06:30	7.48	5.84	02:10	0.175	09:25	1.215	0.601	0.601	-
06/24/2022	02:40	1.75	06:40	3.80	2.70	02:30	2.99	06:40	7.55	5.86	02:40	0.160	06:40	1.194	0.602	0.602	-
06/25/2022	04:50	1.84	10:10	4.14	2.66	00:30	3.01	21:35	7.74	5.65	00:30	0.176	18:35	1.346	0.576	0.576	-
06/26/2022	02:25	1.85	11:15	4.15	2.67	03:30	2.45	09:05	7.78	5.72	03:30	0.150	11:15	1.386	0.591	0.591	-
06/27/2022	04:15	1.87	22:00	3.94	2.64	02:50	2.43	07:00	7.84	5.83	02:50	0.164	22:00	1.277	0.583	0.583	-
06/28/2022	03:25	1.82	19:10	4.02	2.64	02:00	2.89	19:10	7.84	5.72	02:00	0.174	19:10	1.342	0.573	0.573	0.02
06/29/2022	02:20	1.90	07:35	3.93	2.68	02:20	2.42	07:35	7.75	5.73	02:20	0.141	07:35	1.286	0.585	0.585	-
06/30/2022	03:15	1.86	13:05	3.83	2.67	02:25	2.71	06:45	7.50	5.73	03:15	0.176	13:05	1.189	0.579	0.579	-
07/01/2022	02:20	1.81	08:15	4.07	2.65	02:00	2.48	08:15	7.76	5.53	02:20	0.141	08:15	1.351	0.559	0.559	-
07/02/2022	04:05	1.80	19:50	4.20	2.65	03:25	2.21	18:50	7.72	5.43	03:55	0.124	18:50	1.386	0.557	0.557	-
07/03/2022	02:35	1.77	10:40	3.94	2.69	02:20	2.45	08:10	7.58	5.61	02:30	0.138	21:05	1.246	0.590	0.590	0.16
07/04/2022	06:00	1.90	10:25	4.01	2.71	03:50	2.17	17:05	7.67	5.66	03:50	0.128	17:05	1.298	0.598	0.598	-
07/05/2022	03:25	1.85	08:15	3.86	2.66	03:05	2.48	11:05	7.80	5.81	03:50	0.164	11:05	1.251	0.588	0.588	-
07/06/2022	02:35	1.83	20:40	3.83	2.62	03:05	2.44	08:05	7.87	5.78	01:55	0.161	20:40	1.229	0.575	0.575	-
07/07/2022	04:30	1.84	19:25	3.95	2.65	02:15	2.51	11:55	7.66	5.75	02:15	0.165	19:30	1.249	0.577	0.577	0.01
07/08/2022	03:55	1.87	16:20	3.91	2.63	01:20	2.78	08:05	7.56	5.54	02:55	0.174	16:20	1.235	0.556	0.556	-
07/09/2022	00:15	1.85	10:40	3.91	2.66	04:05	2.25	09:45	7.47	5.55	04:15	0.139	10:40	1.216	0.566	0.566	-
07/10/2022	03:10	1.84	19:10	4.11	2.67	02:10	2.04	09:25	7.59	5.50	02:10	0.120	19:10	1.307	0.573	0.573	-
07/11/2022	03:50	1.87	20:50	4.00	2.65	01:30	2.58	20:50	7.57	5.66	01:30	0.170	20:50	1.287	0.572	0.572	-
07/12/2022	04:00	1.87	19:00	3.96	2.65	02:10	2.29	19:00	7.68	5.45	02:15	0.140	19:00	1.288	0.554	0.554	-
07/13/2022	04:10	1.84	13:00	3.92	2.62	02:50	2.29	13:00	7.71	5.50	02:35	0.152	13:00	1.272	0.550	0.550	0.01
07/14/2022	01:15	1.88	20:00	4.01	2.62	01:05	2.46	05:40	7.75	5.56	01:05	0.159	20:00	1.305	0.552	0.552	-
07/15/2022	02:15	1.87	10:50	3.82	2.61	03:20	2.32	12:50	7.62	5.62	02:10	0.137	12:50	1.192	0.557	0.557	-
07/16/2022	03:25	1.84	15:30	4.14	2.59	03:15	2.04	07:45	7.98	5.50	03:15	0.115	07:45	1.324	0.547	0.547	-
07/17/2022	03:25	1.80	10:40	4.32	2.63	02:30	2.10	09:50	7.76	5.55	04:00	0.121	10:40	1.444	0.566	0.566	-
07/18/2022	02:30	1.83	19:40	3.98	2.66	02:25	2.04	07:35	7.68	5.58	02:25	0.114	19:40	1.288	0.572	0.572	-
07/19/2022	01:45	1.86	18:40	3.96	2.60	01:45	2.57	19:35	7.61	5.52	01:45	0.145	19:30	1.254	0.546	0.546	-
07/20/2022	02:20	1.68	18:40	3.87	2.60	01:20	2.10	06:30	7.63	5.69	01:20	0.124	18:40	1.184	0.560	0.560	-
07/21/2022	04:10	1.76	07:40	4.00	2.58	01:00	2.34	06:00	7.89	5.49	01:00	0.131	07:40	1.285	0.540	0.540	-
07/22/2022	03:45	1.80	07:55	3.61	2.58	01:55	2.54	09:45	7.40	5.49	02:35	0.152	09:45	1.076	0.536	0.536	-
07/23/2022	02:45	1.87	10:35	4.13	2.64	02:55	2.19	08:05	7.90	5.27	02:55	0.132	08:05	1.377	0.540	0.540	-
07/24/2022	02:35	1.85	10:00	4.07	2.68	02:45	2.24	10:55	7.37	5.44	02:45	0.134	19:05	1.279	0.568	0.568	-
07/25/2022	02:55	1.84	07:30	4.15	2.68	01:45	2.10	07:35	7.55	5.41	01:45	0.126	07:30	1.316	0.560	0.560	-
07/26/2022	04:30	1.82	19:35	4.29	2.63	02:10	2.11	19:35	7.63	5.23	02:10	0.124	19:35	1.430	0.534	0.534	-
07/27/2022	00:45	1.85	20:00	3.91	2.63	02:45	1.97	16:25	7.65	5.34	02:45	0.123	07:05	1.224	0.540	0.540	-
07/28/2022	00:25	1.90	09:05	3.98	2.56	01:20	2.10	19:55	7.93	5.33	01:20	0.136	06:55	1.294	0.519	0.519	-
07/29/2022	23:40	1.81	07:40	3.73	2.50	01:55	2.34	07:40	7.90	5.48	23:45	0.146	07:40	1.215	0.514	0.514	-
07/30/2022	04:45	1.79	13:25	3.64	2.48	01:40	2.26	08:00	7.72	5.50	04:10	0.132	13:25	1.148	0.512	0.512	-
07/31/2022	02:10	1.79	20:40	3.86	2.53	03:50	2.08	08:40	7.77	5.41	03:50	0.115	11:55	1.232	0.525	0.525	-
08/01/2022	03:35	1.81	13:00	3.95	2.58	01:20	2.52	13:00	7.68	5.34	23:40	0.150	13:00	1.279	0.526	0.526	-
08/02/2022	05:00	1.83	07:25	3.86	2.59	02:45	1.97	07:25	7.66	5.07	02:45	0.114	07:25	1.237	0.502	0.502	-
08/03/2022	02:40	1.83	19:40	4.03	2.59	02:50	1.88	16:55	7.43	5.11	02:50	0.105	19:40	1.275	0.510	0.510	0.02
08/04/2022	00:30	1.92	07:25	3.82	2.49	02:10	2.08	06:35	7.11	4.39	02:10	0.134	07:25	1.104	0.425	0.161	0.20

01/25/2022 00:00 - 08/04/2022 22:55

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			123.384	13.96
Average	2.71	6.27	0.646	

ST_MH24SE200

Site Commentary

SITE INFORMATION

Pipe	Elliptical (16 in H x 16 in W)
Silt	0.00 (in)

OBSERVATIONS

Average flow depth, velocity, and quantity data observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	**DFINAL (in)**	**VFINAL (ft/s)**	**QFINAL (MGD - Total MG)**
Average	11.19	0.40	0.255
Minimum	0.51	0.05	0.019
Maximum	69.39	2.18	1.877
Min Time	03/22/2022 10:10:00 AM	02/12/2022 5:05:00 AM	03/22/2022 10:10:00 AM
Max Time	02/07/2022 11:50:00 AM	03/22/2022 10:10:00 AM	07/14/2022 10:35:00 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions and data on the graphical reports are based on the none average.

DATA UPTIME

Data uptime observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022** is provided in the following table:

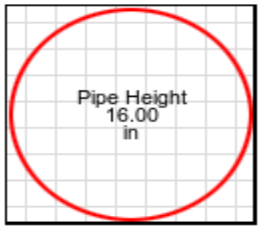
Percent Uptime	
DFINAL (in)	100
VFINAL (ft/s)	99.295
QFINAL (MGD - Total MG)	99.295

Hydrograph Report

ST_MH24SE200

Flow Monitor

ST_MH24SE200



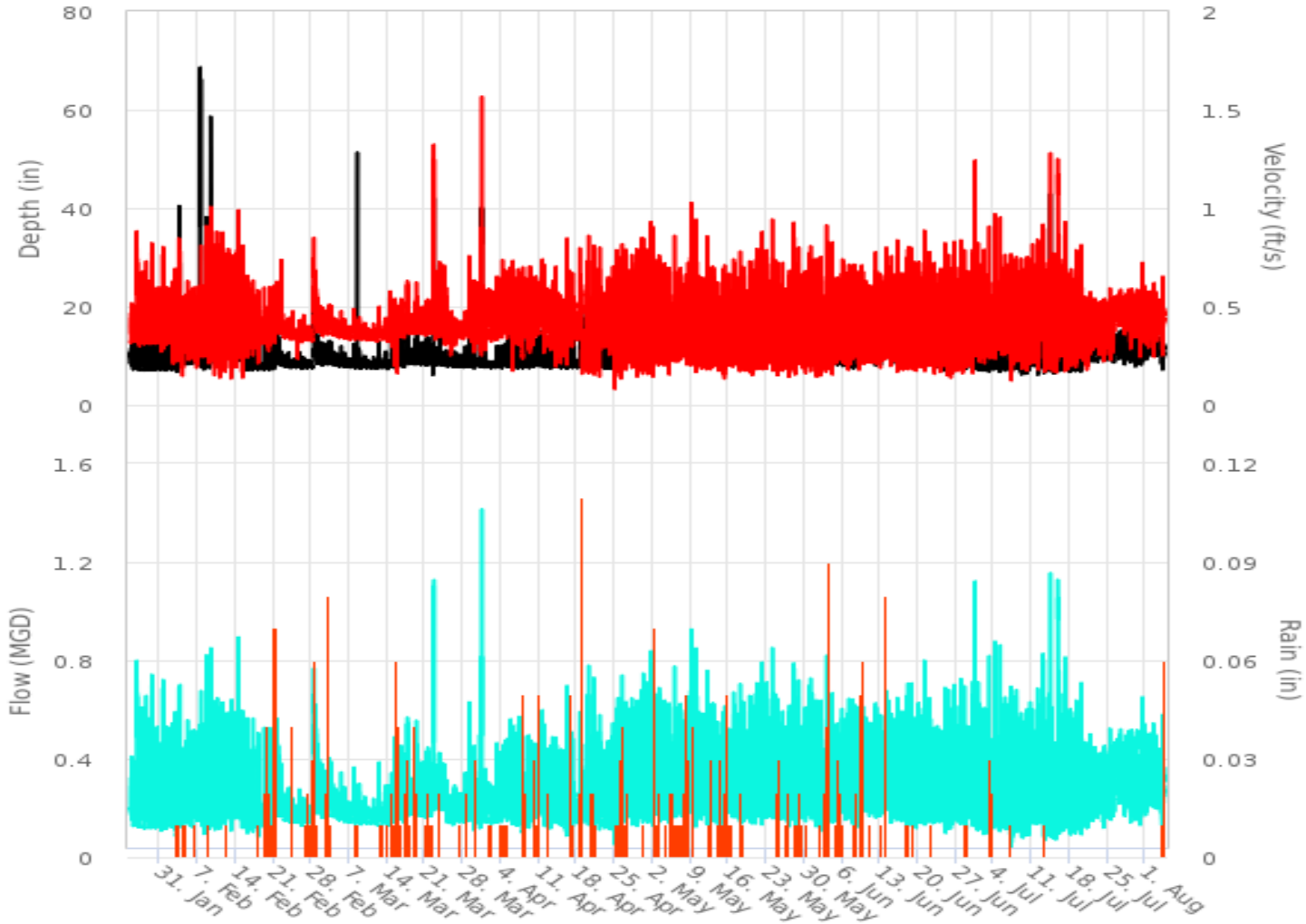
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL
- QFINAL
- Rain
- VFINAL

ADS ENVIRONMENTAL SERVICES

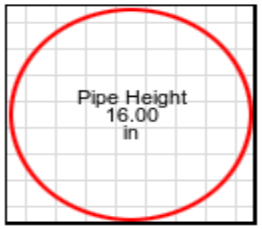


Scattergraph Report

ST_MH24SE200

Flow Monitor

ST_MH24SE200



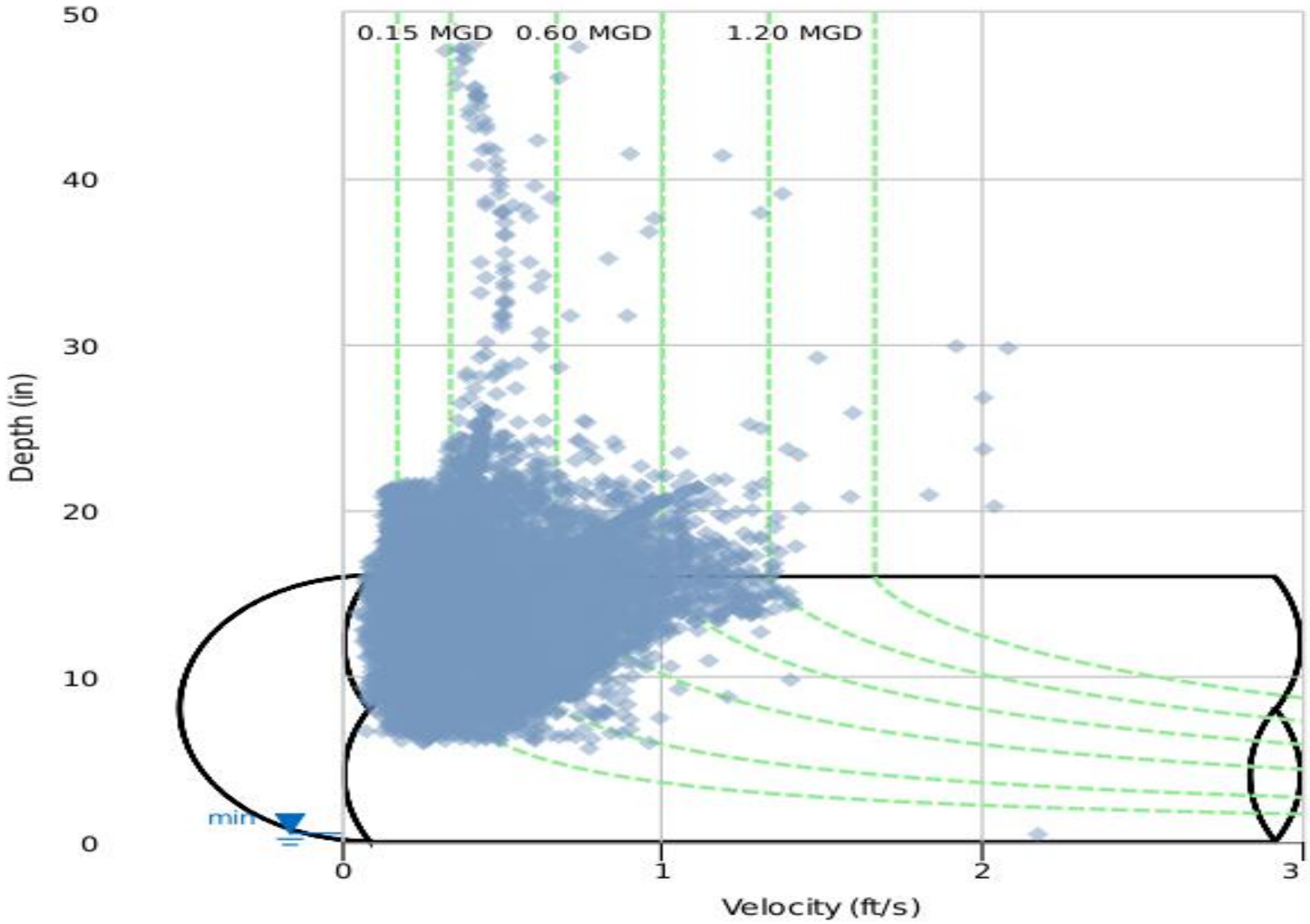
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL - VFINAL
- Iso-Q™
- Min-Max Depth

ADS ENVIRONMENTAL SERVICES



Daily Tabular Report

01/25/2022 00:00 - 08/04/2022 22:55
ST_MH24SE200Pipe: Elliptical (16 in H x 16 in W), Silt0.00 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/25/2022	23:55	7.49	19:20	13.33	10.13	14:40	0.26	19:15	0.52	0.42	23:55	0.137	19:20	0.417	0.254	0.101	-
01/26/2022	01:55	7.21	18:05	19.63	10.17	23:50	0.31	18:05	0.89	0.43	01:50	0.126	18:05	0.807	0.266	0.266	-
01/27/2022	01:40	7.17	19:55	17.34	10.67	06:00	0.29	19:55	0.71	0.44	06:00	0.118	19:55	0.642	0.289	0.289	-
01/28/2022	05:15	6.99	11:55	17.72	10.42	00:30	0.31	11:50	0.74	0.43	05:15	0.116	11:55	0.666	0.278	0.278	-
01/29/2022	04:40	7.03	12:05	18.87	10.20	01:45	0.31	12:05	0.83	0.43	04:45	0.117	12:05	0.750	0.270	0.270	-
01/30/2022	03:35	7.00	04:10	18.44	9.37	00:50	0.31	13:00	0.63	0.39	03:35	0.116	13:00	0.566	0.219	0.219	-
01/31/2022	00:05	6.94	14:05	19.89	9.57	07:55	0.24	14:05	0.93	0.42	05:55	0.101	14:05	0.840	0.240	0.240	-
02/01/2022	01:45	6.96	19:25	16.21	8.96	01:15	0.30	19:25	0.64	0.38	01:15	0.115	19:25	0.580	0.204	0.204	-
02/02/2022	23:50	7.10	10:45	18.08	9.24	14:35	0.07	07:15	1.16	0.38	14:35	0.055	07:15	1.032	0.207	0.207	-
02/03/2022	02:35	6.78	14:05	44.09	11.69	11:00	0.18	11:45	1.05	0.38	02:25	0.079	11:45	0.945	0.243	0.243	0.16
02/04/2022	02:00	7.46	03:30	17.03	11.11	03:55	0.06	04:05	0.79	0.38	03:55	0.043	03:00	0.620	0.249	0.249	0.05
02/05/2022	04:25	7.47	03:10	17.47	11.49	07:45	0.06	03:10	0.72	0.41	07:45	0.044	03:10	0.650	0.284	0.284	-
02/06/2022	05:30	7.61	12:50	17.60	11.91	23:20	0.11	12:50	0.73	0.38	05:30	0.085	12:50	0.658	0.267	0.267	0.01
02/07/2022	23:15	7.34	11:50	69.39	19.52	09:50	0.07	15:00	0.92	0.40	09:50	0.055	15:00	0.828	0.291	0.291	-
02/08/2022	03:25	6.98	13:55	39.57	12.53	03:30	0.06	15:00	1.31	0.40	03:30	0.032	15:00	1.180	0.279	0.279	-
02/09/2022	02:20	6.82	08:20	58.86	16.22	04:20	0.07	12:00	1.40	0.48	02:15	0.053	17:05	1.223	0.342	0.342	0.01
02/10/2022	05:40	7.94	21:35	19.02	12.21	01:45	0.09	17:35	1.39	0.51	04:20	0.070	14:15	1.205	0.363	0.363	-
02/11/2022	02:15	7.91	04:15	17.86	12.17	06:40	0.11	14:15	1.41	0.51	06:40	0.086	14:15	1.198	0.362	0.362	-
02/12/2022	03:55	7.79	05:55	17.84	11.88	05:05	0.05	21:55	1.32	0.50	05:05	0.043	22:20	1.100	0.346	0.346	0.01
02/13/2022	05:50	7.73	03:20	17.63	11.71	07:00	0.08	19:40	1.29	0.48	07:00	0.069	19:40	1.080	0.328	0.328	-
02/14/2022	03:05	7.56	12:50	41.85	12.30	06:55	0.13	12:55	2.01	0.52	06:40	0.068	12:55	1.810	0.364	0.364	-
02/15/2022	23:55	7.29	08:30	17.64	9.97	02:05	0.10	07:45	1.23	0.40	02:05	0.083	07:45	1.093	0.236	0.236	-
02/16/2022	03:25	7.10	03:50	17.00	8.03	04:15	0.23	08:35	0.75	0.36	04:15	0.093	03:50	0.622	0.166	0.166	-
02/17/2022	02:10	6.98	05:10	17.00	8.17	03:50	0.23	05:15	0.72	0.37	03:50	0.093	05:10	0.622	0.173	0.173	0.02
02/18/2022	03:10	7.12	05:35	16.57	8.22	02:40	0.20	05:40	0.70	0.35	02:40	0.079	03:40	0.588	0.167	0.167	-
02/19/2022	06:10	7.15	06:55	16.43	8.09	07:10	0.28	06:55	0.65	0.38	05:40	0.113	06:55	0.591	0.175	0.175	0.18
02/20/2022	01:55	7.09	07:25	16.92	8.13	02:40	0.24	07:25	0.68	0.36	02:40	0.094	07:25	0.617	0.168	0.168	0.09
02/21/2022	01:10	7.21	04:45	17.54	10.73	05:10	0.30	04:45	0.73	0.43	01:05	0.126	04:45	0.654	0.283	0.283	1.19
02/22/2022	23:55	7.87	10:45	11.80	8.77	10:40	0.34	09:50	0.81	0.40	23:55	0.153	09:50	0.418	0.201	0.201	-
02/23/2022	03:35	7.69	19:50	10.92	8.37	00:05	0.34	09:55	0.47	0.37	03:40	0.145	19:50	0.293	0.175	0.175	-
02/24/2022	03:40	7.55	17:20	9.54	8.22	02:15	0.33	13:35	0.50	0.36	03:20	0.139	13:35	0.268	0.170	0.170	0.10
02/25/2022	01:20	7.60	18:35	10.97	8.23	11:30	0.22	18:30	0.44	0.35	11:45	0.116	18:30	0.283	0.166	0.166	-
02/26/2022	05:05	7.27	11:15	10.03	8.12	04:55	0.31	13:15	0.51	0.36	04:55	0.126	11:15	0.262	0.167	0.167	0.01
02/27/2022	03:30	7.49	11:15	9.10	8.17	03:50	0.32	11:20	0.41	0.36	03:50	0.135	11:20	0.215	0.166	0.166	0.06
02/28/2022	02:40	7.45	09:45	21.69	12.30	02:40	0.31	11:10	0.91	0.49	02:40	0.129	11:10	0.821	0.364	0.364	0.80
03/01/2022	23:45	8.26	09:25	13.34	9.97	23:35	0.36	09:25	0.52	0.42	23:40	0.170	09:25	0.418	0.248	0.248	0.01
03/02/2022	02:25	8.04	14:00	14.26	9.06	01:05	0.35	08:30	0.49	0.39	02:25	0.160	14:00	0.373	0.205	0.205	0.26
03/03/2022	02:40	8.18	08:00	13.33	9.81	03:00	0.35	08:00	0.52	0.41	03:00	0.164	08:00	0.417	0.241	0.241	0.23
03/04/2022	03:45	8.08	11:30	11.43	8.71	01:40	0.35	11:25	0.46	0.38	03:40	0.162	11:30	0.318	0.190	0.190	-
03/05/2022	03:15	7.77	11:45	12.44	8.57	01:35	0.34	11:45	0.49	0.37	03:10	0.149	11:45	0.370	0.184	0.184	-
03/06/2022	04:20	7.62	02:30	13.83	8.38	01:50	0.33	02:30	0.54	0.36	01:50	0.142	02:30	0.445	0.175	0.175	-
03/07/2022	03:25	7.57	21:30	12.76	8.57	00:30	0.33	21:30	0.50	0.37	03:25	0.140	21:30	0.386	0.184	0.184	-
03/08/2022	02:40	7.44	11:10	52.62	12.30	00:00	0.33	18:40	0.46	0.36	02:00	0.135	18:35	0.343	0.173	0.142	0.09
03/09/2022	03:35	7.37	20:20	10.21	8.28	00:20	0.33	20:20	0.43	0.36	03:35	0.132	20:20	0.258	0.171	0.171	-
03/10/2022	05:30	7.37	07:15	9.27	8.22	05:30	0.32	07:15	0.40	0.36	05:30	0.131	07:15	0.215	0.168	0.168	-
03/11/2022	02:35	7.46	10:45	9.88	8.25	01:00	0.33	10:45	0.42	0.36	02:30	0.136	10:45	0.243	0.169	0.169	-
03/12/2022	01:50	7.33	12:20	14.51	8.21	01:40	0.32	12:20	0.56	0.36	06:00	0.130	12:20	0.484	0.168	0.168	0.01
03/13/2022	23:40	7.34	12:55	11.23	8.28	23:40	0.32	12:55	0.45	0.36	23:40	0.131	12:55	0.308	0.171	0.171	0.05
03/14/2022	01:30	7.24	18:25	14.61	8.45	18:25	0.25	13:10	0.60	0.42	01:25	0.127	18:20	0.452	0.203	0.203	0.14
03/15/2022	02:35	7.55	10:10	20.09	9.19	18:30	0.08	10:20	0.86	0.36	18:30	0.045	10:20	0.777	0.188	0.188	0.37
03/16/2022	23:55	7.69	13:50	14.30	9.38	04:50	0.34	12:55	0.55	0.40	23:55	0.145	13:50	0.472	0.223	0.223	0.03
03/17/2022	02:40	7.60	16:50	16.13	9.79	00:00	0.34	16:50	0.64	0.41	02:35	0.142	16:50	0.576	0.243	0.243	0.37
03/18/2022	02:40	8.26	07:15	12.05	9.05	00:35	0.36	07:15	0.48	0.39	02:40	0.169	07:15	0.349	0.205	0.205	0.17
03/19/2022	01:35	8.17	08:45	16.76	10.28	00:20	0.36	08:45	0.67	0.43	01:25	0.166	08:45	0.608	0.266	0.266	0.24
03/20/2022	23:55	8.10	11:00	13.12	9.30	23:55	0.35	09:25	0.51	0.40	23:40	0.163	11:00	0.406	0.217	0.217	0.01
03/21/2022	00:20	8.02	17:40	14.11	10.12	00:00	0.35	17:40	0.55	0.42	00:20	0.159	17:40	0.461	0.257	0.257	0.27
03/22/2022	10:10	0.51	15:00	47.75	10.52	20:35	0.30	10:10	2.18	0.50	10:10	0.019	14:15	1.838	0.293	0.293	0.12
03/23/2022	01:40	7.99	15:50	15.08	9.44	15:40	0.20	15:20	0.76	0.52	15:40	0.172	15:55	0.450	0.284	0.284	0.18
03/24/2022	23:45	7.92	19:35	11.31	8.98	21:05	0.27	09:15	0.75	0.51	20:55	0.177	09:15	0.410	0.265	0.265	-
03/25/2022	02:40	7.78	20:45	10.46	8.61	20:35	0.20	08:25	0.51	0.38	20:35	0.112	15:05	0.259	0.186	0.186	-
03/26/2022	02:40	7.66	10:30	11.18	8.55	09:45	0.25	09:20	0.46	0.36	02:35	0.124	10:30	0.305	0.178	0.178	-
03/27/2022	03:35	7.63	09:25	10.45	8.61	01:00	0.34	08:55	0.44	0.37	03:30	0.143	09:25	0.270	0.186	0.186	0.01
03/28/2022	01:40	7.58	10:35	12.12	8.67	01:35	0.33	10:35	0.48	0.38	01:35	0.141	10:35	0.353	0.189	0.189	0.15
03/29/2022	23:55	7.48	03:15	15.87	8.53	23:55	0.26	03:20	0.99	0.42	23:55	0.109	03:20	0.882	0.209	0.209	-
03/30/2022	00:30	7.42	03:10	16.94	8.68	03:05	0.21	03:15	0.79	0.45	00:25	0.107	01:00	0.601	0.225	0.225	0.21
03/31/2022	23:50	7.66	10:15	45.03	9.87	09:50	0.14	11:00	2.01	0.47	02:00	0.113	11:00	1.813	0.246	0.246	-
04/01/2022	01:15	7.58	03:00	16.27	8.36	02:50	0.17	03:05	0.84	0.47	02:50	0.125	03:05	0.621	0.227	0.227	0.05
04/02/2022	04:35	7.46	13:10	8.86	8.19	00:45	0.31	07:50	0.60	0.42	04:10	0.131	13:05	0.300	0.197	0.197	-
04/03/2022	04:20	7.58	05:30	16.00	8.50	07:20	0.26	05:35	0.84	0.43	07:20	0.135	17:45	0.677	0.211	0.211	0.03

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
04/04/2022	02:45	7.50	13:55	16.66	8.84	23:10	0.27	19:55	0.98	0.51	01:05	0.137	19:55	0.788	0.264	0.264	0.15
04/05/2022	23:55	7.46	22:25	17.21	8.84	02:30	0.11	02:50	1.14	0.46	02:30	0.065	02:50	0.949	0.237	0.237	0.01
04/06/2022	23:55	7.43	10:00	18.71	9.36	02:05	0.15	04:15	1.21	0.44	05:10	0.114	04:15	1.064	0.236	0.236	-
04/07/2022	00:00	7.43	03:10	16.72	8.66	03:05	0.14	04:05	1.11	0.42	23:00	0.095	04:05	0.997	0.214	0.214	-
04/08/2022	00:05	7.38	01:35	17.31	8.61	01:30	0.17	00:30	1.07	0.48	00:10	0.078	00:30	0.920	0.240	0.240	0.27
04/09/2022	02:50	7.50	09:00	18.30	8.99	06:40	0.18	08:50	1.40	0.47	04:45	0.112	08:50	0.812	0.245	0.245	0.04
04/10/2022	02:15	7.77	22:40	15.89	9.05	04:45	0.26	05:10	0.81	0.44	04:45	0.140	05:10	0.730	0.233	0.233	0.49
04/11/2022	23:30	7.75	05:05	17.51	9.52	20:55	0.25	22:00	1.13	0.49	23:55	0.143	22:00	0.987	0.275	0.275	-
04/12/2022	02:55	7.53	06:40	17.44	8.63	05:40	0.22	05:50	0.80	0.43	02:55	0.119	05:50	0.695	0.217	0.217	0.03
04/13/2022	01:20	7.47	06:10	16.54	9.11	06:05	0.20	23:55	1.15	0.46	02:50	0.111	23:55	0.999	0.246	0.246	-
04/14/2022	23:55	7.49	01:20	18.93	9.23	04:30	0.17	03:00	1.07	0.45	23:50	0.126	03:00	0.908	0.241	0.241	-
04/15/2022	01:05	7.40	00:25	18.08	9.14	03:55	0.12	01:40	1.13	0.39	03:55	0.086	01:40	0.930	0.206	0.206	-
04/16/2022	02:50	7.33	15:30	17.71	8.77	03:00	0.19	04:20	1.14	0.40	03:30	0.081	04:20	1.017	0.206	0.206	0.12
04/17/2022	03:55	7.51	06:35	18.14	8.70	06:25	0.15	05:15	0.88	0.42	02:55	0.119	05:15	0.779	0.208	0.208	0.01
04/18/2022	02:20	7.50	21:10	20.01	9.82	21:55	0.12	12:30	1.11	0.42	21:55	0.106	12:30	0.992	0.238	0.238	0.45
04/19/2022	23:25	13.15	23:55	22.94	15.87	06:00	0.13	22:55	0.72	0.28	06:00	0.112	22:55	0.649	0.251	0.251	-
04/20/2022	03:35	12.79	01:45	22.02	15.75	01:25	0.14	04:00	1.09	0.30	02:40	0.110	04:00	0.986	0.263	0.263	0.07
04/21/2022	23:50	7.68	02:15	23.04	13.16	05:55	0.12	02:20	1.05	0.38	05:55	0.105	02:20	0.950	0.265	0.265	0.05
04/22/2022	04:15	7.54	01:20	17.57	8.99	21:05	0.12	05:30	1.30	0.43	04:30	0.104	05:30	1.118	0.225	0.225	-
04/23/2022	04:40	7.31	23:55	16.13	8.34	23:40	0.17	19:30	0.79	0.39	23:40	0.095	19:30	0.684	0.186	0.186	-
04/24/2022	05:10	7.28	06:00	17.25	8.93	02:15	0.09	16:35	1.12	0.44	02:15	0.053	16:35	0.958	0.228	0.228	-
04/25/2022	01:20	7.36	23:00	20.12	10.91	00:20	0.07	06:55	1.34	0.38	00:20	0.049	06:55	1.190	0.246	0.246	0.16
04/26/2022	04:05	7.64	05:40	21.28	11.96	03:20	0.08	08:50	1.31	0.39	03:20	0.062	08:50	1.185	0.272	0.272	0.07
04/27/2022	02:45	7.61	23:40	21.77	11.70	04:05	0.14	03:25	1.26	0.40	08:40	0.105	03:25	1.135	0.274	0.274	0.12
04/28/2022	01:00	8.22	02:20	20.51	12.04	04:40	0.15	02:25	1.18	0.39	21:10	0.109	02:25	1.066	0.273	0.273	-
04/29/2022	04:25	8.13	13:20	22.45	13.29	03:05	0.11	15:10	1.31	0.40	05:15	0.073	06:25	1.072	0.303	0.303	-
04/30/2022	00:55	9.65	05:55	23.19	13.70	04:55	0.09	00:45	1.26	0.37	04:55	0.084	00:45	1.133	0.293	0.293	0.10
05/01/2022	23:20	10.42	03:30	24.32	14.17	04:00	0.12	00:55	1.27	0.34	04:00	0.113	00:55	1.144	0.278	0.278	-
05/02/2022	00:40	10.96	02:30	23.94	14.82	02:05	0.11	03:30	1.28	0.35	14:25	0.091	03:30	1.154	0.297	0.297	0.58
05/03/2022	22:55	10.52	02:50	24.49	13.84	05:05	0.16	04:20	1.35	0.37	22:15	0.104	04:20	1.220	0.297	0.297	0.07
05/04/2022	01:40	11.44	02:20	23.94	14.03	02:10	0.13	01:25	1.17	0.36	02:10	0.119	01:25	1.059	0.292	0.292	0.01
05/05/2022	04:50	10.86	01:45	20.78	15.14	01:45	0.12	01:50	0.95	0.35	01:45	0.113	01:50	0.856	0.296	0.296	0.56
05/06/2022	02:50	10.69	02:00	23.00	14.42	19:05	0.16	01:00	1.23	0.34	19:05	0.140	01:00	1.110	0.283	0.283	0.14
05/07/2022	03:10	10.92	02:10	23.02	13.37	11:30	0.16	04:50	1.01	0.34	04:05	0.132	04:50	0.912	0.269	0.269	0.26
05/08/2022	00:50	9.83	01:20	24.51	14.12	20:35	0.16	01:25	1.01	0.36	20:35	0.137	01:25	0.907	0.296	0.296	0.08
05/09/2022	01:45	10.46	01:10	24.43	14.67	23:20	0.14	02:25	1.44	0.36	23:20	0.102	02:25	1.295	0.300	0.300	0.09
05/10/2022	01:05	10.96	03:45	24.00	14.33	02:40	0.15	02:55	1.20	0.35	22:50	0.120	02:55	1.081	0.290	0.290	-
05/11/2022	05:30	9.93	00:15	23.55	14.52	02:35	0.14	02:40	1.17	0.35	22:30	0.106	02:40	1.059	0.293	0.293	-
05/12/2022	22:20	11.39	01:40	25.18	13.81	16:05	0.12	01:45	1.15	0.33	16:05	0.096	01:45	1.034	0.270	0.270	0.21
05/13/2022	23:15	10.54	23:40	22.29	13.32	05:50	0.14	01:30	1.07	0.32	05:50	0.103	01:30	0.969	0.253	0.253	-
05/14/2022	04:40	10.34	01:05	21.00	13.62	03:55	0.15	00:35	1.07	0.33	09:45	0.130	00:35	0.967	0.264	0.264	0.07
05/15/2022	23:55	10.09	23:35	20.79	14.23	05:30	0.13	02:45	1.07	0.34	00:20	0.106	02:45	0.965	0.280	0.280	0.42
05/16/2022	22:10	9.58	22:30	23.64	14.02	12:05	0.15	01:40	1.05	0.37	12:05	0.126	01:40	0.950	0.300	0.300	0.03
05/17/2022	02:00	10.28	02:35	23.91	14.15	06:25	0.14	02:40	1.06	0.34	06:25	0.102	02:40	0.959	0.282	0.282	-
05/18/2022	23:00	11.14	02:50	23.08	13.96	12:15	0.15	02:10	1.36	0.35	22:55	0.112	02:10	1.225	0.284	0.284	0.08
05/19/2022	04:10	10.16	02:55	21.06	13.98	20:15	0.12	04:30	0.93	0.34	20:15	0.109	04:30	0.842	0.278	0.278	-
05/20/2022	23:05	10.50	05:00	23.09	15.85	21:30	0.11	03:50	1.08	0.32	21:30	0.100	03:50	0.974	0.282	0.282	-
05/21/2022	10:20	10.17	05:55	23.95	15.15	02:15	0.08	01:40	1.11	0.34	02:15	0.072	01:40	1.001	0.286	0.286	-
05/22/2022	04:30	10.98	03:45	22.48	15.44	22:00	0.06	03:35	1.08	0.35	22:00	0.050	03:35	0.973	0.301	0.301	-
05/23/2022	23:30	9.27	00:45	23.53	14.04	07:40	0.12	00:50	1.13	0.36	07:40	0.102	00:50	1.020	0.286	0.286	-
05/24/2022	06:20	8.66	00:45	23.12	16.15	02:50	0.10	05:00	1.16	0.38	02:50	0.092	05:00	1.044	0.319	0.319	0.01
05/25/2022	02:40	9.60	23:05	22.72	14.02	01:40	0.13	03:50	1.35	0.36	23:45	0.104	03:50	1.222	0.288	0.288	0.15
05/26/2022	02:40	7.36	04:20	22.13	13.46	02:00	0.11	02:10	1.24	0.33	02:00	0.098	02:10	1.119	0.263	0.263	0.12
05/27/2022	02:35	8.24	01:25	23.80	14.15	09:10	0.10	04:05	0.93	0.37	09:10	0.087	04:05	0.839	0.298	0.298	-
05/28/2022	01:05	7.90	22:15	24.52	13.94	06:45	0.14	23:30	1.26	0.37	06:45	0.095	23:30	1.135	0.295	0.295	0.12
05/29/2022	05:00	7.81	06:35	22.08	13.71	13:30	0.13	03:25	1.05	0.34	13:30	0.114	03:25	0.945	0.269	0.269	0.17
05/30/2022	05:20	7.82	15:40	22.19	13.13	02:50	0.07	02:10	1.15	0.39	02:50	0.059	02:10	1.041	0.295	0.295	0.02
05/31/2022	15:20	8.29	15:40	21.15	12.69	03:30	0.13	04:00	1.20	0.39	21:55	0.098	04:00	1.087	0.290	0.290	-
06/01/2022	03:45	7.94	04:40	22.14	12.87	21:45	0.08	01:30	0.96	0.35	21:45	0.057	01:30	0.862	0.263	0.263	0.02
06/02/2022	04:20	7.29	03:35	19.88	11.91	23:40	0.14	01:30	1.14	0.37	23:40	0.095	01:30	1.027	0.260	0.260	0.03
06/03/2022	23:40	7.53	05:20	21.12	12.31	04:10	0.15	06:05	1.37	0.40	01:20	0.103	06:05	1.235	0.286	0.286	0.45
06/04/2022	03:10	7.54	01:05	20.36	12.47	04:20	0.14	04:30	1.25	0.37	23:50	0.104	04:30	1.132	0.269	0.269	0.06
06/05/2022	04:15	8.05	22:45	21.82	12.25	19:15	0.14	02:55	0.98	0.39	08:55	0.112	02:55	0.881	0.276	0.276	0.32
06/06/2022	03:25	7.70	02:40	21.52	12.54	20:40	0.07	00:45	1.06	0.39	20:40	0.052	00:45	0.957	0.284	0.284	0.01
06/07/2022	23:50	7.57	04:15	21.89	12.75	03:00	0.15	22:50	1.08	0.36	10:45	0.123	22:50	0.978	0.265	0.265	0.01
06/08/2022	01:45	7.36	23:35	20.89	12.92	23:20	0.15	04:30	1.06	0.41	22:35	0.097	04:30	0.955	0.317	0.317	0.02
06/09/2022	04:25	7.40	13:25	25.95	17.80	02:15	0.11	00:35	0.95	0.42	02:15	0.093	00:35	0.848	0.351	0.351	1.13
06/10/2022	23:30	10.65	08:50	20.82	15.53	14:10	0.16	08:15	0.65	0.37	23:35	0.127	08:15	0.588	0.318	0.318	0.02
06/11/2022	00:35	8.80	01:50	20.69	14.17	08:30	0.12	04:10	0.86	0.34	08:30	0.107	04:10	0.775	0.274	0.274	0.03
06/12/2022	04:45	7.91	07:00	21.50	13.06	01:55	0.14	04:00	1.12	0.36	01:55	0.117	04:00	1.009	0.274	0.274	-
06/13/2022	02:10	8.01	01:35	20.92	13.00	01:35	0.14	01:40	1.31	0.39	20:35	0.112	01:40	1.185	0.294	0.294	0.34
06/14/2022	22:40	8.88	03:10	21.83	12.80	21:10	0.16	03:50	1.00	0.40	22:50	0.120	03:50	0.901	0.301	0.301	-
06/15/2022	04:20	7.83	03:05	21.71	12.43	09:50	0.14	05:20	1.11	0.39	09:50	0.119	05:20	1.003	0.283	0.283	-
06/16/2022	02:30	7.84	06:25	20.28	12.63	01:55	0.15	03:45	1.34	0.40	21:50	0.120	03:45	1.207	0.290	0.290	-

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
06/17/2022	00:00	7.80	00:40	22.85	12.67	18:50	0.11	00:45	0.98	0.38	18:50	0.074	00:45	0.888	0.274	0.274	0.03
06/18/2022	20:30	7.69	14:40	22.51	12.78	07:35	0.14	03:45	1.27	0.39	07:35	0.092	03:45	1.147	0.290	0.290	0.03
06/19/2022	05:00	7.32	05:35	18.55	12.01	00:00	0.10	05:40	1.21	0.37	00:00	0.064	05:40	1.093	0.261	0.261	-
06/20/2022	05:05	7.63	00:10	19.77	12.32	02:40	0.07	02:05	1.04	0.36	02:40	0.066	02:05	0.940	0.262	0.262	-
06/21/2022	23:30	7.25	07:00	20.90	11.69	03:05	0.08	04:20	1.07	0.42	03:05	0.068	04:20	0.968	0.283	0.283	-
06/22/2022	22:35	7.66	08:25	19.69	11.72	04:50	0.14	02:05	1.35	0.40	17:00	0.099	02:05	1.221	0.273	0.273	0.02
06/23/2022	16:20	7.68	14:40	19.80	11.67	01:05	0.15	04:10	1.02	0.39	21:20	0.105	04:10	0.906	0.264	0.264	-
06/24/2022	20:25	7.53	23:10	22.48	12.02	03:10	0.15	23:15	1.14	0.39	21:20	0.112	23:15	1.033	0.275	0.275	-
06/25/2022	01:50	6.67	04:15	21.07	12.60	10:00	0.12	15:50	1.22	0.39	02:55	0.087	15:50	1.097	0.293	0.293	-
06/26/2022	04:20	8.26	15:25	19.43	12.66	01:10	0.07	16:30	1.34	0.39	01:10	0.062	23:10	1.206	0.291	0.291	-
06/27/2022	23:25	8.75	22:25	21.86	12.86	04:35	0.11	06:25	1.14	0.38	04:35	0.094	06:25	1.028	0.290	0.290	-
06/28/2022	01:05	7.15	12:05	20.87	10.52	02:10	0.10	05:00	1.03	0.41	02:10	0.084	13:50	0.924	0.250	0.250	0.02
06/29/2022	02:45	6.90	13:25	20.66	12.27	03:25	0.14	04:25	1.23	0.37	00:45	0.111	04:25	1.097	0.265	0.265	-
06/30/2022	23:55	7.20	13:15	47.08	12.06	01:55	0.13	13:20	1.92	0.43	22:35	0.112	13:20	1.731	0.290	0.290	-
07/01/2022	02:30	6.96	03:20	18.94	9.80	10:40	0.16	01:55	0.85	0.38	01:10	0.099	03:20	0.755	0.222	0.222	-
07/02/2022	02:20	6.92	01:45	19.44	9.55	01:35	0.17	04:45	1.16	0.40	02:15	0.087	04:45	1.045	0.221	0.221	-
07/03/2022	01:45	6.75	05:50	18.98	9.43	03:45	0.16	03:10	1.14	0.38	00:00	0.077	03:10	1.033	0.215	0.215	0.16
07/04/2022	22:15	7.03	06:00	19.17	9.30	05:40	0.13	04:50	1.42	0.40	21:25	0.082	04:50	1.285	0.222	0.222	-
07/05/2022	03:05	6.71	06:00	19.02	9.48	05:50	0.17	04:25	1.24	0.39	05:15	0.097	04:25	1.123	0.217	0.217	-
07/06/2022	03:40	6.90	05:40	19.31	9.55	01:25	0.17	01:50	1.00	0.37	05:15	0.088	01:50	0.902	0.212	0.212	-
07/07/2022	05:45	6.59	00:40	19.16	9.34	05:40	0.07	03:40	0.91	0.35	05:40	0.023	03:40	0.824	0.200	0.200	0.01
07/08/2022	23:00	7.08	07:25	19.39	9.80	07:10	0.13	06:05	1.14	0.38	07:10	0.090	06:05	1.032	0.216	0.216	-
07/09/2022	04:05	5.96	01:15	19.02	8.77	04:35	0.10	05:30	1.06	0.32	02:00	0.056	05:30	0.960	0.167	0.167	-
07/10/2022	00:35	6.63	01:25	18.91	9.85	03:30	0.08	06:20	1.08	0.41	03:30	0.059	05:10	0.939	0.234	0.234	-
07/11/2022	23:55	7.69	02:55	19.07	10.16	01:40	0.09	03:00	1.16	0.37	01:40	0.069	03:00	1.044	0.223	0.223	-
07/12/2022	03:50	6.09	05:45	19.22	9.39	02:30	0.15	04:50	1.29	0.42	01:35	0.086	04:50	1.168	0.228	0.228	-
07/13/2022	06:05	6.38	04:05	18.88	9.48	08:55	0.08	05:10	1.28	0.44	08:55	0.040	05:10	1.149	0.252	0.252	0.01
07/14/2022	23:00	6.60	10:30	47.86	10.34	01:10	0.13	10:35	2.08	0.37	21:20	0.063	10:35	1.877	0.214	0.214	-
07/15/2022	03:45	6.23	01:10	18.84	9.56	13:25	0.08	18:20	1.33	0.41	13:25	0.037	18:20	1.201	0.249	0.249	-
07/16/2022	03:20	6.87	01:20	19.27	9.88	06:10	0.19	06:25	1.07	0.39	03:25	0.087	06:25	0.927	0.233	0.233	-
07/17/2022	01:00	6.66	04:20	20.13	10.83	01:45	0.11	00:30	1.02	0.36	01:00	0.079	00:30	0.922	0.232	0.232	-
07/18/2022	01:30	6.71	05:00	19.10	9.50	04:10	0.12	06:05	1.12	0.38	04:10	0.060	06:05	1.009	0.218	0.218	-
07/19/2022	00:00	6.86	05:35	18.93	9.09	01:55	0.08	04:05	0.95	0.40	01:55	0.056	05:40	0.825	0.207	0.207	-
07/20/2022	02:00	6.70	04:15	18.70	12.17	23:20	0.09	02:35	1.27	0.35	23:20	0.065	02:35	1.045	0.253	0.253	-
07/21/2022	10:05	9.54	10:15	18.25	12.36	14:55	0.10	10:20	0.64	0.38	03:35	0.071	10:20	0.581	0.285	0.285	-
07/22/2022	05:30	8.70	13:15	14.11	11.53	10:05	0.08	13:15	0.55	0.41	10:05	0.062	13:15	0.461	0.291	0.291	-
07/23/2022	03:40	8.54	13:00	13.54	11.18	01:50	0.09	12:45	0.54	0.42	01:50	0.056	13:00	0.429	0.281	0.281	-
07/24/2022	05:00	8.78	10:05	14.02	11.47	03:55	0.08	09:40	0.54	0.44	03:55	0.042	10:05	0.456	0.312	0.312	-
07/25/2022	02:25	8.99	10:05	15.12	11.52	03:25	0.09	09:55	0.61	0.40	03:25	0.050	09:55	0.536	0.278	0.278	-
07/26/2022	03:05	8.37	19:10	14.76	12.18	01:10	0.14	19:10	0.57	0.48	02:10	0.068	19:10	0.498	0.357	0.357	-
07/27/2022	04:10	9.28	09:50	15.23	12.20	07:25	0.32	09:50	0.59	0.48	04:10	0.215	09:50	0.526	0.358	0.358	-
07/28/2022	04:25	8.04	09:50	16.03	11.90	06:35	0.28	09:50	0.63	0.47	04:25	0.160	09:50	0.571	0.344	0.344	-
07/29/2022	04:50	8.58	10:35	15.28	11.81	06:55	0.09	10:35	0.60	0.46	06:55	0.050	10:35	0.529	0.333	0.333	-
07/30/2022	03:40	7.75	10:20	15.25	11.21	23:00	0.19	09:35	0.59	0.45	23:35	0.125	10:20	0.527	0.307	0.307	-
07/31/2022	04:50	8.06	10:05	17.54	12.28	00:30	0.13	10:05	0.73	0.48	00:30	0.068	10:05	0.654	0.362	0.362	-
08/01/2022	02:25	9.14	19:45	15.23	12.51	00:00	0.11	11:15	0.58	0.48	00:00	0.063	19:00	0.511	0.365	0.365	-
08/02/2022	02:40	9.81	10:25	15.70	12.68	05:25	0.09	11:30	0.80	0.48	05:25	0.056	11:30	0.686	0.366	0.366	-
08/03/2022	23:55	8.38	08:25	13.91	11.44	21:25	0.11	00:00	0.98	0.45	21:25	0.078	00:00	0.661	0.313	0.313	0.02
08/04/2022	03:30	7.01	04:10	17.88	9.66	03:00	0.10	04:10	0.75	0.40	03:00	0.047	04:10	0.676	0.233	0.103	0.20

01/25/2022 00:00 - 08/04/2022 22:55

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			48.699	13.96
Average	11.19	0.40	0.255	

ST_MH3ONE-090

Site Commentary

SITE INFORMATION

Pipe	Elliptical (15 in H x 15 in W)
Silt	0.00 (in)

OBSERVATIONS

Average flow depth, velocity, and quantity data observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022**, along with observed minimum and maximum data, are provided in the following table.

Observed Flow Conditions			
Item	**DFINAL (in)**	**VFINAL (ft/s)**	**QFINAL (MGD - Total MG)**
Average	2.57	1.12	0.109
Minimum	1.36	0.27	0.011
Maximum	5.58	4.68	1.135
Min Time	05/24/2022 1:10:00 AM	05/24/2022 12:55:00 AM	05/24/2022 1:00:00 AM
Max Time	05/24/2022 2:20:00 PM	05/25/2022 7:05:00 AM	05/25/2022 7:05:00 AM

Based upon the quality and consistency of the observed flow depth and velocity data, the Continuity equation was used to calculate flow rate and quantities during the monitoring period.

Values in the Observed Flow Conditions and data on the graphical reports are based on the none average.

DATA UPTIME

Data uptime observed during **Tuesday, 25 January 2022 to Thursday, 04 August 2022** is provided in the following table. There was a data gap 2/3/22-2/22/22 due to a monitor failure.

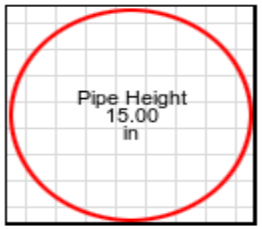
Percent Uptime	
DFINAL (in)	89.567
VFINAL (ft/s)	89.567
QFINAL (MGD - Total MG)	89.567

Hydrograph Report

ST_MH3ONE-090

Flow Monitor

ST_MH3ONE-090



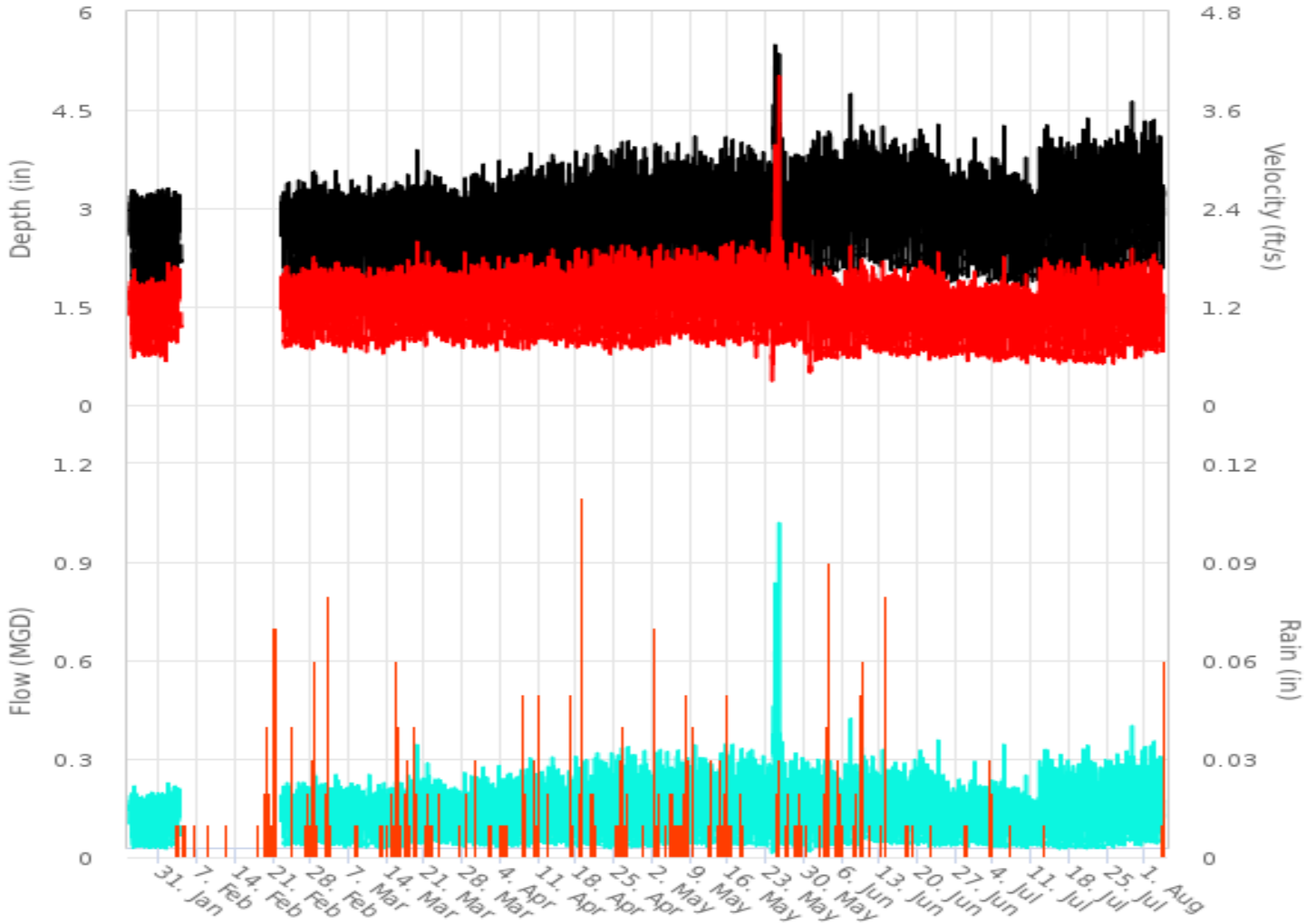
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL
- QFINAL
- Rain
- VFINAL

ADS ENVIRONMENTAL SERVICES

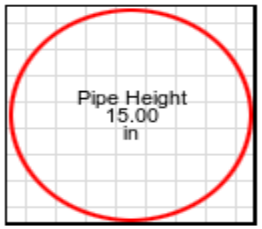


Scattergraph Report

ST_MH3ONE-090

Flow Monitor

ST_MH3ONE-090



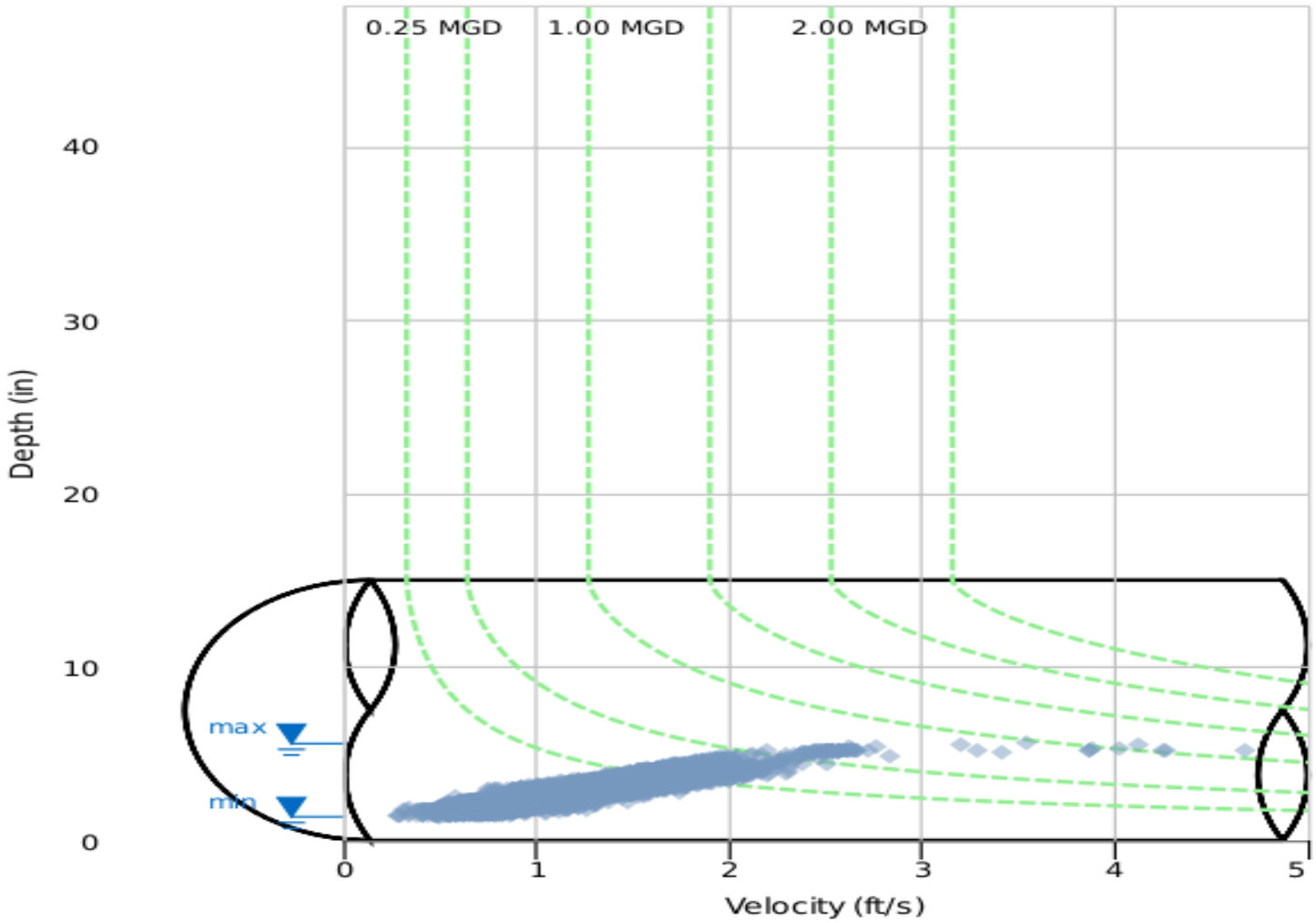
Report Period

01/25/2022
To
08/04/2022

Legend

- DFINAL - VFINAL
- Iso-Q™
- Min-Max Depth

ADS ENVIRONMENTAL SERVICES



Daily Tabular Report

01/25/2022 00:00 - 08/04/2022 22:55
ST_MH3ONE-090Pipe: Elliptical (15 in H x 15 in W), Silt0.00 in

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
01/25/2022	23:50	1.97	15:50	3.47	2.66	23:10	0.83	15:25	1.70	1.19	23:50	0.052	15:50	0.235	0.117	0.052	-
01/26/2022	02:35	1.67	07:40	3.73	2.45	03:55	0.54	07:35	1.85	1.08	02:15	0.027	07:40	0.272	0.098	0.098	-
01/27/2022	03:10	1.63	13:40	3.80	2.44	02:30	0.64	07:05	1.82	1.09	02:30	0.031	13:40	0.271	0.098	0.098	-
01/28/2022	04:50	1.66	14:55	3.65	2.38	01:35	0.51	11:25	1.74	1.06	04:55	0.026	14:55	0.256	0.092	0.092	-
01/29/2022	05:15	1.59	12:15	3.64	2.32	03:25	0.55	11:20	1.74	1.05	05:10	0.026	12:15	0.258	0.089	0.089	-
01/30/2022	04:45	1.58	17:15	3.61	2.33	04:35	0.57	17:15	1.70	1.04	03:10	0.027	17:15	0.250	0.090	0.090	-
01/31/2022	02:05	1.61	19:55	3.53	2.45	23:35	0.51	10:45	1.66	1.06	02:05	0.025	10:45	0.230	0.097	0.097	-
02/01/2022	04:05	1.63	14:15	3.51	2.42	04:30	0.45	12:30	1.89	1.16	04:30	0.022	12:30	0.262	0.105	0.105	-
02/02/2022	02:45	1.57	16:20	3.63	2.38	04:40	0.73	20:30	1.96	1.20	02:40	0.033	20:30	0.282	0.104	0.104	-
02/03/2022	02:45	1.57	10:05	3.44	2.27	02:40	0.72	10:05	1.87	1.14	02:40	0.032	10:05	0.256	0.095	0.057	0.16
02/04/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
02/05/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/06/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
02/07/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/08/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/09/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
02/10/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/11/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/12/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01
02/13/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/14/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/15/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/16/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/17/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02
02/18/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02/19/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.18
02/20/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09
02/21/2022	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.19
02/22/2022	23:55	1.99	20:55	4.20	2.69	23:55	0.85	20:55	2.17	1.27	23:55	0.053	20:55	0.395	0.126	0.072	-
02/23/2022	04:10	1.66	15:45	3.83	2.47	04:10	0.68	07:20	2.01	1.15	04:10	0.033	07:20	0.292	0.106	0.106	-
02/24/2022	02:30	1.72	13:15	3.64	2.44	02:30	0.71	20:45	1.79	1.12	02:30	0.036	13:15	0.255	0.100	0.100	0.10
02/25/2022	03:45	1.76	15:00	4.11	2.48	01:45	0.73	15:00	2.00	1.14	03:45	0.038	15:00	0.352	0.104	0.104	-
02/26/2022	03:10	1.64	17:25	3.89	2.40	03:10	0.66	09:10	1.91	1.10	03:10	0.031	17:25	0.307	0.097	0.097	0.01
02/27/2022	03:40	1.65	09:30	3.73	2.36	03:40	0.67	09:30	1.81	1.11	03:40	0.032	09:30	0.278	0.096	0.096	0.06
02/28/2022	04:05	1.63	20:35	3.80	2.57	04:05	0.66	10:30	1.92	1.24	04:05	0.031	20:35	0.289	0.122	0.122	0.80
03/01/2022	03:20	1.89	11:15	3.80	2.56	03:20	0.80	10:10	1.97	1.24	02:05	0.047	11:15	0.309	0.117	0.117	0.01
03/02/2022	03:15	1.77	08:10	3.59	2.55	03:15	0.73	11:00	1.83	1.25	03:15	0.038	11:00	0.258	0.118	0.118	0.26
03/03/2022	02:40	1.82	07:30	3.69	2.59	02:35	0.76	15:45	1.86	1.25	02:35	0.042	07:30	0.279	0.121	0.121	0.23
03/04/2022	03:05	1.74	20:00	3.74	2.53	02:55	0.72	20:00	1.90	1.20	03:05	0.037	20:00	0.293	0.114	0.114	-
03/05/2022	03:50	1.68	10:05	3.62	2.42	03:40	0.66	10:05	1.92	1.18	03:40	0.033	10:05	0.282	0.105	0.105	-
03/06/2022	04:55	1.57	15:45	3.76	2.36	04:50	0.62	10:20	1.89	1.16	04:55	0.027	15:45	0.279	0.100	0.100	-
03/07/2022	02:40	1.65	20:00	4.00	2.45	02:40	0.67	19:15	1.84	1.19	02:40	0.032	20:00	0.298	0.108	0.108	-
03/08/2022	03:35	1.65	17:10	3.61	2.46	04:05	0.66	07:40	1.81	1.19	03:10	0.033	17:10	0.257	0.108	0.108	0.09
03/09/2022	03:10	1.63	15:50	3.63	2.44	03:10	0.66	18:25	1.83	1.18	03:10	0.031	15:50	0.267	0.107	0.107	-
03/10/2022	03:50	1.57	15:20	4.35	2.44	03:40	0.63	15:20	2.11	1.17	03:40	0.028	15:20	0.403	0.106	0.106	-
03/11/2022	05:35	1.68	14:25	3.73	2.45	05:05	0.72	06:40	1.91	1.19	05:05	0.037	09:55	0.282	0.107	0.107	-
03/12/2022	04:35	1.56	13:00	3.89	2.32	04:30	0.64	13:00	2.05	1.12	04:30	0.029	13:00	0.334	0.094	0.094	0.01
03/13/2022	04:35	1.50	10:05	3.73	2.31	04:35	0.58	10:05	1.83	1.12	04:35	0.024	10:05	0.281	0.095	0.095	0.05
03/14/2022	02:30	1.59	20:50	3.81	2.45	02:15	0.70	14:25	1.84	1.21	02:30	0.032	20:50	0.283	0.110	0.110	0.14
03/15/2022	03:05	1.68	14:40	3.72	2.49	05:20	0.69	09:25	1.88	1.22	05:20	0.034	14:40	0.280	0.113	0.113	0.37
03/16/2022	02:50	1.66	11:45	3.66	2.49	02:40	0.74	11:45	1.93	1.21	02:45	0.037	11:45	0.290	0.111	0.111	0.03
03/17/2022	02:15	1.61	19:40	3.84	2.51	02:10	0.65	18:00	1.84	1.22	02:15	0.029	19:40	0.295	0.115	0.115	0.37
03/18/2022	02:20	1.77	19:30	4.22	2.51	02:20	0.74	19:30	2.17	1.23	02:20	0.039	19:30	0.397	0.114	0.114	0.17
03/19/2022	02:50	1.80	11:20	4.73	2.54	02:45	0.76	11:20	2.46	1.25	02:45	0.041	11:20	0.526	0.118	0.118	0.24
03/20/2022	03:05	1.71	14:35	4.19	2.44	01:55	0.76	14:35	2.19	1.20	01:55	0.040	14:35	0.398	0.107	0.107	0.01
03/21/2022	00:55	1.76	10:25	4.37	2.64	01:25	0.69	10:25	2.50	1.27	00:55	0.038	10:25	0.481	0.128	0.128	0.27
03/22/2022	01:35	1.90	19:35	3.82	2.62	01:25	0.86	08:20	1.86	1.27	01:25	0.052	19:35	0.290	0.124	0.124	0.12
03/23/2022	02:45	1.85	15:10	3.92	2.62	02:35	0.78	15:10	1.88	1.27	02:35	0.044	15:10	0.311	0.126	0.126	0.18
03/24/2022	01:30	1.84	07:00	3.65	2.56	01:30	0.77	18:55	1.80	1.23	01:30	0.043	07:00	0.267	0.117	0.117	-
03/25/2022	00:35	1.78	20:00	3.86	2.55	00:35	0.74	12:05	1.87	1.22	00:35	0.039	20:00	0.293	0.116	0.116	-
03/26/2022	03:50	1.74	10:40	3.91	2.44	03:45	0.72	10:40	1.92	1.17	03:45	0.037	10:40	0.316	0.105	0.105	-
03/27/2022	02:05	1.70	12:10	3.87	2.41	02:15	0.71	08:40	1.90	1.17	02:15	0.036	12:10	0.285	0.102	0.102	0.01
03/28/2022	00:20	1.62	06:40	3.89	2.57	00:20	0.65	06:40	2.21	1.24	00:20	0.030	06:40	0.361	0.120	0.120	0.15
03/29/2022	23:50	1.75	11:50	3.92	2.51	23:40	0.74	11:50	2.00	1.20	23:40	0.039	11:50	0.331	0.112	0.112	-
03/30/2022	03:10	1.65	18:10	3.94	2.48	03:05	0.67	18:10	1.91	1.16	03:05	0.032	18:10	0.317	0.107	0.107	0.21
03/31/2022	03:55	1.68	18:00	4.02	2.44	02:15	0.69	18:00	2.07	1.17	03:55	0.033	18:00	0.354	0.105	0.105	-
04/01/2022	01:40	1.67	17:05	3.86	2.43	01:40	0.68	08:50	2.00	1.17	01:40	0.033	08:50	0.317	0.105	0.105	0.05
04/02/2022	03:05	1.67	14:40	3.86	2.34	03:55	0.68	11:55	1.90	1.13	03:55	0.033	14:40	0.303	0.095	0.095	-
04/03/2022	03:10	1.61	20:35	3.93	2.35	03:00	0.63	12:25	1.98	1.13	03:50	0.030	12:25	0.325	0.097	0.097	0.03

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
04/04/2022	23:55	1.82	10:50	3.90	2.44	02:45	0.78	10:50	1.90	1.18	02:45	0.044	10:50	0.311	0.105	0.105	0.15
04/05/2022	01:30	1.70	18:10	3.95	2.39	02:00	0.70	06:40	1.95	1.15	02:00	0.035	18:10	0.326	0.101	0.101	0.01
04/06/2022	03:10	1.64	15:10	4.17	2.42	03:05	0.67	15:10	2.06	1.17	03:05	0.032	15:10	0.371	0.104	0.104	-
04/07/2022	02:10	1.64	19:20	3.84	2.37	02:10	0.67	19:20	1.92	1.13	02:10	0.031	19:20	0.308	0.098	0.098	-
04/08/2022	01:45	1.64	12:55	4.05	2.42	00:25	0.66	16:00	1.92	1.16	00:25	0.032	12:55	0.326	0.103	0.103	0.27
04/09/2022	03:55	1.66	08:55	4.37	2.35	02:20	0.66	08:55	2.38	1.11	03:55	0.032	08:55	0.457	0.097	0.097	0.04
04/10/2022	03:00	1.70	11:55	4.73	2.49	03:05	0.72	11:55	2.35	1.16	03:05	0.037	11:55	0.504	0.107	0.107	0.49
04/11/2022	01:00	1.81	14:00	4.07	2.58	01:00	0.76	11:10	1.95	1.23	01:00	0.041	14:00	0.332	0.119	0.119	-
04/12/2022	01:25	1.71	16:00	3.92	2.51	03:40	0.77	16:00	1.98	1.20	02:25	0.041	16:00	0.328	0.112	0.112	0.03
04/13/2022	02:15	1.71	11:15	4.03	2.49	02:10	0.72	11:15	2.05	1.19	02:10	0.037	11:15	0.351	0.111	0.111	-
04/14/2022	01:35	1.68	14:00	4.03	2.46	02:15	0.70	11:05	1.94	1.18	02:15	0.035	14:00	0.326	0.108	0.108	-
04/15/2022	02:05	1.83	08:00	3.92	2.52	03:05	0.77	17:10	1.81	1.18	01:00	0.043	17:10	0.286	0.110	0.110	-
04/16/2022	03:45	1.65	13:15	3.96	2.42	03:45	0.67	10:30	1.96	1.16	03:45	0.032	10:30	0.326	0.103	0.103	0.12
04/17/2022	04:10	1.68	10:10	4.53	2.34	01:20	0.72	10:10	2.34	1.13	01:20	0.037	10:10	0.473	0.096	0.096	0.01
04/18/2022	02:45	1.58	10:55	4.16	2.57	02:40	0.64	07:35	2.10	1.24	02:40	0.029	10:55	0.367	0.122	0.122	0.45
04/19/2022	03:30	1.78	18:00	4.12	2.52	01:15	0.71	18:00	2.00	1.21	01:15	0.040	18:00	0.353	0.114	0.114	-
04/20/2022	00:55	1.67	16:00	4.22	2.49	00:55	0.70	20:40	2.04	1.19	00:55	0.034	20:40	0.368	0.110	0.110	0.07
04/21/2022	03:30	1.64	19:00	4.21	2.49	03:05	0.71	19:00	2.04	1.19	03:10	0.034	19:00	0.372	0.111	0.111	0.05
04/22/2022	01:00	1.67	10:40	4.40	2.46	01:05	0.74	10:40	2.23	1.18	01:00	0.036	10:40	0.433	0.108	0.108	-
04/23/2022	03:10	1.51	14:05	4.06	2.34	01:30	0.65	09:45	2.01	1.12	03:10	0.028	09:45	0.341	0.096	0.096	-
04/24/2022	04:15	1.50	13:25	4.21	2.30	04:15	0.58	09:00	2.08	1.11	04:15	0.024	09:00	0.371	0.094	0.094	-
04/25/2022	01:15	1.56	13:45	4.24	2.48	01:20	0.68	13:45	2.07	1.20	01:15	0.030	13:45	0.381	0.112	0.112	0.16
04/26/2022	02:15	1.57	15:10	4.41	2.46	01:55	0.66	15:10	2.25	1.18	01:55	0.030	15:10	0.437	0.109	0.109	0.07
04/27/2022	01:45	1.64	12:30	4.34	2.45	02:00	0.70	12:30	2.20	1.19	01:45	0.033	12:30	0.417	0.109	0.109	0.12
04/28/2022	03:45	1.49	11:10	4.17	2.43	01:55	0.67	06:10	2.11	1.16	03:45	0.029	11:10	0.371	0.106	0.106	-
04/29/2022	03:45	1.57	17:15	4.06	2.38	04:00	0.68	08:25	2.06	1.14	04:00	0.030	17:15	0.348	0.100	0.100	-
04/30/2022	02:15	1.52	12:45	4.49	2.31	03:05	0.63	12:45	2.27	1.11	02:15	0.028	12:45	0.452	0.094	0.094	0.10
05/01/2022	03:45	1.58	17:35	4.07	2.32	02:45	0.69	07:20	2.17	1.11	02:45	0.032	07:20	0.353	0.094	0.094	-
05/02/2022	02:00	1.56	10:20	4.45	2.55	00:50	0.67	10:20	2.12	1.23	02:00	0.030	10:20	0.418	0.120	0.120	0.58
05/03/2022	02:10	1.66	15:20	4.23	2.50	02:20	0.71	10:30	2.05	1.21	02:10	0.035	18:40	0.367	0.113	0.113	0.07
05/04/2022	02:40	1.65	17:20	4.44	2.46	02:40	0.70	17:20	2.25	1.19	02:40	0.033	17:20	0.442	0.109	0.109	0.01
05/05/2022	01:50	1.69	17:40	4.43	2.57	01:00	0.72	17:40	2.18	1.22	01:50	0.036	17:40	0.427	0.119	0.119	0.56
05/06/2022	01:20	1.81	17:30	4.26	2.59	00:30	0.83	10:55	2.31	1.25	00:30	0.050	10:55	0.419	0.122	0.122	0.14
05/07/2022	02:15	1.81	10:50	4.26	2.49	02:10	0.76	10:50	2.12	1.20	02:15	0.041	10:50	0.393	0.110	0.110	0.26
05/08/2022	01:55	1.91	11:45	4.12	2.48	01:20	0.83	19:55	2.16	1.20	04:10	0.050	11:45	0.369	0.109	0.109	0.08
05/09/2022	02:10	1.75	19:30	4.32	2.59	00:50	0.74	04:35	2.31	1.25	00:50	0.040	19:30	0.391	0.122	0.122	0.09
05/10/2022	02:20	1.76	19:30	4.18	2.55	01:55	0.74	12:25	2.08	1.22	01:55	0.039	12:25	0.369	0.116	0.116	-
05/11/2022	02:35	1.75	18:10	4.27	2.52	01:55	0.72	14:50	2.12	1.20	01:55	0.038	14:50	0.377	0.114	0.114	-
05/12/2022	03:10	1.52	18:25	4.17	2.55	02:55	0.67	12:05	2.12	1.23	02:55	0.030	12:05	0.380	0.119	0.119	0.21
05/13/2022	03:05	1.78	18:40	4.24	2.50	02:00	0.74	08:25	2.05	1.18	03:05	0.040	11:55	0.358	0.110	0.110	-
05/14/2022	02:40	1.71	19:35	4.61	2.40	02:35	0.70	19:35	2.24	1.14	02:35	0.036	19:35	0.463	0.101	0.101	0.07
05/15/2022	02:55	1.64	13:15	4.39	2.47	02:15	0.69	16:50	2.23	1.19	02:40	0.033	16:50	0.406	0.111	0.111	0.42
05/16/2022	03:45	1.79	08:50	4.28	2.55	02:10	0.77	12:45	2.14	1.23	02:10	0.042	12:45	0.397	0.118	0.118	0.03
05/17/2022	02:35	1.69	18:10	4.22	2.50	03:00	0.72	18:10	2.10	1.20	03:00	0.036	18:10	0.384	0.112	0.112	-
05/18/2022	01:55	1.70	15:20	4.18	2.51	01:10	0.68	11:35	2.03	1.21	01:10	0.035	11:35	0.359	0.114	0.114	0.08
05/19/2022	03:30	1.69	18:15	4.18	2.52	03:30	0.72	18:15	2.05	1.21	03:30	0.035	18:15	0.371	0.114	0.114	-
05/20/2022	03:40	1.66	11:15	4.14	2.47	03:35	0.74	06:45	2.08	1.20	03:35	0.038	11:15	0.367	0.111	0.111	-
05/21/2022	02:50	1.64	19:15	3.98	2.38	02:20	0.54	07:55	2.09	1.14	02:25	0.032	07:55	0.337	0.100	0.100	-
05/22/2022	03:05	1.62	09:30	4.03	2.37	02:35	0.73	14:55	2.08	1.15	02:35	0.035	09:30	0.354	0.100	0.100	-
05/23/2022	01:55	1.59	16:25	4.15	2.47	02:55	0.71	07:40	2.16	1.19	01:55	0.032	07:40	0.367	0.110	0.110	-
05/24/2022	01:10	1.36	14:20	5.58	3.21	00:50	0.27	14:20	3.55	1.50	00:50	0.011	14:20	0.953	0.254	0.254	0.01
05/25/2022	01:20	1.67	07:40	5.57	2.66	01:05	0.71	07:05	4.68	1.30	01:05	0.035	07:05	1.135	0.152	0.152	0.15
05/26/2022	03:10	1.68	11:45	4.23	2.37	00:35	0.70	11:45	2.25	1.07	02:30	0.034	11:45	0.414	0.093	0.093	0.12
05/27/2022	03:10	1.71	12:15	4.10	2.48	03:10	0.72	17:50	2.16	1.17	03:10	0.036	17:50	0.375	0.108	0.108	-
05/28/2022	03:10	1.61	18:30	4.11	2.33	02:15	0.69	09:45	2.13	1.10	03:10	0.031	09:45	0.365	0.094	0.094	0.12
05/29/2022	02:30	1.75	15:00	3.96	2.39	02:35	0.76	11:10	2.29	1.15	02:35	0.039	11:10	0.373	0.100	0.100	0.17
05/30/2022	23:00	1.44	09:10	4.27	2.35	23:25	0.53	12:35	2.12	1.15	23:25	0.022	12:35	0.390	0.101	0.101	0.02
05/31/2022	00:15	1.46	11:10	4.36	2.70	01:10	0.38	06:50	1.77	0.96	00:20	0.016	11:10	0.339	0.105	0.105	-
06/01/2022	03:25	1.87	11:45	4.46	2.78	02:05	0.51	11:45	1.78	1.01	03:25	0.030	11:45	0.352	0.110	0.110	0.02
06/02/2022	03:30	1.86	18:35	4.36	2.76	01:25	0.52	18:35	1.79	1.00	03:30	0.030	18:35	0.343	0.108	0.108	0.03
06/03/2022	03:50	2.00	11:45	4.44	2.82	01:20	0.55	17:30	1.82	1.01	01:05	0.036	17:30	0.348	0.113	0.113	0.45
06/04/2022	03:35	1.92	10:35	4.39	2.67	03:35	0.51	10:35	1.83	0.94	03:35	0.030	10:35	0.355	0.097	0.097	0.06
06/05/2022	01:40	2.02	17:35	4.33	2.74	01:50	0.55	08:05	1.73	0.95	01:55	0.035	17:35	0.326	0.101	0.101	0.32
06/06/2022	02:55	2.07	11:25	4.57	2.89	02:25	0.58	14:50	1.96	1.04	02:25	0.039	14:50	0.396	0.119	0.119	0.01
06/07/2022	01:25	1.99	13:50	5.20	2.83	01:20	0.55	13:50	2.19	1.01	01:20	0.035	13:50	0.535	0.116	0.116	0.01
06/08/2022	03:00	1.95	16:25	4.40	2.80	03:35	0.55	20:40	1.86	1.01	03:05	0.035	20:40	0.354	0.112	0.112	0.02
06/09/2022	02:10	1.95	15:45	4.66	2.93	02:35	0.52	17:50	2.00	1.10	01:35	0.034	15:45	0.419	0.131	0.131	1.13
06/10/2022	02:25	2.24	13:25	4.56	2.97	23:35	0.71	09:50	1.87	1.06	01:05	0.055	13:25	0.378	0.125	0.125	0.02
06/11/2022	00:50	2.19	12:30	4.45	2.86	00:50	0.64	12:30	1.85	1.03	00:50	0.046	12:30	0.364	0.116	0.116	0.03
06/12/2022	03:00	2.14	12:25	4.47	2.79	01:15	0.60	12:25	1.86	1.00	04:00	0.043	12:25	0.369	0.108	0.108	-
06/13/2022	01:35	2.10	19:40	4.54	2.93	01:35	0.61	11:50	1.92	1.08	01:35	0.041	11:50	0.387	0.125	0.125	0.34
06/14/2022	02:10	2.19	09:10	4.52	2.88	02:40	0.60	09:10	1.84	1.04	03:05	0.044	09:10	0.371	0.117	0.117	-
06/15/2022	02:25	2.00	17:40	4.48	2.87	03:15	0.57	17:40	1.94	1.05	03:15	0.038	17:40	0.387	0.119	0.119	-
06/16/2022	03:00	2.07	15:05	4.37	2.82	03:25	0.57	20:30	1.83	1.03	03:25	0.038	20:30	0.351	0.114	0.114	-

	DFINAL (in)					VFINAL (ft/s)					QFINAL (MGD - Total MG)						Rain (in)
Date	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Time	Min	Time	Max	Avg	Total	Total
06/17/2022	02:25	2.06	15:25	4.39	2.85	02:20	0.59	12:20	1.88	1.05	02:20	0.040	12:20	0.360	0.117	0.117	0.03
06/18/2022	01:55	2.01	09:25	4.33	2.74	01:40	0.56	09:25	1.82	0.99	01:55	0.035	09:25	0.345	0.105	0.105	0.03
06/19/2022	03:00	2.10	09:40	4.69	2.79	04:25	0.61	09:40	1.94	1.03	04:40	0.042	09:40	0.412	0.112	0.112	-
06/20/2022	01:00	1.99	10:15	4.76	2.81	00:50	0.59	10:15	2.02	1.04	00:50	0.038	10:15	0.437	0.116	0.116	-
06/21/2022	02:10	2.01	15:30	4.29	2.77	00:15	0.61	17:35	1.86	1.03	00:15	0.041	15:30	0.345	0.111	0.111	-
06/22/2022	02:05	1.87	18:20	4.16	2.69	02:15	0.53	18:20	1.88	1.01	02:00	0.032	18:20	0.336	0.105	0.105	0.02
06/23/2022	02:05	1.89	16:15	4.96	2.68	02:00	0.56	16:15	2.17	1.04	02:00	0.033	16:15	0.496	0.107	0.107	-
06/24/2022	01:05	1.93	10:10	4.16	2.71	02:25	0.55	06:40	1.72	1.00	01:05	0.033	12:50	0.302	0.105	0.105	-
06/25/2022	02:35	1.90	11:05	4.04	2.64	02:10	0.53	19:00	1.73	0.98	02:10	0.032	19:00	0.292	0.099	0.099	-
06/26/2022	02:35	1.85	12:00	3.92	2.62	01:40	0.58	19:45	1.70	0.98	02:30	0.034	19:45	0.279	0.098	0.098	-
06/27/2022	03:30	1.87	14:50	4.08	2.75	01:05	0.59	14:50	1.67	1.05	02:10	0.034	14:50	0.291	0.112	0.112	-
06/28/2022	03:30	1.94	12:10	3.95	2.72	02:50	0.59	19:25	1.73	1.04	02:50	0.036	19:25	0.283	0.109	0.109	0.02
06/29/2022	03:10	1.92	18:15	4.00	2.82	03:20	0.52	19:30	1.70	1.01	03:15	0.031	18:15	0.280	0.111	0.111	-
06/30/2022	01:55	2.11	10:50	4.65	2.87	01:55	0.61	10:50	1.87	1.00	01:55	0.042	10:50	0.392	0.112	0.112	-
07/01/2022	02:50	1.94	12:25	3.84	2.81	00:55	0.56	19:50	1.57	0.99	02:35	0.036	19:50	0.246	0.109	0.109	-
07/02/2022	03:00	1.94	19:40	4.09	2.72	03:05	0.56	19:40	1.74	1.01	03:05	0.034	19:40	0.305	0.106	0.106	-
07/03/2022	03:40	1.82	15:10	4.59	2.65	02:55	0.53	15:10	1.86	0.97	03:10	0.030	15:10	0.382	0.098	0.098	0.16
07/04/2022	03:50	1.90	08:40	4.10	2.63	02:20	0.52	08:40	1.69	0.95	02:15	0.032	08:40	0.296	0.096	0.096	-
07/05/2022	02:10	1.87	19:15	4.94	2.68	02:00	0.52	19:15	2.12	1.02	02:05	0.030	19:15	0.483	0.106	0.106	-
07/06/2022	02:00	1.78	18:25	3.95	2.64	02:45	0.51	15:55	1.68	1.01	02:00	0.028	18:25	0.275	0.102	0.102	-
07/07/2022	00:35	1.87	23:10	3.92	2.66	00:30	0.58	23:10	1.76	1.03	00:30	0.033	23:10	0.292	0.105	0.105	0.01
07/08/2022	03:25	1.82	19:20	3.81	2.62	04:15	0.57	19:20	1.68	1.01	03:25	0.033	19:20	0.267	0.100	0.100	-
07/09/2022	04:15	1.78	21:30	3.98	2.56	01:40	0.54	21:30	1.70	0.96	04:15	0.029	21:30	0.286	0.093	0.093	-
07/10/2022	02:35	1.73	11:10	3.73	2.55	02:25	0.48	19:50	1.62	0.97	02:25	0.025	19:50	0.243	0.093	0.093	-
07/11/2022	02:50	1.88	14:55	3.81	2.63	01:45	0.56	09:25	1.71	1.02	02:35	0.033	09:25	0.267	0.101	0.101	-
07/12/2022	04:25	1.84	10:05	4.46	2.66	01:10	0.55	10:05	1.99	1.02	04:25	0.031	10:05	0.394	0.106	0.106	-
07/13/2022	01:00	1.83	18:30	4.58	2.65	01:15	0.51	11:15	1.98	1.01	01:15	0.028	11:15	0.384	0.104	0.104	0.01
07/14/2022	03:10	1.87	14:35	4.34	2.63	03:10	0.53	10:55	1.86	1.01	03:10	0.030	10:55	0.343	0.102	0.102	-
07/15/2022	02:35	1.77	13:55	4.35	2.62	01:05	0.53	13:55	1.88	1.01	02:35	0.029	13:55	0.358	0.102	0.102	-
07/16/2022	02:00	1.68	07:35	4.69	2.50	02:00	0.46	07:35	2.00	0.95	02:00	0.023	07:35	0.424	0.090	0.090	-
07/17/2022	03:50	1.67	07:15	4.24	2.52	02:35	0.51	11:35	1.86	0.95	02:35	0.025	11:35	0.337	0.093	0.093	-
07/18/2022	03:15	1.79	11:55	4.41	2.62	01:35	0.53	15:15	1.86	1.01	01:35	0.029	11:55	0.360	0.102	0.102	-
07/19/2022	01:55	1.73	19:25	4.44	2.62	03:55	0.48	19:25	1.89	1.00	01:55	0.025	19:25	0.372	0.101	0.101	-
07/20/2022	02:45	1.78	18:35	4.35	2.61	02:35	0.52	12:30	1.92	1.00	02:35	0.029	12:30	0.356	0.101	0.101	-
07/21/2022	03:30	1.69	06:35	4.87	2.58	01:55	0.47	06:35	1.98	0.96	03:30	0.024	06:35	0.442	0.096	0.096	-
07/22/2022	03:30	1.81	12:20	4.22	2.60	02:20	0.51	15:35	1.77	0.94	02:20	0.029	15:35	0.322	0.094	0.094	-
07/23/2022	04:30	1.79	15:15	4.23	2.50	01:35	0.50	15:20	1.79	0.88	04:30	0.027	15:15	0.320	0.084	0.084	-
07/24/2022	04:20	1.74	11:05	4.40	2.57	02:05	0.48	11:05	1.88	0.95	04:15	0.026	11:05	0.365	0.094	0.094	-
07/25/2022	03:40	1.97	11:00	4.48	2.71	01:25	0.57	11:00	1.91	1.04	01:25	0.037	11:00	0.380	0.109	0.109	-
07/26/2022	03:00	1.85	18:15	4.43	2.67	02:10	0.49	18:15	1.85	1.01	02:10	0.029	18:15	0.362	0.104	0.104	-
07/27/2022	02:00	1.97	21:05	4.81	2.68	02:00	0.53	21:05	2.00	1.02	02:00	0.032	21:05	0.439	0.106	0.106	-
07/28/2022	00:55	1.97	16:20	4.62	2.81	01:20	0.53	13:00	1.88	1.06	00:55	0.033	16:20	0.386	0.118	0.118	-
07/29/2022	02:10	2.07	12:00	4.94	2.82	00:15	0.70	12:00	2.11	1.07	02:20	0.047	12:00	0.480	0.119	0.119	-
07/30/2022	02:45	2.01	15:55	4.51	2.79	04:30	0.53	15:55	2.04	1.06	02:45	0.036	15:55	0.410	0.116	0.116	-
07/31/2022	04:20	1.90	21:45	4.83	2.78	04:05	0.56	12:40	2.03	1.04	04:05	0.033	12:40	0.438	0.114	0.114	-
08/01/2022	02:35	2.10	12:10	4.73	2.95	02:30	0.64	18:40	1.98	1.13	02:30	0.043	12:10	0.413	0.133	0.133	-
08/02/2022	01:55	2.08	10:25	4.87	2.91	01:55	0.64	10:25	2.04	1.11	01:55	0.043	10:25	0.456	0.130	0.130	-
08/03/2022	02:15	2.03	12:50	4.61	2.90	02:05	0.61	17:05	1.96	1.12	02:05	0.040	17:05	0.397	0.129	0.129	0.02
08/04/2022	02:45	2.07	03:05	3.91	2.55	00:55	0.62	06:00	1.62	0.92	00:55	0.042	06:00	0.267	0.089	0.032	0.20

01/25/2022 00:00 - 08/04/2022 22:55

	DFINAL (in)	VFINAL (ft/s)	QFINAL (MGD - Total MG)	Rain (in)
Total			18.698	13.96
Average	2.57	1.12	0.109	

Appendix G
Hydraulic Analyses Results

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1784	MH-1878	MH-1879	8	161	137.88	134.41	2.155	PVC	0.00	137.88	0.0	≤50%
P-1785	MH-1879	MH-1880	8	200	134.31	130.85	1.73	PVC	0.00	134.31	0.0	≤50%
P-1786	MH-1880	MH-1881	8	200	130.75	128.93	0.91	PVC	0.00	130.75	0.0	≤50%
P-1787	MH-1881	MH-1882	8	142	128.83	127.4	1.007	PVC	0.00	128.83	0.0	≤50%
P-1788	MH-1882	MH-1877	8	217	127.28	125.58	0.783	PVC	0.00	127.28	0.0	≤50%
P-1782	MH-1876	MH-1877	8	371	134.3	125.58	2.35	PVC	0.00	134.3	0.0	≤50%
P-1783	MH-1877	MH-1874	8	122	125.58	124.94	0.525	PVC	0.00	125.58	0.0	≤50%
P-1777	MH-1870	MH-1871	8	66	135.03	133.42	2.439	PVC	0.00	135.03	0.0	≤50%
P-1778	MH-1871	MH-1872	8	169	133.34	129.04	2.544	PVC	0.00	133.34	0.0	≤50%
P-1779	MH-1872	MH-1873	8	144	128.94	125.65	2.285	PVC	0.00	128.94	0.0	≤50%
P-1780	MH-1873	MH-1874	8	69	125.55	124.94	0.884	PVC	0.00	125.55	0.0	≤50%
P-1781	MH-1874	MH-1875	8	283	124.84	123.18	0.587	PVC	0.00	124.84	0.0	≤50%
P-1875	MH-1875	WW-10	8	10	123	123	0	PVC	0.00	123	0.0	≤50%
P-390	MH-389	MH-387	12	58	125.59	125.21	0.655	PVC	20.11	125.68	1.1	≤50%
P-493	MH-491	MH-492	8	282	191.11	182.09	3.199	PVC	0.62	191.13	0.2	≤50%
P-495	MH-492	MH-494	8	282	181.98	180.01	0.699	PVC	1.25	182.01	0.4	≤50%
P-497	MH-494	MH-496	8	150	179.94	179	0.627	PVC	1.87	179.97	0.4	≤50%
P-499	MH-496	MH-498	8	230	178.93	174.07	2.113	PVC	2.49	178.96	0.4	≤50%
P-500	MH-498	MH-474	8	260	173.93	158.13	6.077	PVC	3.11	173.97	0.5	≤50%
P-467	MH-465	MH-466	8	112	179.62	178.85	0.688	PVC	0.62	179.64	0.2	≤50%
P-469	MH-466	MH-468	8	239	178.85	171.09	3.247	PVC	1.25	178.87	0.2	≤50%
P-471	MH-468	MH-470	8	293	170.92	160.08	3.7	PVC	1.87	170.95	0.4	≤50%
P-473	MH-470	MH-472	8	159	159.94	159.08	0.541	PVC	2.49	159.98	0.5	≤50%
P-475	MH-472	MH-474	8	146	159.03	158.19	0.575	PVC	3.11	159.07	0.5	≤50%
P-477	MH-474	MH-476	8	359	157.88	156.37	0.421	PVC	6.85	157.94	0.7	≤50%
P-479	MH-476	MH-478	8	71	156.21	155.85	0.507	PVC	7.47	156.27	0.7	≤50%
P-481	MH-478	MH-480	8	180	155.85	155.15	0.389	PVC	8.09	155.92	0.8	≤50%
P-483	MH-480	MH-482	8	64	155.02	154.72	0.469	PVC	8.72	155.09	0.8	≤50%
P-485	MH-482	MH-484	8	69	154.72	152.33	3.464	PVC	9.34	154.78	0.7	≤50%
P-487	MH-484	MH-486	8	244	152.33	146.91	2.221	PVC	9.96	152.4	0.8	≤50%
P-489	MH-486	MH-488	12	256	146.6	138.64	3.109	PVC	10.59	146.66	0.7	≤50%
P-490	MH-488	MH-383	12	193	138.5	131.82	3.461	PVC	11.21	138.56	0.7	≤50%
P-372	MH-370	MH-371	8	78	230.75	224.6	7.885	PVC	0.62	230.77	0.2	≤50%
P-374	MH-371	MH-373	8	278	224.43	201.79	8.144	PVC	1.25	224.45	0.2	≤50%
P-376	MH-373	MH-375	8	301	201.7	196.85	1.611	PVC	1.87	201.73	0.4	≤50%
P-394	MH-393	MH-375	8	128	197.93	196.75	0.922	PVC	0.62	197.95	0.2	≤50%
P-378	MH-375	MH-377	8	249	196.72	179.76	6.811	PVC	3.11	196.76	0.5	≤50%
P-380	MH-377	MH-379	8	267	179.56	155.67	8.948	PVC	3.74	179.6	0.5	≤50%
P-382	MH-379	MH-381	8	147	155.55	139.74	10.755	PVC	4.36	155.59	0.5	≤50%
P-410	MH-409	MH-406	8	350	165.94	161.08	1.389	PVC	0.62	165.96	0.2	≤50%
P-412	MH-411	MH-402	8	145	198.2	193.94	2.938	PVC	0.62	198.22	0.2	≤50%
P-397	MH-395	MH-396	8	106	226.27	221.56	4.443	PVC	0.62	226.29	0.2	≤50%
P-399	MH-396	MH-398	8	106	221.36	216.32	4.755	PVC	1.25	221.38	0.2	≤50%
P-401	MH-398	MH-400	8	81	216.08	212.33	4.63	PVC	1.87	216.11	0.4	≤50%
P-403	MH-400	MH-402	8	399	212.21	194.02	4.559	PVC	2.49	212.24	0.4	≤50%
P-405	MH-402	MH-404	8	327	193.84	179.16	4.489	PVC	3.74	193.88	0.5	≤50%
P-407	MH-404	MH-406	8	338	179.02	161.08	5.308	PVC	4.36	179.06	0.5	≤50%
P-408	MH-406	MH-381	8	387	161	139.74	5.494	PVC	5.60	161.05	0.6	≤50%
P-384	MH-381	MH-383	12	219	139.43	131.82	3.475	PVC	10.59	139.49	0.7	≤50%
P-386	MH-383	MH-385	12	20	131.66	131.33	1.65	PVC	22.42	131.75	1.1	≤50%
P-388	MH-385	MH-387	12	62	131.26	125.21	9.758	PVC	22.42	131.35	1.1	≤50%
P-685	MH-387	WW-COPPER	30	23	125.12	122.5	11.391	PVC	42.53	125.22	1.2	≤50%
P-719	MH-717	MH-718	8	32	79.2	79	0.625	PVC	0.42	79.22	0.2	≤50%
P-721	MH-718	MH-720	8	33	79	78.72	0.848	PVC	0.83	79.02	0.2	≤50%
P-723	MH-720	MH-722	8	104	78.71	77.97	0.712	PVC	1.25	78.74	0.4	≤50%
P-725	MH-722	MH-724	8	64	77.87	77.29	0.906	PVC	1.67	77.9	0.4	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-731	MH-724	MH-730	8	20	76.31	74.48	9.15	PVC	2.09	76.34	0.4	≤50%
P-734	MH-732	MH-733	8	325	76.9	75.6	0.4	PVC	0.42	76.92	0.2	≤50%
P-735	MH-733	MH-730	8	256	75.5	74.48	0.398	PVC	0.83	75.76	3.1	≤50%
P-691	MH-730	WW-LINDSTROM	30	1	74.48	74.46	2	PVC	3.34	75.76	15.4	52%
P-1455	MH-1450	MH-1451	6	105	45.71	40.8	4.676	PVC	0.42	45.72	0.1	≤50%
P-1469	MH-1451	MH-1467	8	50	40.7	40.2	1	PVC	0.83	40.72	0.2	≤50%
P-1456	MH-1449	MH-1448	8	246	53.16	35.4	7.22	PVC	0.42	53.17	0.1	≤50%
P-1457	MH-1448	MH-1447	8	157	35.3	34.51	0.503	PVC	0.83	35.32	0.2	≤50%
P-1458	MH-1447	MH-1454	8	104	34.41	33.93	0.462	PVC	1.25	34.44	0.4	≤50%
P-1459	MH-1454	MH-1453	8	91	33.83	33.37	0.505	PVC	1.67	33.86	0.4	≤50%
P-1460	MH-1453	MH-1452	8	36	33.27	33.09	0.5	PVC	2.09	33.31	0.5	≤50%
P-1468	MH-1452	MH-1467	8	52	32.99	32.47	1	PVC	2.50	33.02	0.4	≤50%
P-689	MH-1467	WW-TAYLOR	30	1	32.47	32	47	PVC	3.76	32.5	0.4	≤50%
P-1130	MH-1129	MH-1127	8	228	99.66	95.7	1.737	PVC	1.54	99.69	0.4	≤50%
P-1128	MH-1127	MH-1125	8	268	95.6	76.5	7.127	PVC	3.08	95.64	0.5	≤50%
P-1132	MH-1131	MH-1125	8	143	80.16	76.5	2.559	PVC	1.54	80.19	0.4	≤50%
P-1126	MH-1125	MH-1123	8	202	76.4	52.18	11.99	PVC	6.15	76.45	0.6	≤50%
P-1124	MH-1123	MH-1121	8	194	52.08	35.89	8.345	PVC	7.69	52.14	0.7	≤50%
P-1122	MH-1121	MH-1119	8	397	35.79	31.06	1.191	PVC	9.23	35.85	0.7	≤50%
P-1120	MH-1119	MH-1117	8	410	30.96	27.27	0.9	PVC	10.76	31.03	0.8	≤50%
P-1106	MH-1104	MH-1105	8	251	100.83	100.03	0.319	PVC	1.54	100.86	0.4	≤50%
P-771	MH-1648	MH-686	8	174	114	106.68	4.207	PVC	1.54	114.03	0.4	≤50%
P-1524	MH-686	MH-1105	8	285	106.58	103.56	1.06	PVC	3.08	106.62	0.5	≤50%
P-1108	MH-1105	MH-1107	8	264	99.93	98.45	0.561	PVC	6.15	99.99	0.7	≤50%
P-1110	MH-1107	MH-1109	8	182	98.35	97.31	0.571	PVC	7.69	98.41	0.7	≤50%
P-1112	MH-1109	MH-1111	8	237	97.21	92.31	2.068	PVC	9.23	97.27	0.7	≤50%
P-1114	MH-1111	MH-1113	8	313	92.21	75.59	5.31	PVC	10.76	92.28	0.8	≤50%
P-1116	MH-1113	MH-1115	8	289	75.58	38.31	12.896	PVC	12.30	75.65	0.8	≤50%
P-1118	MH-1115	MH-1117	8	50	38.21	27.27	21.88	PVC	13.84	38.29	1.0	≤50%
P-1138	MH-1117	MH-1134	8	126	27.17	26.21	0.762	PVC	26.14	27.28	1.3	≤50%
P-1135	MH-1133	MH-1134	8	212	26.93	26.21	0.34	PVC	18.37	27.04	1.3	≤50%
P-1137	MH-1134	MH-1136	8	34	26.11	26	0.324	PVC	46.05	26.28	2.0	≤50%
P-682	MH-1136	WW-PIONEER	30	88	26	22	4.545	PVC	47.59	26.1	1.2	≤50%
P-1291	MH-1289	MH-1290	6	140	0	-0.89	0.636	PVC	10.02	0.08	1.0	≤50%
P-1677	MH-1770	MH-1769	8	200	1.19	0.39	0.4	PVC	0.00	1.19	0.0	≤50%
P-1676	MH-1769	MH-1290	8	298	0.29	-0.89	0.396	PVC	0.00	0.29	0.0	≤50%
P-1292	MH-1290	MH-1276	8	330	-0.99	-6.99	1.818	PVC	12.69	-0.91	1.0	≤50%
P-1319	MH-1317	MH-1318	8	209	-0.02	-0.88	0.411	Asbestos Cement	2.67	0.02	0.5	≤50%
P-1321	MH-1318	MH-1320	8	202	-0.88	-1.48	0.297	Asbestos Cement	5.34	-0.82	0.7	≤50%
P-1323	MH-1320	MH-1322	8	126	-1.48	-1.92	0.349	Asbestos Cement	8.02	-1.41	0.8	≤50%
P-1325	MH-1322	MH-1324	8	317	-1.92	-3.01	0.344	Asbestos Cement	10.69	-1.84	1.0	≤50%
P-1327	MH-1324	MH-1326	8	272	-3.01	-4.06	0.386	Asbestos Cement	13.36	-2.92	1.1	≤50%
P-1330	MH-1329	MH-1326	8	230	-3.13	-4.06	0.404	Asbestos Cement	2.67	-3.09	0.5	≤50%
P-1328	MH-1326	MH-1270	8	374	-4.06	-5.5	0.385	Asbestos Cement	18.71	-3.95	1.3	≤50%
P-1316	MH-1315	MH-1268	8	263	0.12	-0.92	0.395	Asbestos Cement	2.67	0.16	0.5	≤50%
P-1312	MH-1311	MH-1262	8	197	-1.75	-5.89	2.102	Asbestos Cement	2.67	-1.72	0.4	≤50%
P-1309	MH-1307	MH-1308	8	341	-0.48	-2.64	0.633	Asbestos Cement	2.67	-0.44	0.5	≤50%
P-1310	MH-1308	MH-1262	8	29	-2.64	-5.89	11.207	Asbestos Cement	5.34	-2.59	0.6	≤50%
P-1306	MH-1305	MH-1260	8	316	-1.76	-3.4	0.519	Asbestos Cement	2.67	-1.72	0.5	≤50%
P-1298	MH-1297	MH-1258	8	383	-0.58	-2.53	0.509	Asbestos Cement	2.67	-0.54	0.5	≤50%
P-1296	MH-1295	MH-1258	8	341	-1.54	-2.53	0.29	Asbestos Cement	2.67	-1.49	0.6	≤50%
P-1294	MH-1293	MH-1256	8	339	0.28	-1.38	0.49	Asbestos Cement	2.67	0.32	0.5	≤50%
P-1257	MH-1255	MH-1256	8	376	0.79	-0.38	0.311	Asbestos Cement	2.67	0.83	0.5	≤50%
P-1259	MH-1256	MH-1258	8	290	-1.38	-2.53	0.397	Asbestos Cement	8.02	-1.31	0.8	≤50%
P-1261	MH-1258	MH-1260	8	284	-2.53	-3.4	0.306	Asbestos Cement	16.03	-2.43	1.2	≤50%
P-1301	MH-1299	MH-1300	8	237	-0.93	-1.93	0.422	Asbestos Cement	2.67	-0.89	0.5	≤50%

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Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1303	MH-1300	MH-1302	8	139	-1.93	-2.33	0.288	Asbestos Cement	5.34	-1.87	0.7	≤50%
P-1304	MH-1302	MH-1260	8	341	-2.4	-3.4	0.293	Asbestos Cement	8.02	-2.32	1.0	≤50%
P-1263	MH-1260	MH-1262	8	170	-3.4	-3.89	0.288	Asbestos Cement	29.40	-3.26	1.7	≤50%
P-1265	MH-1262	MH-1264	8	122	-3.89	-4.25	0.295	Asbestos Cement	40.09	-3.72	2.0	≤50%
P-1267	MH-1264	MH-1266	8	38	-4.25	-4.41	0.421	Asbestos Cement	42.76	-4.09	1.9	≤50%
P-1269	MH-1266	MH-1268	8	110	-4.41	-4.74	0.3	Asbestos Cement	45.43	-4.23	2.2	≤50%
P-1314	MH-1313	MH-1268	8	357	0.21	-4.74	1.387	Asbestos Cement	2.67	0.24	0.4	≤50%
P-1271	MH-1268	MH-1270	8	262	-4.74	-5.54	0.305	Asbestos Cement	53.45	-4.55	2.3	≤50%
P-1273	MH-1270	MH-1272	8	119	-5.54	-5.95	0.345	Asbestos Cement	74.83	-5.32	2.6	≤50%
P-1332	MH-1331	MH-1272	8	390	-4.3	-5.95	0.423	PVC	2.67	-4.26	0.5	≤50%
P-1275	MH-1272	MH-1274	8	143	-5.95	-6.47	0.364	Asbestos Cement	80.17	-5.73	2.6	≤50%
P-1277	MH-1274	MH-1276	8	199	-6.47	-6.99	0.261	Asbestos Cement	121.37	-6.16	3.7	≤50%
P-1279	MH-1276	MH-1278	8	302	-6.99	-7.89	0.298	Asbestos Cement	136.74	-6.67	3.8	≤50%
P-1287	MH-1285	MH-1286	8	242	-1.93	-3.35	0.587	Asbestos Cement	2.67	-1.89	0.5	≤50%
P-1288	MH-1286	MH-1278	8	291	-3.35	-4.64	0.443	Asbestos Cement	5.34	-3.29	0.7	≤50%
P-1281	MH-1278	MH-1280	8	128	-7.89	-8.25	0.281	Asbestos Cement	144.75	-7.56	4.0	≤50%
P-1283	MH-1280	MH-1282	8	393	-8.25	-9.45	0.305	Asbestos Cement	147.43	-7.92	4.0	≤50%
P-1284	MH-1282	MH-1206	8	38	-9.45	-9.62	0.447	Asbestos Cement	150.10	-9.15	3.6	≤50%
P-1247	MH-1245	MH-1246	8	121	-1.63	-2.16	0.438	Asbestos Cement	1.11	-1.6	0.4	≤50%
P-1249	MH-1246	MH-1248	8	112	-2.36	-2.8	0.393	Asbestos Cement	2.22	-2.32	0.5	≤50%
P-1251	MH-1248	MH-1250	8	313	-2.8	-4.05	0.399	Asbestos Cement	3.33	-2.75	0.6	≤50%
P-1253	MH-1250	MH-1252	8	318	-4.05	-5.29	0.39	Asbestos Cement	4.44	-4	0.6	≤50%
P-1254	MH-1252	MH-1200	8	152	-5.39	-7.16	1.164	Asbestos Cement	5.56	-5.34	0.6	≤50%
P-1528	MH-696	MH-695	8	258	2.23	-3.93	2.388	PVC	1.11	2.25	0.2	≤50%
P-782	MH-695	MH-1472	10	222	-4.03	-4.93	0.405	PVC	2.22	-4	0.4	≤50%
P-1527	MH-1472	MH-693	10	225	-5.03	-5.93	0.4	PVC	3.33	-4.99	0.5	≤50%
P-1526	MH-693	MH-1471	10	115	-6.03	-6.6	0.496	PVC	4.44	-5.99	0.5	≤50%
P-1244	MH-1243	MH-1194	8	109	0.09	-1.89	1.817	Asbestos Cement	1.11	0.11	0.2	≤50%
P-1242	MH-1241	MH-1192	8	112	0.28	-3.84	3.679	Asbestos Cement	1.11	0.3	0.2	≤50%
P-1235	MH-1233	MH-1234	8	240	1	-0.9	0.792	Asbestos Cement	1.11	1.02	0.2	≤50%
P-1239	MH-1237	MH-1238	8	238	4	1.1	1.218	Asbestos Cement	1.11	4.02	0.2	≤50%
P-1240	MH-1238	MH-1234	8	158	1	-0.9	1.203	Asbestos Cement	2.22	1.03	0.4	≤50%
P-1236	MH-1234	MH-1190	8	164	-1	-2.96	1.195	Asbestos Cement	4.44	-0.96	0.5	≤50%
P-1231	MH-1229	MH-1230	8	193	-0.42	-1.24	0.425	Asbestos Cement	1.11	-0.39	0.4	≤50%
P-1232	MH-1230	MH-1188	8	210	-1.24	-2.08	0.4	Asbestos Cement	2.22	-1.2	0.5	≤50%
P-1185	MH-1183	MH-1184	8	300	0.65	-1.1	0.583	Asbestos Cement	1.11	0.68	0.4	≤50%
P-1187	MH-1184	MH-1186	6	234	-1.1	-1.21	0.047	PVC	2.22	-1.03	0.8	≤50%
P-1227	MH-1225	MH-1226	8	206	0.26	-0.5	0.369	PVC	1.11	0.29	0.4	≤50%
P-1228	MH-1226	MH-1186	8	200	-0.58	-1.21	0.315	Corrugated HDPE (Smooth Interior)	2.22	-0.54	0.5	≤50%
P-1189	MH-1186	MH-1188	8	287	-1.21	-2.08	0.303	Asbestos Cement	5.56	-1.15	0.7	≤50%
P-1191	MH-1188	MH-1190	8	288	-2.08	-2.96	0.306	Asbestos Cement	63.67	-1.87	2.5	≤50%
P-1193	MH-1190	MH-1192	8	307	-2.96	-3.84	0.287	Asbestos Cement	69.23	-2.74	2.6	≤50%
P-1195	MH-1192	MH-1194	12	305	-4.44	-5.77	0.436	Asbestos Cement	71.45	-4.26	2.2	≤50%
P-1197	MH-1194	MH-1196	12	83	-5.77	-6.16	0.47	Asbestos Cement	73.67	-5.59	2.2	≤50%
P-1525	MH-1196	MH-1471	12	60	-6.16	-6.6	0.733	Concrete	74.78	-5.99	2.0	≤50%
P-778	MH-1471	MH-1198	12	344	-6.7	-7.61	0.265	Concrete	80.34	-6.49	2.5	≤50%
P-1201	MH-1198	MH-1200	12	115	-7.61	-8.16	0.478	Asbestos Cement	81.45	-7.43	2.2	≤50%
P-1203	MH-1200	MH-1202	12	174	-8.16	-8.84	0.391	Asbestos Cement	88.12	-7.96	2.4	≤50%
P-1205	MH-1202	MH-1204	12	107	-8.84	-9.26	0.393	Asbestos Cement	89.23	-8.64	2.4	≤50%
P-1215	MH-1213	MH-1214	6	125	1.5	-0.07	1.256	PVC	1.11	1.52	0.2	≤50%
P-1222	MH-1221	MH-1214	6	36	3.82	-0.07	10.806	PVC	1.11	3.84	0.2	≤50%
P-1217	MH-1214	MH-1216	8	196	-0.17	-0.95	0.398	PVC	3.33	-0.12	0.6	≤50%
P-1219	MH-1216	MH-1218	8	283	-1.05	-2.39	0.473	PVC	4.44	-1	0.6	≤50%
P-1220	MH-1218	MH-1204	8	56	-2.49	-2.76	0.482	PVC	5.56	-2.43	0.7	≤50%
P-1207	MH-1204	MH-1206	12	229	-9.26	-10.15	0.389	Asbestos Cement	95.89	-9.05	2.5	≤50%
P-1209	MH-1206	MH-1208	15	388	-10.28	-11.02	0.191	Asbestos Cement	247.99	-9.9	4.6	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1757	MH-1846	MH-1845	8	96	-0.39	-0.77	0.396	PVC	0.00	-0.39	0.0	≤50%
P-1756	MH-1845	MH-1843	8	46	-0.87	-1.05	0.391	PVC	0.00	-0.87	0.0	≤50%
P-1755	MH-1844	MH-1843	8	172	-0.36	-1.05	0.401	PVC	0.00	-0.36	0.0	≤50%
P-1754	MH-1843	MH-1842	8	128	-1.15	-1.66	0.398	PVC	0.00	-1.15	0.0	≤50%
P-1753	MH-1842	MH-1223	8	41	-1.66	-1.93	0.659	PVC	0.00	-1.66	0.0	≤50%
P-1224	MH-1223	MH-1208	8	324	-2.56	-4.66	0.648	Asbestos Cement	2.00	-2.53	0.4	≤50%
P-1211	MH-1208	MH-1210	15	365	-11.02	-11.68	0.181	Asbestos Cement	252.00	-10.64	4.6	≤50%
P-1212	MH-1210	MH-99	14	313	-11.68	-13.2	0.486	PVC	254.00	-11.38	3.6	≤50%
P-1169	MH-1168	MH-1166	8	83	-2	-4.1	2.53	PVC	3.58	-1.96	0.5	≤50%
P-1167	MH-1166	MH-1164	8	234	-4	-6.1	0.897	PVC	7.16	-3.94	0.7	≤50%
P-1163	MH-1161	MH-1162	8	197	1	-2.1	1.574	PVC	3.58	1.04	0.5	≤50%
P-1165	MH-1162	MH-1164	8	246	-2	-6.1	1.667	PVC	7.16	-1.94	0.7	≤50%
P-1170	MH-1164	MH-95	8	367	-6	-10.76	1.297	PVC	17.89	-5.91	1.1	≤50%
P-1639	MH-1732	MH-1731	8	115	3.23	2.71	0.452	PVC	0.00	3.23	0.0	≤50%
P-1638	MH-1731	MH-1730	8	139	2.61	1.99	0.446	PVC	0.00	2.61	0.0	≤50%
P-1637	MH-1730	MH-1729	8	188	1.89	0.93	0.511	PVC	0.00	1.89	0.0	≤50%
P-1636	MH-1729	MH-1141	8	128	0.83	0.18	0.508	PVC	0.00	0.83	0.0	≤50%
P-1142(1)	MH-1141	MH-1983	8	201	-4	-6.14	1.065	PVC	3.58	-3.95	0.6	≤50%
P-1142(2)	MH-1983	MH-87	8	164	-4	-6.14	1.305	PVC	3.58	-3.96	0.5	≤50%
P-1885	MH-1982	MH-1981	8	230	3.8	1.4	1.043	PVC	0.00	3.8	0.0	≤50%
P-1884	MH-1981	MH-1980	8	155	1.4	-3.46	3.135	PVC	0.00	1.4	0.0	≤50%
P-1883	MH-1980	MH-87	8	15	-3.46	-4.11	4.333	PVC	0.00	-3.46	0.0	≤50%
P-950	MH-948	MH-949	8	364	-0.39	-1.85	0.401	Asbestos Cement	1.99	-0.35	0.5	≤50%
P-951	MH-949	MH-943	8	140	-1.85	-2.41	0.4	Asbestos Cement	3.98	-1.8	0.6	≤50%
P-1882	MH-1979	MH-1978	8	196	-0.07	-2.03	1	PVC	0.00	-0.07	0.0	≤50%
P-1881	MH-1978	MH-941	8	60	-2.13	-4.73	4.333	PVC	0.00	-2.13	0.0	≤50%
P-954	MH-952	MH-953	8	102	-2.68	-3.09	0.402	Asbestos Cement	1.99	-2.64	0.5	≤50%
P-955	MH-953	MH-939	8	52	-3.09	-3.27	0.346	Asbestos Cement	3.98	-3.04	0.6	≤50%
P-938	MH-936	MH-937	6	73	0	-1.9	2.603	PVC	1.99	0.03	0.4	≤50%
P-940	MH-937	MH-939	8	153	-1.9	-3.27	0.895	PVC	3.98	-1.86	0.5	≤50%
P-942	MH-939	MH-941	8	372	-3.27	-4.78	0.406	Asbestos Cement	9.94	-3.19	1.0	≤50%
P-944	MH-941	MH-943	8	284	-4.78	-5.91	0.398	Asbestos Cement	11.93	-4.69	1.1	≤50%
P-945	MH-943	MH-83	8	157	-5.91	-6.43	0.331	PVC	19.48	-5.81	1.2	≤50%
P-1643	MH-1733	MH-1037	10	45	-2.08	-2.19	0.24	PVC	0.00	-2.08	0.0	≤50%
P-1038	MH-1037	MH-1035	10	100	-2.29	-2.51	0.22	PVC	1.99	-2.25	0.5	≤50%
P-739	MH-1035	MH-1393	10	50	-2.61	-2.72	0.22	PVC	3.98	-2.56	0.6	≤50%
P-747	MH-1393	MH-75	8	187	-2.82	-4.53	0.914	Concrete	5.96	-2.77	0.6	≤50%
P-751	MH-676	MH-75	12	206	-1	-4.43	1.665	PVC	1.99	-0.97	0.4	≤50%
P-78	MH-75	MH-77	14	253	-4.53	-5.51	0.387	Asbestos Cement	9.94	-4.47	0.7	≤50%
P-80	MH-77	MH-79	14	363	-5.51	-6.29	0.215	Cast iron	11.93	-5.43	1.0	≤50%
P-82	MH-79	MH-81	14	409	-6.29	-6.72	0.105	Asbestos Cement	13.91	-6.19	1.2	≤50%
P-947	MH-946	MH-81	8	186	-4.52	-6.37	0.995	Asbestos Cement	3.58	-4.48	0.5	≤50%
P-84	MH-81	MH-83	14	132	-6.72	-7.12	0.303	Asbestos Cement	21.07	-6.63	1.1	≤50%
P-86	MH-83	MH-85	14	297	-7.12	-7.95	0.279	Asbestos Cement	44.13	-6.98	1.7	≤50%
P-88	MH-85	MH-87	14	323	-7.95	-8.58	0.195	Asbestos Cement	47.70	-7.79	1.9	≤50%
P-1140	MH-1139	MH-87	8	152	-4.25	-6.14	1.243	PVC	3.58	-4.21	0.5	≤50%
P-90	MH-87	MH-89	14	343	-8.27	-9.07	0.233	Asbestos Cement	58.44	-8.11	1.9	≤50%
P-92	MH-89	MH-91	14	342	-9.07	-10.11	0.304	Asbestos Cement	62.01	-8.91	1.9	≤50%
P-1145	MH-1143	MH-1144	8	201	-2.18	-4.18	0.995	PVC	3.58	-2.14	0.5	≤50%
P-1335	MH-1144	MH-1333	8	300	-4.28	-7.28	1	PVC	7.16	-4.22	0.7	≤50%
P-1160	MH-1159	MH-1156	6	61	2.7	2.3	0.656	PVC	3.58	2.96	3.1	53%
P-1157	MH-1155	MH-1156	6	54	5	2.88	3.926	PVC	3.58	5.04	0.5	≤50%
P-1158	MH-1156	MH-1150	6	118	2.88	-1.92	4.068	PVC	10.73	2.95	0.8	≤50%
P-1151	MH-1149	MH-1150	8	145	-0.52	-1.92	0.966	PVC	3.58	-0.48	0.5	≤50%
P-1338	MH-1150	MH-1336	8	209	-2.02	-4.18	1.033	PVC	17.89	-1.93	1.1	≤50%
P-1337	MH-1336	MH-1333	8	301	-4.28	-7.28	0.997	PVC	21.47	-4.18	1.2	≤50%

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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1334	MH-1333	MH-1146	8	98	-7.38	-8.13	0.765	PVC	32.20	-7.26	1.4	≤50%
P-1148	MH-1146	MH-91	8	268	-8.5	-9.48	0.366	Asbestos Cement	35.78	-8.35	1.8	≤50%
P-94	MH-91	MH-93	14	284	-10.11	-10.32	0.074	Asbestos Cement	101.37	-9.83	3.4	≤50%
P-1347	MH-93	MH-95	14	167	-10.48	-10.76	0.168	Asbestos Cement	104.95	-10.24	2.9	≤50%
P-695	MH-95	MH-97	14	152	-10.76	-11.33	0.375	Asbestos Cement	126.41	-10.55	2.5	≤50%
P-100	MH-97	MH-99	14	291	-11.33	-12.08	0.258	Asbestos Cement	129.99	-11.09	2.9	≤50%
P-102	MH-99	MH-101	20	245	-13.2	-13.29	0.037	Asbestos Cement	387.57	-12.49	8.5	≤50%
P-1173	MH-1171	MH-1172	8	176	0.3	-0.49	0.449	PVC	3.58	0.35	0.6	≤50%
P-1175	MH-1172	MH-1174	8	272	-0.59	-1.82	0.452	PVC	7.16	-0.53	0.7	≤50%
P-1177	MH-1174	MH-1176	8	205	-1.92	-2.85	0.454	PVC	10.73	-1.84	1.0	≤50%
P-1179	MH-1176	MH-1178	8	358	-2.95	-4.46	0.422	PVC	14.31	-2.86	1.1	≤50%
P-1181	MH-1178	MH-1180	8	229	-4.41	-5.76	0.59	Asbestos Cement	17.89	-4.32	1.1	≤50%
P-1873	MH-1966	MH-1967	6	216	-2.51	-4.67	1	PVC	0.00	-2.51	0.0	≤50%
P-1874	MH-1967	MH-1180	6	13	-4.67	-5.08	3.154	PVC	0.00	-4.67	0.0	≤50%
P-1182	MH-1180	MH-101	12	267	-5.61	-8.03	0.906	PVC	21.47	-5.52	1.1	≤50%
P-681	MH-101	WW-MAIN	20	27	-13.35	-13	-1.296	Cast iron	412.61	-12.52	10.0	≤50%
P-958	MH-956	MH-957	8	363	146	141	1.377	PVC	4.61	146.05	0.6	≤50%
P-960	MH-957	MH-959	8	265	140.9	134.4	2.453	PVC	9.23	140.96	0.7	≤50%
P-962	MH-959	MH-961	8	185	134.3	116.3	9.73	PVC	13.84	134.38	1.0	≤50%
P-964	MH-961	MH-963	8	122	116.2	99.2	13.934	PVC	18.45	116.29	1.1	≤50%
P-966	MH-963	MH-965	8	185	99.1	90.1	4.865	PVC	23.06	99.2	1.2	≤50%
P-968	MH-965	MH-967	8	144	90	87.11	2.007	PVC	27.68	90.11	1.3	≤50%
P-1017	MH-1015	MH-1016	8	366	140.2	125.2	4.098	PVC	4.61	140.25	0.6	≤50%
P-1019	MH-1016	MH-1018	8	182	125.1	114.1	6.044	PVC	9.23	125.16	0.7	≤50%
P-1022	MH-1021	MH-1018	8	139	116	114.1	1.367	PVC	4.61	116.05	0.6	≤50%
P-1020	MH-1018	MH-967	8	157	114	90.11	15.217	PVC	18.45	114.09	1.1	≤50%
P-970	MH-967	MH-969	8	96	87.01	80.01	7.292	PVC	50.74	87.16	1.8	≤50%
P-972	MH-969	MH-971	8	83	79.91	72.91	8.434	PVC	55.35	80.07	1.9	≤50%
P-974	MH-971	MH-973	8	69	72.81	68.81	5.797	PVC	59.96	72.98	2.0	≤50%
P-976	MH-973	MH-975	8	106	68.71	68.31	0.377	Concrete	64.58	68.91	2.4	≤50%
P-1024	MH-1023	MH-975	8	120	74.08	68.21	4.892	Concrete	4.61	74.13	0.6	≤50%
P-978	MH-975	MH-977	8	291	68.11	50.88	5.921	Concrete	73.80	68.3	2.3	≤50%
P-980	MH-977	MH-979	8	170	50.78	44.86	3.482	Concrete	78.41	50.97	2.3	≤50%
P-1027	MH-1025	MH-1026	8	215	60.8	47.9	6	Concrete	4.61	60.85	0.6	≤50%
P-1028	MH-1026	MH-979	8	115	47.8	44.86	2.557	Concrete	9.23	47.86	0.7	≤50%
P-982	MH-979	MH-981	8	154	44.76	34.76	6.494	Concrete	92.25	44.97	2.5	≤50%
P-776	MH-1470	MH-690	8	347	178.04	177.39	0.187	PVC	2.31	178.08	0.5	≤50%
P-775	MH-690	MH-1469	8	187	177.29	171.88	2.893	PVC	4.61	177.34	0.6	≤50%
P-774	MH-1469	MH-688	8	164	171.83	167.32	2.75	PVC	6.92	171.89	0.7	≤50%
P-772	MH-688	MH-1092	8	105	167.17	163.64	3.362	PVC	9.23	167.23	0.7	≤50%
P-1094	MH-1092	MH-1093	8	156	163.51	160	2.25	PVC	11.53	163.58	0.8	≤50%
P-1096	MH-1093	MH-1095	8	319	159.9	130.9	9.091	PVC	13.84	159.98	1.0	≤50%
P-1098	MH-1095	MH-1097	8	105	130.9	129.22	1.6	PVC	16.14	130.99	1.1	≤50%
P-1100	MH-1097	MH-1099	8	112	129.12	125.24	3.464	PVC	18.45	129.21	1.1	≤50%
P-1102	MH-1099	MH-1101	8	399	125.14	112.58	3.148	PVC	20.76	125.24	1.2	≤50%
P-1103	MH-1101	MH-1056	8	358	112.48	104.79	2.148	PVC	23.06	112.58	1.2	≤50%
P-1087	MH-1086	MH-1070	8	138	131.21	130.56	0.471	PVC	2.31	131.25	0.5	≤50%
P-1085	MH-1084	MH-1072	8	270	148.87	147.53	0.496	PVC	2.31	148.91	0.5	≤50%
P-1083	MH-1082	MH-1080	8	180	171.73	168.38	1.861	PVC	2.31	171.76	0.4	≤50%
P-1081	MH-1080	MH-1078	8	89	168.28	163.87	4.955	PVC	4.61	168.33	0.6	≤50%
P-1079	MH-1078	MH-1076	8	217	163.77	154.86	4.106	PVC	6.92	163.83	0.7	≤50%
P-1077	MH-1076	MH-1074	8	95	154.76	152.33	2.558	PVC	9.23	154.82	0.7	≤50%
P-1075	MH-1074	MH-1072	8	119	152.23	147.53	3.95	PVC	11.53	152.3	0.8	≤50%
P-1073	MH-1072	MH-1070	8	284	147.43	130.56	5.94	PVC	16.14	147.52	1.1	≤50%
P-1071	MH-1070	MH-1068	8	104	130.46	126.87	3.452	PVC	20.76	130.56	1.2	≤50%
P-1069	MH-1068	MH-1066	8	111	126.77	121.45	4.793	PVC	23.06	126.87	1.2	≤50%

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Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1863	MH-1956	MH-1955	8	394	175.88	156.83	4.835	PVC	0.00	175.88	0.0	≤50%
P-1862	MH-1955	MH-1954	8	250	156.83	146.9	3.972	PVC	0.00	156.83	0.0	≤50%
P-1861	MH-1954	MH-1947	8	250	146.9	129.45	6.98	PVC	0.00	146.9	0.0	≤50%
P-1860	MH-1953	MH-1952	8	203	156.88	147.16	4.788	PVC	0.00	156.88	0.0	≤50%
P-1859	MH-1952	MH-1951	8	87	147.16	134.79	14.218	PVC	0.00	147.16	0.0	≤50%
P-1871	MH-1964	MH-1965	8	349	165.55	151.38	4.06	PVC	0.00	165.55	0.0	≤50%
P-1872	MH-1965	MH-1961	8	105	151.38	148.98	2.286	PVC	0.00	151.38	0.0	≤50%
P-1864	MH-1957	MH-1958	8	256	180.86	179.46	0.547	PVC	0.00	180.86	0.0	≤50%
P-1865	MH-1958	MH-1959	8	235	179.46	169.65	4.174	PVC	0.00	179.46	0.0	≤50%
P-1866	MH-1959	MH-1960	8	86	169.65	162.15	8.721	PVC	0.00	169.65	0.0	≤50%
P-1867	MH-1960	MH-1961	8	133	162.15	148.98	9.902	PVC	0.00	162.15	0.0	≤50%
P-1868	MH-1961	MH-1962	8	202	148.98	136.29	6.282	PVC	0.00	148.98	0.0	≤50%
P-1869	MH-1962	MH-1963	8	153	136.29	135.4	0.582	PVC	0.00	136.29	0.0	≤50%
P-1870	MH-1963	MH-1951	8	98	135.4	134.79	0.622	PVC	0.00	135.4	0.0	≤50%
P-1858	MH-1951	MH-1950	8	96	134.79	134.19	0.625	PVC	0.00	134.79	0.0	≤50%
P-1857	MH-1950	MH-1949	8	107	134.19	133.53	0.617	PVC	0.00	134.19	0.0	≤50%
P-1856	MH-1949	MH-1948	8	255	133.53	132.14	0.545	PVC	0.00	133.53	0.0	≤50%
P-1855	MH-1948	MH-1947	8	256	132.14	129.45	1.051	PVC	0.00	132.14	0.0	≤50%
P-1854	MH-1947	MH-1088	8	169	129.45	123.09	3.763	PVC	0.00	129.45	0.0	≤50%
P-1089	MH-1088	MH-1066	8	357	123.26	121.48	0.499	PVC	19.64	123.36	1.2	≤50%
P-1067	MH-1066	MH-1064	8	161	121.38	117.66	2.311	PVC	45.01	121.52	1.7	≤50%
P-1065	MH-1064	MH-1062	8	119	111.09	109.72	1.151	PVC	47.32	111.24	1.8	≤50%
P-1091	MH-1090	MH-1062	8	149	111.09	109.72	0.919	PVC	2.31	111.12	0.4	≤50%
P-1063	MH-1062	MH-1060	8	108	109.62	108.05	1.454	PVC	51.93	109.78	1.9	≤50%
P-1061	MH-1060	MH-1058	8	200	107.95	105.78	1.085	PVC	54.24	108.11	1.9	≤50%
P-1059	MH-1058	MH-1056	8	182	105.68	104.79	0.489	PVC	56.54	105.85	2.0	≤50%
P-1057	MH-1056	MH-1054	8	262	104.69	103.41	0.489	PVC	81.91	104.9	2.5	≤50%
P-1055	MH-1054	MH-1052	8	293	103.3	101.95	0.461	PVC	84.22	103.52	2.6	≤50%
P-1053	MH-1052	MH-1050	8	309	101.85	97.5	1.408	PVC	86.53	102.05	2.4	≤50%
P-1051	MH-1050	MH-1048	8	91	97.4	90.1	8.022	PVC	88.83	97.6	2.4	≤50%
P-1049	MH-1048	MH-1046	8	361	90	62.95	7.493	Concrete	91.14	90.21	2.5	≤50%
P-1047	MH-1046	MH-1044	8	193	62.95	47.9	7.798	Concrete	93.44	63.16	2.5	≤50%
P-1045	MH-1044	MH-1042	15	18	47.9	47.77	0.722	PVC	95.75	48.08	2.2	≤50%
P-1043	MH-1042	MH-1040	15	412	47.6	46.14	0.354	PVC	551.80	48.04	5.3	≤50%
P-1041	MH-1040	MH-989	15	378	46.14	44.67	0.389	PVC	554.11	46.58	5.3	≤50%
P-1003	MH-1001	MH-1002	6	149	147	145.1	1.275	PVC	2.31	147.03	0.4	≤50%
P-1005	MH-1002	MH-1004	6	199	145	141.1	1.96	PVC	4.61	145.05	0.6	≤50%
P-1007	MH-1004	MH-1006	6	335	141	137.1	1.164	PVC	6.92	141.06	0.7	≤50%
P-1009	MH-1006	MH-1008	6	170	137	119.1	10.529	PVC	9.23	137.07	0.8	≤50%
P-1011	MH-1008	MH-1010	8	232	119	101.1	7.716	Concrete	11.53	119.07	0.8	≤50%
P-1013	MH-1010	MH-1012	8	360	101	95.1	1.639	Concrete	13.84	101.08	1.0	≤50%
P-1014	MH-1012	MH-991	8	240	95	64.12	12.867	Concrete	49.51	95.15	1.8	≤50%
P-1000	MH-999	MH-997	8	267	107.12	106.03	0.408	Concrete	2.31	107.16	0.5	≤50%
P-998	MH-997	MH-995	8	275	106.03	104.94	0.396	Concrete	4.61	106.08	0.6	≤50%
P-996	MH-995	MH-993	8	313	104.94	86.96	5.744	Concrete	6.92	105	0.7	≤50%
P-994	MH-993	MH-991	8	305	86.96	64.02	7.521	Concrete	9.23	87.02	0.7	≤50%
P-992	MH-991	MH-989	8	187	64.02	49.06	8	Concrete	61.04	64.19	2.0	≤50%
P-990	MH-989	MH-987	15	153	44.67	44.07	0.392	PVC	617.45	45.13	5.5	≤50%
P-988	MH-987	MH-985	15	332	44.07	42.75	0.398	PVC	622.07	44.54	5.6	≤50%
P-986	MH-985	MH-983	15	259	42.75	41.7	0.405	PVC	626.68	43.22	5.6	≤50%
P-984	MH-983	MH-981	15	274	41.7	34.86	2.496	PVC	631.29	42.17	5.6	≤50%
P-1390	MH-981	MH-1375	12	285	34.6	5.04	10.372	Corrugated HDPE (Smooth Interior)	728.16	35.14	6.5	55%
P-784	MH-1474	MH-65	8	227	65.06	43.1	9.674	Concrete	1.88	65.09	0.4	≤50%
P-68(1)	MH-65	MH-1984	8	224	43	41.96	0.464	Concrete	3.76	43.06	0.7	≤50%
P-68(2)	MH-1984	MH-67	8	25	43	41.96	4.16	Concrete	3.76	43.04	0.5	≤50%
P-688	MH-687	MH-223	8	141	93.91	85.51	5.957	Concrete	1.47	93.94	0.4	≤50%

City of Stanwood
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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-240	MH-238	MH-239	8	126	132	130.1	1.508	PVC	11.75	132.07	0.8	≤50%
P-242	MH-239	MH-241	8	337	130	120.1	2.938	PVC	13.22	130.08	1.0	≤50%
P-1349	MH-241	MH-207	18	19	120	119.06	4.947	PVC	14.70	120.07	0.8	≤50%
P-1789	MH-1884	MH-1883	8	129	148.59	148.07	0.403	PVC	0.00	148.59	0.0	≤50%
P-247	MH-245	MH-246	8	365	244.65	240.69	1.085	PVC	1.47	244.68	0.4	≤50%
P-249	MH-246	MH-248	8	98	240.59	230.55	10.245	PVC	2.95	240.63	0.5	≤50%
P-251	MH-248	MH-250	8	400	230.45	219.1	2.838	PVC	4.42	230.49	0.5	≤50%
P-300	MH-298	MH-299	8	253	223.33	213.27	3.976	PVC	1.47	223.36	0.4	≤50%
P-302	MH-299	MH-301	8	93	213.17	212.79	0.409	PVC	2.95	213.21	0.5	≤50%
P-303	MH-301	MH-250	8	159	212.69	210.7	1.252	PVC	4.42	212.73	0.5	≤50%
P-253	MH-250	MH-252	8	288	210.6	208.76	0.639	PVC	10.32	210.67	0.8	≤50%
P-255	MH-252	MH-254	8	263	208.66	194.58	5.354	PVC	11.79	208.73	0.8	≤50%
P-257	MH-254	MH-256	8	230	194.48	182.94	5.017	PVC	13.27	194.56	1.0	≤50%
P-259	MH-256	MH-258	8	360	182.84	181.42	0.394	PVC	14.74	182.93	1.1	≤50%
P-1764	MH-1853	MH-258	8	212	194.79	184.8	4.712	PVC	0.00	194.79	0.0	≤50%
P-1763	MH-1852	MH-258	8	120	185.75	184.8	0.792	PVC	0.00	185.75	0.0	≤50%
P-261	MH-258	MH-260	10	272	181.32	161.9	7.14	PVC	17.30	181.4	1.0	≤50%
P-263	MH-260	MH-262	10	106	161.8	147.91	13.104	PVC	18.78	161.89	1.1	≤50%
P-297	MH-296	MH-293	8	28	154.4	153.53	3.107	PVC	1.47	154.43	0.4	≤50%
P-292	MH-290	MH-291	8	23	160.16	160.04	0.522	PVC	1.47	160.19	0.4	≤50%
P-294	MH-291	MH-293	8	125	159.94	153.99	4.76	PVC	2.95	159.98	0.5	≤50%
P-295	MH-293	MH-262	8	253	153.43	145.67	3.067	PVC	5.90	153.48	0.6	≤50%
P-265(1)	MH-262	MH-1883	10	136	147.66	134.16	9.926	PVC	26.15	147.76	1.2	≤50%
P-265(2)	MH-1883	MH-264	10	185	147.66	134.16	7.297	PVC	26.15	147.76	1.2	≤50%
P-267	MH-264	MH-266	10	324	134.06	125.91	2.515	PVC	27.62	134.17	1.3	≤50%
P-269	MH-266	MH-268	12	271	125.71	124.75	0.354	Steel	29.09	125.83	1.4	≤50%
P-271	MH-268	MH-270	12	307	124.5	123.36	0.371	Steel	30.57	124.62	1.4	≤50%
P-273	MH-270	MH-272	12	401	123.26	121.9	0.339	Steel	32.04	123.39	1.6	≤50%
P-275	MH-272	MH-274	12	401	121.8	120.44	0.339	Steel	33.52	121.93	1.6	≤50%
P-276	MH-274	MH-207	12	375	120.34	119.06	0.341	Steel	34.99	120.47	1.6	≤50%
P-1361	MH-1360	MH-181	8	150	224	214.41	6.393	PVC	2.07	224.03	0.4	≤50%
P-1704	MH-1798	MH-1797	8	222	225.91	225.02	0.4	PVC	0.00	225.91	0.0	≤50%
P-1703	MH-1797	MH-1789	8	81	225.02	224.7	0.4	PVC	0.00	225.02	0.0	≤50%
P-1702	MH-1796	MH-1794	8	198	228.18	227.39	0.4	PVC	0.00	228.18	0.0	≤50%
P-1701	MH-1795	MH-1794	8	405	229.01	227.39	0.4	PVC	0.00	229.01	0.0	≤50%
P-1700	MH-1794	MH-1791	8	261	227.39	226.34	0.4	PVC	0.00	227.39	0.0	≤50%
P-1699	MH-1793	MH-1791	8	112	226.79	226.34	0.4	PVC	0.00	226.79	0.0	≤50%
P-1698	MH-1792	MH-1791	8	119	226.82	226.34	0.4	PVC	0.00	226.82	0.0	≤50%
P-1697	MH-1791	MH-1790	8	333	226.34	225.01	0.4	PVC	0.00	226.34	0.0	≤50%
P-1696	MH-1790	MH-1789	8	78	225.01	224.7	0.4	PVC	0.00	225.01	0.0	≤50%
P-1695	MH-1789	MH-176	8	120	224.7	224.22	0.4	PVC	0.00	224.7	0.0	≤50%
P-178	MH-176	MH-177	8	305	224.22	222.68	0.505	PVC	13.31	224.3	1.0	≤50%
P-180	MH-177	MH-179	8	308	222.68	218.82	1.253	PVC	15.38	222.76	1.0	≤50%
P-182	MH-179	MH-181	8	239	218.82	214.41	1.845	PVC	17.45	218.91	1.1	≤50%
P-184	MH-181	MH-183	8	212	214.41	202.48	5.627	PVC	21.59	214.51	1.2	≤50%
P-186	MH-183	MH-185	8	206	202.48	194.44	3.903	PVC	23.67	202.58	1.2	≤50%
P-188	MH-185	MH-187	8	47	194.44	191.6	6.043	PVC	25.74	194.55	1.3	≤50%
P-190	MH-187	MH-189	8	162	191.6	190.78	0.506	PVC	27.81	191.72	1.4	≤50%
P-192	MH-189	MH-191	8	157	190.78	184.15	4.223	PVC	29.88	190.9	1.4	≤50%
P-194	MH-191	MH-193	8	279	184.15	161.51	8.115	PVC	31.95	184.27	1.4	≤50%
P-196	MH-193	MH-195	8	42	161.51	154.32	17.119	PVC	34.02	161.64	1.6	≤50%
P-198	MH-195	MH-197	8	128	154.32	143.68	8.312	PVC	36.09	154.45	1.6	≤50%
P-200	MH-197	MH-199	8	84	143.58	141	3.071	Concrete	38.16	143.71	1.6	≤50%
P-202	MH-199	MH-201	8	324	139.9	131.1	2.716	Concrete	40.23	140.04	1.7	≤50%
P-204	MH-201	MH-203	8	476	131	124.76	1.311	Concrete	42.30	131.14	1.7	≤50%
P-288	MH-286	MH-287	8	300	127.72	126.43	0.43	PVC	2.07	127.76	0.5	≤50%

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Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-289	MH-287	MH-203	8	300	126.43	124.76	0.557	PVC	4.14	126.48	0.6	≤50%
P-206	MH-203	MH-205	8	276	124.66	119.6	1.833	Concrete	48.52	124.81	1.8	≤50%
P-208	MH-205	MH-207	8	23	119.5	119.06	1.913	PVC	49.99	119.65	1.8	≤50%
P-210	MH-207	MH-209	12	263	118.96	117.37	0.605	PVC	101.15	119.15	2.3	≤50%
P-212	MH-209	MH-211	12	275	117.27	115.62	0.6	PVC	102.63	117.47	2.4	≤50%
P-230	MH-228	MH-229	8	308	126.83	125.31	0.494	Concrete	1.47	126.86	0.4	≤50%
P-232(1)	MH-229	MH-1946	8	265	123.21	123.14	0.026	Concrete	2.95	123.3	1.1	≤50%
P-232(2)	MH-1946	MH-231	8	144	123.21	123.14	0.049	Concrete	2.95	123.28	0.8	≤50%
P-234	MH-231	MH-233	8	205	123.04	119.5	1.727	PVC	4.42	123.08	0.5	≤50%
P-236	MH-233	MH-235	8	218	119.4	116.1	1.514	PVC	5.90	119.45	0.6	≤50%
P-237	MH-235	MH-211	8	30	116	115.62	1.267	PVC	7.37	116.06	0.7	≤50%
P-214	MH-211	MH-213	12	366	115.52	113.3	0.607	PVC	111.47	115.72	2.4	≤50%
P-279	MH-277	MH-278	6	464	124	116	1.724	PVC	1.47	124.03	0.4	≤50%
P-1356	MH-1355	MH-284	8	218	122.87	121.91	0.44	Concrete	1.47	122.9	0.4	≤50%
P-741	MH-284	MH-282	8	274	121.91	120.84	0.391	Concrete	2.95	121.95	0.5	≤50%
P-743	MH-282	MH-280	8	224	120.84	116.32	2.018	PVC	4.42	120.88	0.5	≤50%
P-745	MH-280	MH-278	8	154	116.32	115.58	0.481	PVC	5.90	116.38	0.7	≤50%
P-697	MH-278	MH-213	8	16	115.9	113.3	16.25	Concrete	8.84	115.96	0.7	≤50%
P-216	MH-213	MH-215	12	278	113.2	105.58	2.741	PVC	121.79	113.41	2.5	≤50%
P-1342	MH-1341	MH-215	8	11	105.7	105.58	1.091	Steel	1.47	105.73	0.4	≤50%
P-218	MH-215	MH-217	12	353	105.48	101.95	1	PVC	124.74	105.7	2.6	≤50%
P-220	MH-217	MH-219	12	15	101.7	101.6	0.667	PVC	126.21	101.92	2.6	≤50%
P-222	MH-219	MH-221	8	72	101.5	94.51	9.708	Concrete	127.69	101.75	3.0	≤50%
P-690	MH-689	MH-221	8	217	95.43	94.51	0.424	Concrete	1.47	95.46	0.4	≤50%
P-759	MH-221	MH-223	8	291	94.41	85.51	3.058	PVC	130.63	94.66	3.0	≤50%
P-1422	MH-223	MH-1421	8	133	85.41	72.4	9.782	Concrete	133.58	85.66	3.0	≤50%
P-1425	MH-1421	MH-1417	8	27	72.06	69.69	8.778	PVC	135.06	72.31	3.0	≤50%
P-104	MH-103	MH-25	8	119	190.8	188.81	1.672	PVC	0.88	190.82	0.2	≤50%
P-21	MH-19	MH-20	8	131	234.62	228.59	4.603	PVC	0.88	234.64	0.2	≤50%
P-23	MH-20	MH-22	8	209	228.49	215.96	5.995	PVC	1.77	228.52	0.4	≤50%
P-26	MH-22	MH-25	8	232	215.86	188.81	11.659	PVC	2.65	215.89	0.4	≤50%
P-28	MH-25	MH-27	8	109	179.83	164.06	14.468	PVC	4.42	179.87	0.5	≤50%
P-30	MH-27	MH-29	8	124	164.06	151.94	9.774	PVC	5.31	164.11	0.6	≤50%
P-32	MH-29	MH-31	8	100	151.84	139.99	11.85	PVC	6.19	151.89	0.6	≤50%
P-34	MH-31	MH-33	8	113	139.99	139.89	0.088	PVC	7.08	140.08	1.1	≤50%
P-36	MH-33	MH-35	8	166	139.89	133.12	4.078	PVC	7.96	139.95	0.7	≤50%
P-38	MH-35	MH-37	8	195	133.02	127.2	2.985	PVC	8.84	133.08	0.7	≤50%
P-40	MH-37	MH-39	8	186	126	121.64	2.344	PVC	9.73	126.07	0.8	≤50%
P-166	MH-164	MH-165	8	191	123.49	122.73	0.398	PVC	0.88	123.51	0.2	≤50%
P-168	MH-165	MH-167	8	124	122.63	122.15	0.387	PVC	1.77	122.66	0.4	≤50%
P-169	MH-167	MH-39	8	328	122.05	120.77	0.39	PVC	2.65	122.09	0.5	≤50%
P-42	MH-39	MH-41	8	271	121.54	120.21	0.491	PVC	13.27	121.63	1.1	≤50%
P-172	MH-170	MH-171	8	301	122.82	121.62	0.399	PVC	0.88	122.84	0.2	≤50%
P-174	MH-171	MH-173	8	167	121.52	120.85	0.401	PVC	1.77	121.55	0.4	≤50%
P-175	MH-173	MH-41	8	286	120.85	120.21	0.224	PVC	2.65	120.9	0.6	≤50%
P-44	MH-41	MH-43	8	267	120.11	118.75	0.509	PVC	16.80	120.2	1.1	≤50%
P-306	MH-304	MH-43	8	304	126.25	118.75	2.467	PVC	0.88	126.27	0.2	≤50%
P-46	MH-43	MH-45	8	84	118.65	118.22	0.512	PVC	18.57	118.75	1.2	≤50%
P-48	MH-45	MH-47	8	211	118.12	117.06	0.502	PVC	19.46	118.22	1.2	≤50%
P-50	MH-47	MH-49	8	18	116.96	116.8	0.889	PVC	20.34	117.52	6.7	90%
P-1809	MH-1906	MH-1905	8	101	203.82	196.29	7.455	PVC	0.00	203.82	0.0	≤50%
P-1807	MH-1903	MH-1904	8	257	214.92	204.15	4.191	PVC	0.00	214.92	0.0	≤50%
P-1808	MH-1904	MH-1905	8	249	204.15	196.29	3.157	PVC	0.00	204.15	0.0	≤50%
P-1811	MH-1905	MH-1895	8	361	196.29	193.05	0.898	PVC	0.00	196.29	0.0	≤50%
P-1806	MH-1902	MH-1894	8	313	199.97	194.48	1.754	PVC	0.00	199.97	0.0	≤50%
P-1797	MH-1893	MH-1892	8	204	213.75	205.28	4.152	PVC	0.00	213.75	0.0	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1796	MH-1892	MH-1891	8	98	205.28	200.53	4.847	PVC	0.00	205.28	0.0	≤50%
P-1795	MH-1891	MH-1890	8	33	200.53	199.27	3.818	PVC	0.00	200.53	0.0	≤50%
P-1794	MH-1889	MH-1890	8	110	200.6	199.27	1.209	PVC	0.00	200.6	0.0	≤50%
P-1798	MH-1890	MH-1894	8	284	199.27	194.48	1.687	PVC	0.00	199.27	0.0	≤50%
P-1799	MH-1894	MH-1895	8	250	194.48	193.05	0.572	PVC	0.00	194.48	0.0	≤50%
P-1800	MH-1895	MH-1896	8	139	193.05	192.11	0.676	PVC	0.00	193.05	0.0	≤50%
P-1801	MH-1896	MH-1897	8	203	192.11	190.71	0.69	PVC	0.00	192.11	0.0	≤50%
P-1802	MH-1897	MH-1898	8	71	190.71	189.7	1.423	PVC	0.00	190.71	0.0	≤50%
P-1803	MH-1898	MH-1899	8	241	189.7	187.7	0.83	PVC	0.00	189.7	0.0	≤50%
P-1804	MH-1899	MH-1900	8	290	187.7	185.69	0.693	PVC	0.00	187.7	0.0	≤50%
P-1805	MH-1900	MH-133	8	252	185.69	184.29	0.556	PVC	0.00	185.69	0.0	≤50%
P-124	MH-122	MH-123	8	343	240.58	237.2	0.985	PVC	0.88	240.6	0.2	≤50%
P-1687	MH-1780	MH-1779	8	203	239.68	238.87	0.4	PVC	0.00	239.68	0.0	≤50%
P-1686	MH-1779	MH-1778	8	45	238.87	238.69	0.4	PVC	0.00	238.87	0.0	≤50%
P-1685	MH-1778	MH-1772	8	228	238.69	237.78	0.4	PVC	0.00	238.69	0.0	≤50%
P-1684	MH-1777	MH-1776	8	264	241	239.94	0.4	PVC	0.00	241	0.0	≤50%
P-1683	MH-1776	MH-1775	8	65	239.94	239.68	0.4	PVC	0.00	239.94	0.0	≤50%
P-1682	MH-1775	MH-1774	8	133	239.68	239.15	0.4	PVC	0.00	239.68	0.0	≤50%
P-1681	MH-1774	MH-1773	8	87	239.15	238.8	0.4	PVC	0.00	239.15	0.0	≤50%
P-1680	MH-1773	MH-1772	8	257	238.8	237.78	0.4	PVC	0.00	238.8	0.0	≤50%
P-1679	MH-1772	MH-1771	8	113	237.78	237.32	0.4	PVC	0.00	237.78	0.0	≤50%
P-1678	MH-1771	MH-123	8	31	237.32	237.2	0.4	PVC	0.00	237.6	3.4	≤50%
P-126	MH-123	MH-125	8	305	237.2	225.96	3.685	PVC	315.40	237.6	4.8	63%
P-128	MH-125	MH-127	8	400	225.8	206.99	4.703	PVC	316.28	226.2	4.8	63%
P-130	MH-127	MH-129	8	400	206.87	196.08	2.698	PVC	317.17	207.27	4.8	63%
P-132	MH-129	MH-131	8	362	196.08	184.48	3.204	PVC	318.05	196.48	4.8	63%
P-134	MH-131	MH-133	8	42	184.38	183.38	2.381	PVC	329.74	184.78	4.8	63%
P-136(1)	MH-133	MH-1901	15	105	182.62	174.75	7.495	PVC	330.62	182.96	4.1	≤50%
P-136(2)	MH-1901	MH-135	15	208	182.62	174.75	3.784	PVC	330.62	182.96	4.1	≤50%
P-138	MH-135	MH-137	15	327	174.68	173.14	0.471	PVC	331.51	175.03	4.2	≤50%
P-1749	SSMH #24 - Westchester	SSMH #23 - Westchester	8	150	196.51	195.91	0.4	PVC	0.00	196.51	0.0	≤50%
P-1748	SSMH #25 - Westchester	SSMH #23 - Westchester	8	113	196.36	195.91	0.398	PVC	0.00	196.36	0.0	≤50%
P-1747	SSMH #23 - Westchester	SSMH #20 - Westchester	8	219	195.81	194.93	0.402	PVC	0.00	195.81	0.0	≤50%
P-1735	SSMH #22 - Westchester	SSMH #20 - Westchester	8	223	207.55	194.93	5.659	PVC	0.00	207.55	0.0	≤50%
P-1734	SSMH #20 - Westchester	SSMH #19 - Westchester	8	153	194.93	186.24	5.68	PVC	0.00	194.93	0.0	≤50%
P-1733	SSMH #19 - Westchester	SSMH #18 - Westchester	8	356	186.14	173.29	3.61	PVC	0.00	186.14	0.0	≤50%
P-1732	SSMH #18 - Westchester	MH-137	8	46	173.19	173.14	0.109	PVC	0.00	173.4	2.5	≤50%
P-140	MH-137	MH-139	15	252	173.06	171.81	0.496	PVC	332.39	173.4	4.1	≤50%
P-142	MH-139	MH-141	15	401	171.74	169.66	0.519	PVC	360.30	172.09	4.2	≤50%
P-1737	SSMH #15 - Westchester	SSMH #14 - Westchester	8	144	182.09	181.41	0.472	PVC	0.00	182.09	0.0	≤50%
P-1736	SSMH #14 - Westchester	SSMH #3 - Westchester	8	400	181.31	179.71	0.4	PVC	0.00	181.31	0.0	≤50%
P-1739	SSMH #17 - Westchester	SSMH #16 - Westchester	8	150	198.79	195.9	1.927	PVC	0.00	198.79	0.0	≤50%
P-1738	SSMH #16 - Westchester	SSMH #4 - Westchester	8	400	195.8	194.2	0.4	PVC	0.00	195.8	0.0	≤50%
P-1745	SSMH #13 - Westchester	SSMH #8 - Westchester	8	213	221.35	216.28	2.38	PVC	0.00	221.35	0.0	≤50%
P-1746	SSMH #12 - Westchester	SSMH #9 - Westchester	8	270	229.81	221.99	2.896	PVC	0.00	229.81	0.0	≤50%
P-1744	SSMH #11 - Westchester	SSMH #10 - Westchester	8	284	235.15	227.63	2.648	PVC	0.00	235.15	0.0	≤50%
P-1743	SSMH #10 - Westchester	SSMH #9 - Westchester	8	149	227.53	221.99	3.718	PVC	0.00	227.53	0.0	≤50%
P-1742	SSMH #9 - Westchester	SSMH #8 - Westchester	8	131	221.89	216.28	4.282	PVC	0.00	221.89	0.0	≤50%
P-1741	SSMH #8 - Westchester	SSMH #7 - Westchester	8	138	216.18	215.46	0.522	PVC	0.00	216.18	0.0	≤50%
P-1740	SSMH #7 - Westchester	SSMH #6 - Westchester	8	352	215.36	213.95	0.401	PVC	0.00	215.36	0.0	≤50%
P-1731	SSMH #6 - Westchester	SSMH #5 - Westchester	8	76	213.85	207.89	7.842	PVC	0.00	213.85	0.0	≤50%
P-1730	SSMH #5 - Westchester	SSMH #4 - Westchester	8	169	207.79	194.2	8.041	PVC	0.00	207.79	0.0	≤50%
P-1729	SSMH #4 - Westchester	SSMH #3 - Westchester	8	242	194.1	179.71	5.946	PVC	0.00	194.1	0.0	≤50%
P-1728	SSMH #3 - Westchester	SSMH #2 - Westchester	8	73	179.61	178.88	1	PVC	0.00	179.61	0.0	≤50%
P-1727	SSMH #2 - Westchester	SSMH #1 - Westchester	8	92	178.78	178.02	0.826	PVC	0.00	178.78	0.0	≤50%
P-1726	SSMH #1 - Westchester	MH-141	8	134	177.92	169.66	6.164	PVC	0.00	177.92	0.0	≤50%

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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-144	MH-141	MH-143	15	205	169.58	168.74	0.41	PVC	370.06	169.96	4.6	≤50%
P-146	MH-143	MH-145	15	291	168.72	167.22	0.515	PVC	370.94	169.08	4.3	≤50%
P-148	MH-145	MH-147	15	397	167.18	139.79	6.899	PVC	371.83	167.54	4.3	≤50%
P-150	MH-147	MH-149	15	336	139.66	136.31	0.997	PVC	372.71	140.02	4.3	≤50%
P-152	MH-149	MH-151	15	100	136.22	135.04	1.18	PVC	373.59	136.58	4.3	≤50%
P-154	MH-151	MH-153	15	134	134.87	131.93	2.194	PVC	374.48	135.23	4.3	≤50%
P-162	MH-160	MH-161	12	242	132.95	132.4	0.227	PVC	0.88	132.98	0.4	≤50%
P-163	MH-161	MH-153	12	72	132.4	132.25	0.208	PVC	1.77	132.44	0.5	≤50%
P-156	MH-153	MH-155	15	100	131.83	131.09	0.74	PVC	377.13	132.19	4.3	≤50%
P-158	MH-155	MH-157	15	249	130.99	122.09	3.574	PVC	378.02	131.35	4.3	≤50%
P-159	MH-157	MH-49	15	310	122.09	117.19	1.581	PVC	378.90	122.45	4.3	≤50%
P-52	MH-49	MH-51	8	147	117.07	114.49	1.755	Concrete	400.13	117.52	5.4	72%
P-54	MH-51	MH-53	8	277	114.49	110.02	1.614	Concrete	401.01	114.94	5.4	72%
P-679	MH-677	MH-678	8	269	125.79	121.09	1.747	Concrete	0.88	125.81	0.2	≤50%
P-680	MH-678	MH-53	8	293	121.09	110.25	3.7	Concrete	1.77	121.12	0.4	≤50%
P-56	MH-53	MH-55	8	50	110.02	106.76	6.52	Concrete	403.67	110.47	5.4	72%
P-58	MH-55	MH-57	8	157	106.76	95.81	6.975	Concrete	404.55	107.21	5.4	72%
P-60	MH-57	MH-59	8	125	95.81	85.38	8.344	Concrete	405.43	96.26	5.4	72%
P-62	MH-59	MH-61	8	136	85.38	72.78	9.265	Concrete	406.32	85.83	5.4	72%
P-683	MH-681	MH-682	8	324	109	83.64	7.827	Concrete	0.88	109.02	0.2	≤50%
P-684	MH-682	MH-61	8	219	83.28	72.78	4.795	Concrete	1.77	83.31	0.4	≤50%
P-64	MH-61	MH-63	8	87	72.78	66.2	7.563	Concrete	408.97	73.23	5.4	72%
P-753	MH-63	MH-1417	15	313	66.1	64.57	0.489	PVC	410.45	66.48	4.6	≤50%
P-755	MH-1417	MH-225	15	157	64.47	57.05	4.726	PVC	546.98	64.91	5.3	≤50%
P-757	MH-225	MH-67	15	100	56.95	41.96	14.99	PVC	548.45	57.39	5.3	≤50%
P-70	MH-67	MH-69	15	202	41.86	26.06	7.822	PVC	554.10	42.3	5.3	≤50%
P-716	MH-715	MH-69	8	383	28.38	26.84	0.402	Concrete	1.88	28.42	0.5	≤50%
P-72	MH-69	MH-71	15	78	25.96	19.77	7.936	PVC	557.86	26.4	5.3	≤50%
P-930	MH-928	MH-929	8	303	115.97	103.16	4.228	PVC	1.51	116	0.4	≤50%
P-932	MH-929	MH-931	8	301	102.98	85.22	5.9	PVC	3.01	103.02	0.5	≤50%
P-934	MH-931	MH-933	8	297	85.05	59.9	8.468	PVC	4.52	85.1	0.6	≤50%
P-935	MH-933	MH-837	8	302	59.25	32	9.023	PVC	6.02	59.3	0.6	≤50%
P-866	MH-864	MH-865	8	128	83.22	82.97	0.195	PVC	0.33	83.24	0.2	≤50%
P-867	MH-865	MH-799	8	253	82.87	81.42	0.573	PVC	0.67	82.89	0.2	≤50%
P-760	MH-759	MH-757	8	108	98	95.1	2.685	PVC	0.33	98.01	0.1	≤50%
P-758	MH-757	MH-755	8	123	95	92	2.439	PVC	0.67	95.02	0.2	≤50%
P-756	MH-755	MH-753	8	160	91.9	89.1	1.75	PVC	1.00	91.92	0.2	≤50%
P-762	MH-761	MH-753	8	127	91	89.1	1.496	PVC	0.33	91.01	0.1	≤50%
P-754	MH-753	MH-751	8	331	89	83.8	1.571	PVC	1.67	89.03	0.4	≤50%
P-752	MH-751	MH-749	8	74	83.7	82.27	1.932	PVC	2.01	83.73	0.4	≤50%
P-750	MH-749	MH-747	8	35	82.17	82.01	0.457	PVC	2.34	82.89	8.6	> 100%
P-765	MH-763	MH-764	8	245	107.25	95.23	4.906	PVC	0.33	107.26	0.1	≤50%
P-767	MH-764	MH-766	8	190	95.13	92.22	1.532	PVC	0.67	95.15	0.2	≤50%
P-773	MH-771	MH-772	8	76	93.33	92.99	0.447	PVC	0.33	93.35	0.2	≤50%
P-1348	MH-772	MH-766	8	103	92.89	92.22	0.65	PVC	0.67	92.91	0.2	≤50%
P-1351	MH-766	MH-768	8	188	92.22	91.58	0.34	PVC	1.67	92.25	0.4	≤50%
P-770	MH-768	MH-741	8	40	84.93	84.65	0.7	PVC	5.42	86.84	22.9	> 100%
P-738	MH-736	MH-737	8	107	87.23	86.66	0.533	Steel	0.33	87.25	0.2	≤50%
P-740	MH-737	MH-739	8	60	86.34	86.01	0.55	PVC	173.76	87.21	10.4	> 100%
P-742	MH-739	MH-741	8	305	86.01	84.65	0.446	PVC	174.10	87.15	13.7	> 100%
P-798	MH-797	MH-794	8	201	86.83	85.65	0.587	PVC	5.75	87.73	10.8	> 100%
P-777	MH-775	MH-776	8	233	99.74	98.69	0.451	PVC	0.33	99.76	0.2	≤50%
P-779	MH-776	MH-778	8	131	98.69	98.22	0.359	PVC	0.67	98.71	0.2	≤50%
P-781	MH-778	MH-780	8	298	98.22	97.09	0.379	PVC	1.00	98.25	0.4	≤50%
P-783	MH-780	MH-782	8	278	96.99	90.47	2.345	PVC	1.34	97.01	0.2	≤50%
P-785	MH-782	MH-784	8	85	90.47	89.85	0.729	PVC	1.67	90.5	0.4	≤50%

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Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-787	MH-784	MH-786	8	199	89.75	88.85	0.452	PVC	2.01	89.79	0.5	≤50%
P-789	MH-786	MH-788	8	298	88.8	88	0.268	PVC	2.34	88.84	0.5	≤50%
P-791	MH-788	MH-790	8	121	87.9	87.03	0.719	PVC	2.68	88.63	8.8	> 100%
P-793	MH-790	MH-792	8	85	86.93	86.55	0.447	PVC	3.01	88.63	20.4	> 100%
P-352	MH-350	MH-351	8	92	144	141.69	2.511	PVC	1.56	144.03	0.4	≤50%
P-354	MH-351	MH-353	8	201	141.61	133.61	3.98	PVC	3.11	141.65	0.5	≤50%
P-356	MH-353	MH-355	8	269	133.6	126.19	2.755	PVC	4.67	133.65	0.6	≤50%
P-358	MH-355	MH-357	8	187	126.15	120.57	2.984	PVC	6.23	126.2	0.6	≤50%
P-363	MH-362	MH-357	8	170	124.05	120.22	2.253	PVC	1.56	124.08	0.4	≤50%
P-360	MH-357	MH-359	8	142	120.26	116.05	2.965	PVC	9.34	120.32	0.7	≤50%
P-361	MH-359	MH-322	8	132	115.93	108.45	5.667	PVC	10.90	116	0.8	≤50%
P-366	MH-364	MH-365	8	221	142.26	134.78	3.385	PVC	1.56	142.29	0.4	≤50%
P-368	MH-365	MH-367	8	231	134.73	128.57	2.667	PVC	3.11	134.77	0.5	≤50%
P-369	MH-367	MH-322	8	207	128.57	108.47	9.71	PVC	4.67	128.62	0.6	≤50%
P-344	MH-342	MH-343	8	69	151.34	149.82	2.203	PVC	1.56	151.37	0.4	≤50%
P-346	MH-343	MH-345	8	264	149.65	134.49	5.742	PVC	3.11	149.69	0.5	≤50%
P-348	MH-345	MH-347	8	151	134.49	127.94	4.338	PVC	4.67	134.54	0.6	≤50%
P-349	MH-347	MH-318	8	227	127.84	109.89	7.907	PVC	6.23	127.89	0.6	≤50%
P-328	MH-326	MH-327	8	162	135.65	129.51	3.79	PVC	1.56	135.68	0.4	≤50%
P-330	MH-327	MH-329	8	78	129.35	127.37	2.538	PVC	3.11	129.39	0.5	≤50%
P-331	MH-329	MH-310	8	124	127.3	125.92	1.113	PVC	4.67	127.35	0.6	≤50%
P-309	MH-307	MH-308	8	90	143.9	141.24	2.956	PVC	1.56	143.93	0.4	≤50%
P-311	MH-308	MH-310	8	312	141.2	125.96	4.885	PVC	3.11	141.24	0.5	≤50%
P-313	MH-310	MH-312	8	282	125.74	116.72	3.199	PVC	9.34	125.8	0.7	≤50%
P-315	MH-312	MH-314	8	58	116.62	116.19	0.741	PVC	10.90	116.69	0.8	≤50%
P-317	MH-314	MH-316	8	189	116.14	113.49	1.402	PVC	12.45	116.21	0.8	≤50%
P-334	MH-332	MH-333	8	145	155.87	148.67	4.966	PVC	1.56	155.9	0.4	≤50%
P-336	MH-333	MH-335	8	223	148.6	134.6	6.278	PVC	3.11	148.64	0.5	≤50%
P-338	MH-335	MH-337	8	150	134.54	129.68	3.24	PVC	4.67	134.59	0.6	≤50%
P-340	MH-337	MH-339	8	206	129.66	118.75	5.296	PVC	6.23	129.71	0.6	≤50%
P-341	MH-339	MH-316	8	94	118.72	113.43	5.628	PVC	7.78	118.78	0.7	≤50%
P-319	MH-316	MH-318	8	227	113.26	109.89	1.485	PVC	21.79	113.36	1.2	≤50%
P-321	MH-318	MH-320	8	54	109.82	109.48	0.63	PVC	29.58	109.94	1.4	≤50%
P-323	MH-320	MH-322	8	220	109.45	108.34	0.505	PVC	31.13	109.58	1.6	≤50%
P-325	MH-322	MH-324	8	180	108.28	107.47	0.45	PVC	48.26	108.44	1.9	≤50%
P-687	MH-324	MH-1739	8	66	107.47	107.23	0.364	PVC	49.81	107.65	2.2	≤50%
P-1771	MH-1863	MH-1862	8	248	169.55	160.86	3.504	PVC	0.00	169.55	0.0	≤50%
P-1623	MH-1718	MH-1717	8	126	208.78	206.38	1.905	PVC	0.00	208.78	0.0	≤50%
P-1622	MH-1717	MH-1716	8	351	206.28	184.8	6.12	PVC	0.00	206.28	0.0	≤50%
P-1853	MH-1945	MH-1944	8	292	210.58	192.78	6.096	PVC	0.00	210.58	0.0	≤50%
P-1852	MH-1944	MH-1721	8	163	192.78	191.71	0.656	0	0.00	192.78	0.0	≤50%
P-1626	MH-1721	MH-1720	8	125	191.71	191.08	0.504	PVC	0.00	191.71	0.0	≤50%
P-1628	MH-1723	MH-1722	8	166	211.79	210.13	1	PVC	0.00	211.79	0.0	≤50%
P-1629	MH-1724	MH-1722	8	124	211.84	210.13	1.379	PVC	0.00	211.84	0.0	≤50%
P-1627	MH-1722	MH-1720	8	312	210.03	191.08	6.074	PVC	0.00	210.03	0.0	≤50%
P-1625	MH-1720	MH-1719	8	45	190.98	187.2	8.4	PVC	0.00	190.98	0.0	≤50%
P-1624	MH-1719	MH-1716	8	387	187.1	184.8	0.594	PVC	0.00	187.1	0.0	≤50%
P-1621	MH-1716	MH-1715	8	199	184.7	167.24	8.774	PVC	0.00	184.7	0.0	≤50%
P-1620	MH-1715	MH-1714	8	67	167.14	166.39	1.119	PVC	0.00	167.14	0.0	≤50%
P-645	MH-643	MH-644	8	196	169.21	167.81	0.714	PVC	5.01	169.26	0.6	≤50%
P-1618	MH-644	MH-1714	8	121	167.26	166.29	0.802	PVC	16.06	167.35	1.1	≤50%
P-1619	MH-1714	MH-646	8	131	166.19	165.55	0.489	PVC	16.06	166.81	7.4	97%
P-649	MH-646	MH-648	8	172	166.72	164.43	1.331	PVC	18.24	166.81	1.1	≤50%
P-669	MH-667	MH-668	8	113	199.97	196.79	2.814	PVC	2.18	200	0.4	≤50%
P-671	MH-668	MH-670	8	267	196.69	180.94	5.899	PVC	4.36	196.73	0.5	≤50%
P-673	MH-670	MH-672	8	124	180.84	172.51	6.718	PVC	6.54	180.89	0.6	≤50%

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Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-674	MH-672	MH-648	8	134	172.41	164.43	5.955	PVC	8.72	172.47	0.7	≤50%
P-651	MH-648	MH-650	8	244	164.33	162.57	0.721	PVC	29.14	164.45	1.4	≤50%
P-653(1)	MH-650	MH-1862	8	46	162.47	158.81	7.957	PVC	31.32	162.59	1.4	≤50%
P-653(2)	MH-1862	MH-652	8	194	162.47	158.81	1.887	PVC	31.32	162.59	1.4	≤50%
P-655	MH-652	MH-654	8	360	158.71	143.06	4.347	PVC	35.46	158.84	1.6	≤50%
P-657	MH-654	MH-656	8	89	142.96	140.35	2.933	PVC	37.64	143.09	1.6	≤50%
P-659(1)	MH-656	MH-1700	8	75	140.25	136.45	5.067	PVC	39.82	140.39	1.7	≤50%
P-659(2)	MH-1700	MH-658	8	73	140.25	136.45	5.205	PVC	39.82	140.39	1.7	≤50%
P-660	MH-658	MH-459	8	140	136.36	135.79	0.407	PVC	42.00	136.52	1.9	≤50%
P-627	MH-625	MH-626	8	400	143.5	139.83	0.917	PVC	2.18	143.53	0.4	≤50%
P-635	MH-633	MH-634	8	153	157.79	156.13	1.085	PVC	2.18	157.82	0.4	≤50%
P-637	MH-634	MH-636	8	348	156.04	146.32	2.793	PVC	4.36	156.08	0.5	≤50%
P-638	MH-636	MH-626	8	187	146.26	139.92	3.39	PVC	6.54	146.31	0.6	≤50%
P-629	MH-626	MH-628	8	86	139.75	136.93	3.279	PVC	10.90	139.82	0.8	≤50%
P-631	MH-628	MH-630	8	107	136.87	136.04	0.776	PVC	13.08	136.95	1.0	≤50%
P-632	MH-630	MH-457	8	104	135.99	135.25	0.712	PVC	15.26	136.74	9.0	> 100%
P-623	MH-621	MH-622	8	304	154.04	140.78	4.362	PVC	2.18	154.07	0.4	≤50%
P-624	MH-622	MH-453	8	78	140.62	137.71	3.731	PVC	4.36	140.66	0.5	≤50%
P-663	MH-661	MH-662	8	118	156.46	154.06	2.034	PVC	2.18	156.49	0.4	≤50%
P-665	MH-662	MH-664	8	374	153.96	144.93	2.414	PVC	4.36	154	0.5	≤50%
P-666	MH-664	MH-451	8	42	144.84	144.31	1.262	PVC	6.54	144.9	0.7	≤50%
P-613	MH-611	MH-612	6	14	163.36	161.87	10.643	PVC	2.18	163.39	0.4	≤50%
P-640	MH-639	MH-612	6	72	164.36	161.87	3.458	PVC	2.18	164.39	0.4	≤50%
P-615	MH-612	MH-614	8	239	161.77	154.19	3.172	PVC	6.54	161.82	0.6	≤50%
P-617	MH-614	MH-616	8	243	154.09	153.13	0.395	PVC	8.72	154.16	0.8	≤50%
P-642	MH-641	MH-616	8	110	159.22	153.13	5.536	PVC	2.18	159.25	0.4	≤50%
P-619	MH-616	MH-618	8	125	153.03	152.46	0.456	PVC	13.08	153.12	1.1	≤50%
P-620	MH-618	MH-447	8	128	152.36	149.04	2.594	PVC	15.26	152.44	1.0	≤50%
P-1823	MH-1919	MH-1918	12	400	158.52	157.52	0.25	PVC	0.00	158.52	0.0	≤50%
P-1848	MH-1940	MH-1914	8	166	175.57	171.65	2.361	PVC	0.00	175.57	0.0	≤50%
P-1818	MH-1914	MH-1911	8	180	171.65	167.4	2.361	PVC	0.00	171.65	0.0	≤50%
P-1815	MH-1911	MH-1910	8	36	167.4	158.13	25.75	PVC	0.00	167.4	0.0	≤50%
P-1830	MH-1925	MH-1924	8	142	186.01	183.03	2.099	PVC	0.00	186.01	0.0	≤50%
P-1829	MH-1924	MH-1923	8	25	183.03	182	4.12	PVC	0.00	183.03	0.0	≤50%
P-1828	MH-1923	MH-1921	8	124	182	179.6	1.935	PVC	0.00	182	0.0	≤50%
P-1827(2)	MH-1921	MH-1922	8	318	179.6	172.79	2.142	PVC	0.00	179.6	0.0	≤50%
P-1827(1)	MH-1922	MH-1909	8	57	172.79	171.4	2.439	PVC	0.00	172.79	0.0	≤50%
P-1812	MH-1907	MH-1908	8	41	172.43	171.99	1.073	PVC	0.00	172.43	0.0	≤50%
P-1813	MH-1908	MH-1909	8	98	171.99	171.4	0.602	PVC	0.00	171.99	0.0	≤50%
P-1814	MH-1909	MH-1910	8	261	171.4	158.13	5.084	PVC	0.00	171.4	0.0	≤50%
P-1819	MH-1915	MH-1912	8	122	159.83	159.06	0.631	PVC	0.00	159.83	0.0	≤50%
P-1842	MH-1937	MH-1936	8	70	167.1	165.45	2.357	PVC	0.00	167.1	0.0	≤50%
P-1839	MH-1933	MH-1934	8	297	180.75	178.87	0.633	PVC	0.00	180.75	0.0	≤50%
P-1840	MH-1934	MH-1935	8	322	178.87	166.92	3.711	PVC	0.00	178.87	0.0	≤50%
P-1841	MH-1935	MH-1936	8	80	166.92	165.45	1.838	PVC	0.00	166.92	0.0	≤50%
P-1844	MH-1936	MH-1938	8	77	165.45	164.54	1.182	PVC	0.00	165.45	0.0	≤50%
P-1846	MH-1938	MH-1931	8	109	164.54	163.94	0.55	PVC	0.00	164.54	0.0	≤50%
P-1837	MH-1931	MH-1913	8	309	163.94	161.81	0.689	PVC	0.00	163.94	0.0	≤50%
P-1836	MH-1930	MH-1928	12	119	184.83	179.31	4.639	PVC	0.00	184.83	0.0	≤50%
P-1831	MH-1926	MH-1927	8	113	185.8	183.16	2.336	PVC	0.00	185.8	0.0	≤50%
P-1832	MH-1927	MH-1928	8	401	183.16	179.31	0.96	PVC	0.00	183.16	0.0	≤50%
P-1835	MH-1928	MH-1929	8	204	179.31	173.56	2.819	PVC	0.00	179.31	0.0	≤50%
P-1834	MH-1929	MH-1913	8	387	173.56	161.81	3.036	PVC	0.00	173.56	0.0	≤50%
P-1817	MH-1913	MH-1912	12	95	161.81	159.06	2.895	PVC	0.00	161.81	0.0	≤50%
P-1816	MH-1912	MH-1910	12	420	159.06	158.13	0.221	PVC	0.00	159.06	0.0	≤50%
P-1847	MH-1910	MH-1918	12	271	158.13	157.52	0.225	PVC	0.00	158.13	0.0	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1822	MH-1918	MH-1917	12	168	157.52	157.09	0.256	PVC	0.00	157.52	0.0	≤50%
P-1821	MH-1916	MH-1917	8	273	167.39	157.09	3.773	PVC	0.00	167.39	0.0	≤50%
P-1826	MH-1917	MH-1920	12	133	157.09	156.68	0.308	0	0.00	157.09	0.0	≤50%
P-1825	MH-1920	MH-600	12	32	156.68	156.62	0.188	PVC	0.00	156.7	0.2	≤50%
P-601	MH-599	MH-600	8	393	158.18	156.69	0.379	PVC	23.79	158.3	1.4	≤50%
P-603	MH-600	MH-602	8	158	156.59	154.76	1.158	PVC	25.97	156.7	1.3	≤50%
P-605	MH-602	MH-604	8	31	154.66	154.21	1.452	PVC	28.14	154.77	1.3	≤50%
P-607	MH-604	MH-606	8	28	154.11	152.05	7.357	PVC	30.32	154.23	1.4	≤50%
P-609	MH-606	MH-608	8	188	152.05	149.86	1.165	PVC	32.50	152.17	1.4	≤50%
P-610	MH-608	MH-445	8	41	149.86	149.66	0.488	PVC	34.68	150	1.7	≤50%
P-1768	MH-1858	MH-1857	8	144	204.01	203.29	0.5	PVC	0.00	204.01	0.0	≤50%
P-559	MH-557	MH-558	8	76	206.81	206.41	0.526	PVC	2.18	206.85	0.5	≤50%
P-561	MH-558	MH-560	8	400	206.41	204.57	0.46	PVC	4.36	206.46	0.6	≤50%
P-1851	MH-1943	MH-597	8	165	240.45	233.77	4.048	PVC	0.00	240.45	0.0	≤50%
P-1850	MH-1942	MH-1941	8	93	234.23	233.77	0.495	PVC	0.00	234.23	0.0	≤50%
P-1849	MH-1941	MH-597	8	129	233.67	223.05	8.233	PVC	0.00	233.67	0.0	≤50%
P-598	MH-597	MH-560	8	287	222.95	204.57	6.404	PVC	2.18	222.98	0.4	≤50%
P-589	MH-587	MH-588	8	168	234.47	214.64	11.804	PVC	2.18	234.5	0.4	≤50%
P-591	MH-588	MH-590	8	47	214.54	213.28	2.681	PVC	4.36	214.58	0.5	≤50%
P-593	MH-590	MH-592	8	210	213.18	209.06	1.962	PVC	6.54	213.23	0.6	≤50%
P-595	MH-592	MH-594	8	109	208.96	208.37	0.541	PVC	8.72	209.03	0.8	≤50%
P-596	MH-594	MH-560	8	80	208.27	204.57	4.625	PVC	10.90	208.34	0.8	≤50%
P-563(1)	MH-560	MH-1857	8	294	204.47	203.29	0.4	PVC	19.61	204.56	1.1	≤50%
P-563(2)	MH-1857	MH-562	8	52	203.19	202.98	0.4	PVC	19.61	203.28	1.1	≤50%
P-565	MH-562	MH-564	8	77	202.88	202.57	0.4	PVC	21.79	202.99	1.3	≤50%
P-567	MH-564	MH-566	8	375	202.47	200.97	0.4	PVC	23.97	202.59	1.4	≤50%
P-569	MH-566	MH-568	8	86	200.87	200.6	0.314	PVC	26.15	201	1.6	≤50%
P-571	MH-568	MH-570	8	288	200.5	199.35	0.399	PVC	28.33	200.63	1.6	≤50%
P-1693	MH-1786	MH-1785	8	213	255.4	254.54	0.4	PVC	0.00	255.4	0.0	≤50%
P-1692	MH-1785	MH-1784	8	46	254.54	254.36	0.4	PVC	0.00	254.54	0.0	≤50%
P-1691	MH-1784	MH-1783	8	160	254.36	253.72	0.4	PVC	0.00	254.36	0.0	≤50%
P-1690	MH-1783	MH-1782	8	68	253.72	253.45	0.4	PVC	0.00	253.72	0.0	≤50%
P-1689	MH-1782	MH-1781	8	122	253.45	252.96	0.4	PVC	0.00	253.45	0.0	≤50%
P-1688	MH-1781	MH-577	8	10	252.96	252.92	0.4	PVC	0.00	252.99	0.4	≤50%
P-579	MH-577	MH-578	8	240	252.92	241.07	4.938	PVC	9.96	252.99	0.8	≤50%
P-581	MH-578	MH-580	8	152	240.97	227.6	8.796	PVC	12.14	241.04	0.8	≤50%
P-586	MH-585	MH-580	8	174	233.68	227.6	3.494	PVC	2.18	233.71	0.4	≤50%
P-583	MH-580	MH-582	8	400	227.5	202.51	6.248	PVC	16.50	227.59	1.1	≤50%
P-584	MH-582	MH-570	8	57	202.41	199.45	5.193	PVC	18.68	202.5	1.1	≤50%
P-573	MH-570	MH-572	8	373	199.35	176.21	6.204	PVC	49.19	199.5	1.8	≤50%
P-575	MH-572	MH-574	8	281	176.11	173.45	0.947	PVC	51.37	176.26	1.8	≤50%
P-576	MH-574	MH-441	8	400	173.35	171.25	0.525	PVC	53.55	173.52	2.0	≤50%
P-1770	MH-1861	MH-1860	8	156	185.33	184.6	0.468	PVC	0.00	185.33	0.0	≤50%
P-1769	MH-1860	MH-1859	8	366	184.5	181.12	0.923	PVC	0.00	184.5	0.0	≤50%
P-539(2)	MH-1859	MH-538	8	193	181.02	179.99	0.534	PVC	0.00	181.02	0.0	≤50%
P-541	MH-538	MH-540	8	218	179.89	177.66	1.023	PVC	2.18	179.92	0.4	≤50%
P-543	MH-540	MH-542	8	58	177.56	177.25	0.534	PVC	4.36	177.61	0.6	≤50%
P-545	MH-542	MH-544	8	141	177.15	175.1	1.454	PVC	6.54	177.2	0.6	≤50%
P-547	MH-544	MH-546	8	324	175	172.2	0.864	PVC	8.72	175.06	0.7	≤50%
P-551	MH-549	MH-550	8	97	180.72	178.72	2.062	PVC	2.18	180.75	0.4	≤50%
P-553	MH-550	MH-552	8	148	178.62	177.73	0.601	PVC	4.36	178.67	0.6	≤50%
P-555	MH-552	MH-554	8	169	177.63	176.62	0.598	PVC	6.54	177.69	0.7	≤50%
P-556	MH-554	MH-546	8	278	176.52	172.2	1.554	PVC	8.72	176.58	0.7	≤50%
P-548	MH-546	MH-437	8	345	171.98	169.85	0.617	PVC	19.61	172.08	1.2	≤50%
P-513	MH-511	MH-512	8	276	186.12	183.48	0.957	PVC	2.18	186.15	0.4	≤50%
P-515	MH-512	MH-514	8	382	183.18	181.06	0.555	PVC	4.36	183.23	0.6	≤50%

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Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-532	MH-531	MH-514	8	343	192.81	189.44	0.983	PVC	2.18	192.84	0.4	≤50%
P-517	MH-514	MH-516	8	166	180.95	179.74	0.729	PVC	8.72	181.01	0.7	≤50%
P-1429	MH-1428	MH-675	10	390	188.2	186.64	0.4	PVC	2.18	188.24	0.5	≤50%
P-676	MH-675	MH-516	10	164	186.18	179.89	3.835	PVC	4.36	186.22	0.5	≤50%
P-519	MH-516	MH-518	10	401	179.7	177.06	0.658	PVC	15.26	179.78	1.0	≤50%
P-520	MH-518	MH-431	10	399	176.97	174.58	0.599	PVC	17.43	177.06	1.1	≤50%
P-536	MH-535	MH-429	8	348	186.97	186.26	0.204	PVC	2.18	187.01	0.5	≤50%
P-530	MH-529	MH-524	8	101	190.75	181.73	8.931	PVC	2.18	190.78	0.4	≤50%
P-523	MH-521	MH-522	8	268	185.31	182.26	1.138	PVC	2.18	185.34	0.4	≤50%
P-525	MH-522	MH-524	8	65	182.16	181.63	0.815	PVC	4.36	182.2	0.5	≤50%
P-527	MH-524	MH-526	8	250	181.63	179.85	0.712	PVC	8.72	181.69	0.7	≤50%
P-528	MH-526	MH-427	8	249	179.75	177.61	0.859	PVC	10.90	179.82	0.8	≤50%
P-534	MH-533	MH-425	8	173	182.49	178.79	2.139	PVC	2.18	182.52	0.4	≤50%
P-1532	MH-1477	MH-703	8	325	197.73	196.43	0.4	PVC	2.18	197.76	0.4	≤50%
P-790	MH-703	MH-702	8	67	196.33	196.06	0.403	PVC	4.36	196.38	0.6	≤50%
P-1531	MH-702	MH-1475	8	256	195.96	194.94	0.398	PVC	6.54	196.02	0.7	≤50%
P-788	MH-701	MH-1476	8	183	205.13	203.15	1.082	PVC	2.18	205.16	0.4	≤50%
P-1530	MH-1476	MH-699	8	66	203.05	202.35	1.061	PVC	4.36	203.09	0.5	≤50%
P-786	MH-699	MH-1475	8	148	202.25	194.94	4.939	PVC	6.54	202.3	0.6	≤50%
P-803	MH-1481	MH-413	8	238	210.13	207.36	1.164	PVC	2.18	210.16	0.4	≤50%
P-1529	MH-413	MH-1475	8	235	207.26	194.94	5.243	PVC	4.36	207.3	0.5	≤50%
P-792	MH-1475	MH-417	8	186	194.84	194.1	0.398	PVC	19.61	194.94	1.2	≤50%
P-698	MH-417	MH-419	8	90	183.23	182.87	0.4	PVC	21.79	183.34	1.3	≤50%
P-694	MH-419	MH-421	8	192	182.77	181.92	0.443	PVC	23.97	182.89	1.4	≤50%
P-700	MH-421	MH-423	8	285	181.82	180.68	0.4	PVC	26.15	181.94	1.4	≤50%
P-706	MH-423	MH-425	8	400	180.58	178.79	0.448	PVC	28.33	180.71	1.6	≤50%
P-708	MH-425	MH-427	8	269	178.69	177.61	0.401	PVC	32.69	178.83	1.7	≤50%
P-710	MH-427	MH-429	8	308	177.51	176.16	0.438	PVC	45.77	177.67	1.9	≤50%
P-712	MH-429	MH-431	8	170	176.06	175.14	0.541	PVC	50.12	176.22	1.9	≤50%
P-715	MH-431	MH-433	10	372	174.51	172.5	0.54	PVC	69.74	174.68	2.0	≤50%
P-717	MH-433	MH-435	10	392	172.5	170.07	0.62	PVC	71.92	172.67	2.0	≤50%
P-718	MH-435	MH-437	10	91	170.02	169.7	0.352	PVC	74.10	170.22	2.4	≤50%
P-720	MH-437	MH-439	8	112	169.7	169.13	0.509	PVC	95.89	169.93	2.8	≤50%
P-722	MH-439	MH-441	8	175	169.13	167.9	0.703	PVC	98.07	169.35	2.6	≤50%
P-724	MH-441	MH-443	8	244	167.9	164.82	1.262	PVC	153.80	168.17	3.2	≤50%
P-726	MH-443	MH-445	8	280	164.72	157.16	2.7	PVC	155.98	164.99	3.2	≤50%
P-728	MH-445	MH-447	8	47	149.66	149.1	1.191	PVC	192.84	149.97	3.7	≤50%
P-729	MH-447	MH-449	8	217	149	145.9	1.429	PVC	210.28	149.32	3.8	≤50%
P-730	MH-449	MH-451	8	258	145.8	144.66	0.442	PVC	212.45	146.17	4.4	57%
P-732	MH-451	MH-453	8	308	144.56	137.93	2.153	PVC	221.17	144.89	4.0	≤50%
P-1776	MH-1868	MH-1867	8	30	142.07	141.93	0.467	PVC	0.00	142.21	1.7	≤50%
P-1775	MH-1867	MH-1866	8	188	141.93	141.07	0.457	PVC	163.11	142.21	3.4	≤50%
P-1774	MH-1866	MH-1865	8	290	141.07	139.69	0.476	PVC	163.11	141.35	3.4	≤50%
P-1773	MH-1865	MH-1864	8	138	139.56	138.87	0.5	PVC	163.11	139.84	3.4	≤50%
P-1772	MH-1864	MH-453	8	68	138.82	138.47	0.515	PVC	163.11	139.1	3.4	≤50%
P-733	MH-453	MH-455	8	265	137.93	136.8	0.426	PVC	390.82	139.03	13.2	> 100%
P-736	MH-455	MH-457	8	175	136.7	136.1	0.343	PVC	393.00	137.66	11.5	> 100%
P-737	MH-457	MH-459	8	51	136.1	135.92	0.353	PVC	410.43	136.74	7.7	99%
P-1657	MH-459	MH-1751	12	323	135.69	134.64	0.325	PVC	469.53	136.13	5.3	≤50%
P-1656	MH-1751	MH-1750	12	204	134.64	131.6	1.49	PVC	469.53	135.07	5.2	≤50%
P-1655	MH-1750	MH-1749	12	222	131.13	126.79	1.955	PVC	469.53	131.56	5.2	≤50%
P-1654	MH-1749	MH-1748	12	237	126.61	120.78	2.46	PVC	469.53	127.04	5.2	≤50%
P-1653	MH-1748	MH-1747	12	29	120.66	119.4	4.345	PVC	469.53	121.09	5.2	≤50%
P-1652	MH-1747	MH-1746	12	157	119.29	116.44	1.815	PVC	469.53	119.72	5.2	≤50%
P-1651	MH-1746	MH-1745	12	308	116.33	111.05	1.714	PVC	469.53	116.76	5.2	≤50%
P-1650	MH-1745	MH-1744	12	113	110.86	109.73	1	PVC	469.53	111.29	5.2	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1649	MH-1744	MH-1743	12	146	109.6	108.85	0.514	PVC	469.53	110.03	5.2	≤50%
P-1648	MH-1743	MH-1742	12	121	108.85	107.8	0.868	PVC	469.53	109.28	5.2	≤50%
P-1646	MH-1742	MH-1741	15	8	107.7	107.65	0.625	PVC	469.53	108.1	4.8	≤50%
P-1606(1)(1)(1)(2)	MH-1741	MH-1739	15	53	107.55	107.23	0.604	PVC	469.53	107.95	4.8	≤50%
P-1606(1)(1)(2)	MH-1739	MH-1738	15	6	107.13	107.1	0.5	PVC	519.34	107.55	5.0	≤50%
P-1606(1)(2)	MH-1738	MH-1737	15	172	107	105.98	0.593	PVC	519.34	107.42	5.0	≤50%
P-1606(2)	MH-1737	MH-1703	15	315	105.88	103.99	0.6	PVC	519.34	106.3	5.0	≤50%
P-1607	MH-1703	MH-1704	15	128	103.89	103.12	0.602	PVC	519.34	104.31	5.0	≤50%
P-1608	MH-1704	MH-1705	15	220	103.02	101.7	0.6	PVC	519.34	103.44	5.0	≤50%
P-1609	MH-1705	MH-1706	15	341	101.6	99.55	0.601	PVC	519.34	102.02	5.0	≤50%
P-1610	MH-1706	MH-1707	15	63	99.45	99.07	0.603	PVC	519.34	99.87	5.0	≤50%
P-1611(1)(1)	MH-1707	MH-1972	15	142	98.97	98.1	0.613	PVC	519.34	99.39	5.0	≤50%
P-1611(1)(2)	MH-1972	MH-1736	15	172	98.97	98.1	0.506	PVC	519.34	99.39	5.0	≤50%
P-1611(2)	MH-1736	MH-1708	15	67	98.1	94.69	5.09	PVC	519.34	98.52	5.0	≤50%
P-1612	MH-1708	MH-1709	12	16	92.69	90.73	12.25	PVC	528.45	93.15	5.5	≤50%
P-1613	MH-1709	MH-1710	12	104	90.63	90.18	0.433	PVC	528.45	91.09	5.5	≤50%
P-1614	MH-1710	MH-1711	12	58	90.08	89.87	0.362	PVC	528.45	90.54	5.5	≤50%
P-1615	MH-1711	MH-1712	12	65	89.77	89.49	0.431	PVC	528.45	90.23	5.5	≤50%
P-1616	MH-1712	MH-792	12	246	89.39	88.41	0.398	PVC	528.45	89.85	5.5	≤50%
P-795	MH-792	MH-794	10	309	86.28	85.19	0.353	PVC	531.80	88.63	28.2	> 100%
P-796	MH-794	MH-741	10	297	85.11	84.31	0.269	PVC	537.89	87.73	31.4	> 100%
P-744	MH-741	MH-743	10	237	84.1	83.26	0.354	PVC	717.74	86.84	32.9	> 100%
P-746	MH-743	MH-745	10	252	83.18	82.48	0.278	PVC	718.08	85.58	28.8	> 100%
P-748	MH-745	MH-747	10	243	82.4	81.84	0.23	PVC	730.54	84.23	22.0	> 100%
P-800	MH-747	MH-799	10	173	81.74	81.25	0.283	PVC	733.22	82.89	13.8	> 100%
P-1750	MH-799	MH-1839	12	18	81.07	80.98	0.5	PVC	734.22	81.61	6.5	55%
P-1751	MH-1839	MH-1840	12	42	80.88	80.68	0.476	PVC	734.22	81.42	6.5	55%
P-1752	MH-1840	MH-1760	12	298	80.58	79.09	0.5	PVC	734.22	81.12	6.5	55%
P-848	MH-846	MH-847	8	53	82.12	81.71	0.774	PVC	0.33	82.13	0.1	≤50%
P-850	MH-847	MH-849	8	136	81.71	71.09	7.809	PVC	0.67	81.73	0.2	≤50%
P-852	MH-849	MH-851	8	65	80.95	80.69	0.4	PVC	1.00	80.98	0.4	≤50%
P-853	MH-851	MH-803	8	324	80.59	79.29	0.401	PVC	1.34	80.62	0.4	≤50%
P-861(2)	MH-803	MH-1760	15	16	79.09	78.95	0.875	PVC	1.67	79.42	4.0	≤50%
P-863	MH-862	MH-855	8	100	81.5	81.15	0.35	PVC	6.12	81.56	0.7	≤50%
P-856	MH-854	MH-855	8	149	81.7	81.15	0.369	PVC	0.33	81.72	0.2	≤50%
P-858	MH-855	MH-857	8	150	81.15	80.36	0.527	PVC	6.79	81.21	0.7	≤50%
P-860	MH-857	MH-859	8	66	80.36	79.83	0.803	PVC	7.12	80.42	0.7	≤50%
P-861(1)	MH-859	MH-1760	8	52	79.58	79.32	0.5	PVC	7.46	79.64	0.7	≤50%
P-1666	MH-1760	MH-1758	15	355	78.91	77.43	0.417	PVC	743.35	79.42	6.1	≤50%
P-1665	MH-1758	MH-1757	15	165	72.77	70.54	1.352	PVC	743.35	73.28	6.1	≤50%
P-1664	MH-1757	MH-1756	15	278	70.44	69.26	0.424	PVC	743.35	70.95	6.1	≤50%
P-1663	MH-1756	MH-1755	15	400	69.16	67.46	0.425	PVC	743.35	69.67	6.1	≤50%
P-1662	MH-1755	MH-1754	15	400	67.36	65.66	0.425	PVC	743.35	67.87	6.1	≤50%
P-1660	MH-1754	MH-711	15	23	65.65	65.56	0.391	PVC	743.35	66.16	6.1	≤50%
P-845	MH-844	MH-811	8	276	68.3	66.85	0.525	PVC	0.33	68.31	0.1	≤50%
P-808	MH-805	MH-807	8	285	79.06	77.63	0.502	PVC	0.33	79.07	0.1	≤50%
P-870	MH-868	MH-869	8	138	82.98	81.93	0.761	PVC	0.33	82.99	0.1	≤50%
P-871	MH-869	MH-807	8	281	81.83	76.84	1.776	PVC	0.67	81.85	0.2	≤50%
P-810	MH-807	MH-809	8	300	77.53	68.78	2.917	PVC	1.34	77.55	0.2	≤50%
P-812	MH-809	MH-811	8	155	68.1	66.85	0.806	PVC	5.32	68.15	0.6	≤50%
P-1538	MH-811	MH-711	15	37	65.75	65.56	0.514	PVC	5.99	65.97	2.6	≤50%
P-801	MH-711	MH-1480	15	252	65.46	64.21	0.496	PVC	749.68	65.97	6.1	≤50%
P-1537	MH-1480	MH-709	15	249	64.1	61.73	0.952	PVC	764.01	64.62	6.2	≤50%
P-799	MH-709	MH-1479	15	398	61.63	55.94	1.43	PVC	764.33	62.15	6.2	≤50%
P-1536	MH-1479	MH-1444	15	19	55.84	55.74	0.526	PVC	764.65	56.66	9.8	70%
P-1446	MH-1444	MH-1436	12	114	56.11	55.4	0.623	PVC	764.97	56.67	6.7	58%

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= Pipe Area Percent Full between 70 and 99 percent.
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Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1440	MH-1436	MH-817	12	16	55.3	55.25	0.312	PVC	765.28	55.93	7.6	66%
P-820	MH-817	MH-819	12	175	55.15	54.68	0.269	PVC	765.60	55.9	9.0	80%
P-874	MH-872	MH-873	8	160	114	106.35	4.781	PVC	0.32	114.01	0.1	≤50%
P-891	MH-890	MH-873	8	313	109.05	106.35	0.863	PVC	0.32	109.06	0.1	≤50%
P-876	MH-873	MH-875	8	310	106.25	94.71	3.723	PVC	0.95	106.27	0.2	≤50%
P-894	MH-892	MH-893	8	144	102	96.51	3.813	PVC	0.32	102.01	0.1	≤50%
P-895	MH-893	MH-875	8	330	96.41	94.71	0.515	PVC	0.63	96.43	0.2	≤50%
P-878	MH-875	MH-877	8	186	94.61	86.76	4.22	PVC	1.90	94.64	0.4	≤50%
P-880	MH-877	MH-879	8	255	86.66	58.71	10.961	PVC	2.22	86.69	0.4	≤50%
P-889	MH-888	MH-879	8	160	60.28	58.71	0.981	PVC	0.32	60.29	0.1	≤50%
P-882	MH-879	MH-881	8	112	58.61	56.75	1.661	PVC	2.86	58.65	0.5	≤50%
P-886	MH-884	MH-885	8	300	60.5	58.23	0.757	PVC	0.32	60.51	0.1	≤50%
P-887	MH-885	MH-881	8	273	58.13	56.75	0.505	PVC	0.63	58.15	0.2	≤50%
P-883	MH-881	MH-819	8	140	56.65	55.01	1.171	PVC	3.81	56.69	0.5	≤50%
P-822	MH-819	MH-821	12	302	54.58	53.51	0.354	PVC	769.73	55.26	8.2	72%
P-1431	MH-821	MH-1430	12	301	53.41	52.33	0.359	PVC	920.81	54.2	9.5	85%
P-1659	MH-1430	MH-1752	15	297	52.23	51.79	0.148	PVC	921.13	52.95	8.6	60%
P-1673	MH-1752	MH-1766	15	27	51.69	51.47	0.815	PVC	921.13	52.26	6.8	≤50%
P-1672	MH-1766	MH-1765	15	178	51.37	49.73	0.921	PVC	921.13	51.94	6.8	≤50%
P-1671	MH-1765	MH-1764	15	154	49.63	48.25	0.896	PVC	921.13	50.2	6.8	≤50%
P-1670	MH-1764	MH-1763	15	154	48.15	46.73	0.922	PVC	921.13	48.72	6.8	≤50%
P-1669	MH-1763	MH-707	15	154	46.63	45.22	0.916	PVC	921.13	47.2	6.8	≤50%
P-908	MH-907	MH-905	8	208	110	102.67	3.524	PVC	0.32	110.01	0.1	≤50%
P-904	MH-902	MH-903	8	103	105	104	0.971	PVC	0.32	105.01	0.1	≤50%
P-906	MH-903	MH-905	8	122	103.9	102.67	1.008	PVC	0.63	103.92	0.2	≤50%
P-911	MH-909	MH-910	8	91	113	109	4.396	PVC	0.32	113.01	0.1	≤50%
P-912	MH-910	MH-905	8	474	108.9	102.65	1.319	PVC	0.63	108.92	0.2	≤50%
P-914	MH-905	MH-913	8	135	102.55	101.85	0.519	PVC	1.90	102.58	0.4	≤50%
P-916	MH-913	MH-915	8	338	101.75	85.11	4.923	PVC	2.22	101.78	0.4	≤50%
P-924	MH-922	MH-923	8	148	104.5	98.1	4.324	PVC	0.32	104.51	0.1	≤50%
P-926	MH-923	MH-925	8	107	98	92.1	5.514	PVC	0.63	98.02	0.2	≤50%
P-927	MH-925	MH-915	8	212	92	85.11	3.25	PVC	0.95	92.02	0.2	≤50%
P-918	MH-915	MH-917	8	163	85.01	71.6	8.227	PVC	3.49	85.05	0.5	≤50%
P-920	MH-917	MH-919	8	81	71.5	66.18	6.568	PVC	3.81	71.54	0.5	≤50%
P-921	MH-919	MH-831	8	190	66.08	45.52	10.821	PVC	4.13	66.12	0.5	≤50%
P-898	MH-896	MH-897	8	165	65.5	63.1	1.455	PVC	0.32	65.51	0.1	≤50%
P-900	MH-897	MH-899	8	217	63	59	1.843	PVC	0.63	63.02	0.2	≤50%
P-901	MH-899	MH-827	8	131	58.9	48.33	8.069	PVC	0.95	58.92	0.2	≤50%
P-828	MH-825	MH-827	8	246	50.37	48.23	0.87	PVC	0.32	50.38	0.1	≤50%
P-830	MH-827	MH-829	8	42	48.23	47.76	1.119	PVC	1.59	48.26	0.4	≤50%
P-832	MH-829	MH-831	8	300	47.71	45.52	0.73	PVC	1.90	47.74	0.4	≤50%
P-1535	MH-831	MH-707	15	38	45.42	45.22	0.526	PVC	6.35	45.69	3.2	≤50%
P-1534	MH-707	MH-1478	15	393	45.12	38.98	1.562	PVC	927.79	45.69	6.8	≤50%
P-794	MH-1478	MH-705	15	412	38.88	32.71	1.498	PVC	928.11	39.45	6.8	≤50%
P-1533	MH-705	MH-837	18	64	32.17	32	0.266	PVC	929.62	32.73	6.7	≤50%
P-840	MH-837	MH-839	10	239	31.9	28.41	1.46	PVC	937.15	32.55	7.8	84%
P-842	MH-839	MH-841	10	116	28.32	27.63	0.595	PVC	939.03	28.97	7.8	84%
P-1668	MH-841	MH-1762	18	45	27.6	27.45	0.337	PVC	940.91	28.15	6.6	≤50%
P-699	MH-697	MH-698	8	351	113	105.3	2.194	PVC	1.88	113.03	0.4	≤50%
P-701	MH-698	MH-700	8	426	105.2	103.2	0.469	Concrete	3.76	105.25	0.6	≤50%
P-702	MH-700	MH-692	8	442	103.1	80.1	5.204	Concrete	5.65	103.15	0.6	≤50%
P-693	MH-691	MH-692	8	190	99.5	80.2	10.158	Concrete	2.16	99.53	0.4	≤50%
P-703	MH-692	MH-1473	8	164	80	71.3	5.305	Concrete	9.69	80.07	0.8	≤50%
P-696	MH-694	MH-1473	8	224	82.5	71.2	5.045	Concrete	1.88	82.53	0.4	≤50%
P-705(1)	MH-1473	MH-1762	8	330	71.1	32.83	11.597	Concrete	13.45	71.18	1.0	≤50%
P-1667	MH-1762	MH-1761	18	51	27.35	27.18	0.333	PVC	954.36	27.9	6.6	≤50%

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Appendix G - Hydraulic Analyses Results
Existing PHF Pipe Capacity Table (No Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Existing Pipe Length (ft.)	Existing Pipe US Invert El. (ft.)	Existing Pipe DS Invert El. (ft.)	Existing Pipe Slope (%)	Existing Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-707(2)	MH-1761	MH-706	18	303	27.08	26.02	0.35	PVC	954.36	27.63	6.6	≤50%
P-709	MH-706	MH-708	18	233	25.92	25.11	0.348	PVC	956.25	26.47	6.6	≤50%
P-711	MH-708	MH-710	15	59	25.01	24.59	0.712	PVC	958.13	25.59	7.0	≤50%
P-713	MH-710	MH-712	15	363	24.49	22.22	0.625	PVC	960.01	25.07	7.0	≤50%
P-714	MH-712	MH-71	15	376	22.12	19.77	0.625	PVC	994.49	22.71	7.1	≤50%
P-749	MH-71	MH-1391	12	144	19.67	10.5	6.368	Concrete	1,554.23	20.47	9.6	86%
P-1392	MH-1391	MH-1375	12	76	10.4	5.14	6.921	Corrugated HDPE (Smooth Interior)	1,556.22	11.2	9.6	86%
P-1389	MH-1375	MH-1374	18	440	4.94	-2.16	1.614	PVC	2,286.36	5.81	10.4	60%
P-1388	MH-1374	MH-1373	24	162	-2.26	-4.29	1.253	PVC	2,288.35	-1.46	9.6	≤50%
P-1387	MH-1373	MH-1372	27	150	-4.49	-4.51	0.013	PVC	2,290.34	-3.26	14.8	56%
P-1386	MH-1372	MH-1371	27	409	-4.51	-4.66	0.037	PVC	2,292.33	-3.35	13.9	52%
P-1385	MH-1371	MH-1370	27	151	-4.76	-5.08	0.212	PVC	2,295.90	-3.95	9.7	≤50%
P-1384	MH-1370	MH-1369	27	325	-5.08	-5.46	0.117	PVC	2,299.48	-4.13	11.4	≤50%
P-1383	MH-1369	MH-1368	27	302	-5.46	-5.89	0.142	PVC	2,303.06	-4.55	10.9	≤50%
P-1382	MH-1368	MH-1367	27	371	-5.89	-6.21	0.086	PVC	2,306.64	-4.87	12.2	≤50%
P-1381	MH-1367	MH-1366	27	302	-6.31	-6.75	0.146	PVC	2,310.22	-5.41	10.8	≤50%
P-1380	MH-1366	MH-1365	27	599	-6.85	-7.55	0.117	PVC	2,313.79	-5.9	11.4	≤50%
P-704	MH-1365	MH-1364	27	89	-7.65	-7.98	0.371	PVC	2,317.37	-6.81	10.1	≤50%
P-1378	MH-1364	MH-1363	27	263	-7.98	-8.01	0.011	PVC	2,320.95	-6.75	14.8	56%
P-1377	MH-1363	MH-1362	27	230	-8.01	-8.2	0.083	PVC	2,324.53	-7	12.1	≤50%
P-1641	MH-1362	WW-MAIN	24	23	-8.4	-8.8	1.739	Ductile Iron	2,328.10	-7.6	9.6	≤50%

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Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1784	MH-1878	MH-1879	8	8		161	137.88	134.41	135.08	2.155	PVC	0.00	137.88	0.0	≤50%
P-1785	MH-1879	MH-1880	8	8		200	134.31	130.85	131.52	1.73	PVC	0.00	134.31	0.0	≤50%
P-1786	MH-1880	MH-1881	8	8		200	130.75	128.93	129.60	0.91	PVC	0.00	130.75	0.0	≤50%
P-1787	MH-1881	MH-1882	8	8		142	128.83	127.4	128.07	1.007	PVC	0.00	128.83	0.0	≤50%
P-1788	MH-1882	MH-1877	8	8		217	127.28	125.58	126.25	0.783	PVC	0.00	127.28	0.0	≤50%
P-1782	MH-1876	MH-1877	8	8		371	134.3	125.58	126.25	2.35	PVC	0.00	134.3	0.0	≤50%
P-1783	MH-1877	MH-1874	8	8		122	125.58	124.94	125.61	0.525	PVC	0.00	125.58	0.0	≤50%
P-1777	MH-1870	MH-1871	8	8		66	135.03	133.42	134.09	2.439	PVC	0.00	135.03	0.0	≤50%
P-1778	MH-1871	MH-1872	8	8		169	133.34	129.04	129.71	2.544	PVC	0.00	133.34	0.0	≤50%
P-1779	MH-1872	MH-1873	8	8		144	128.94	125.65	126.32	2.285	PVC	0.00	128.94	0.0	≤50%
P-1780	MH-1873	MH-1874	8	8		69	125.55	124.94	125.61	0.884	PVC	0.00	125.55	0.0	≤50%
P-1781	MH-1874	MH-1875	8	8		283	124.84	123.18	123.85	0.587	PVC	0.00	124.84	0.0	≤50%
P-1875	MH-1875	WW-10	8	8		10	123	123	123.67	0	PVC	0.00	123	0.0	≤50%
P-390	MH-389	MH-387	12	12		58	125.59	125.21	126.21	0.655	PVC	45.88	125.72	1.6	≤50%
P-493	MH-491	MH-492	8	8		282	191.11	182.09	182.76	3.199	PVC	0.81	191.13	0.2	≤50%
P-495	MH-492	MH-494	8	8		282	181.98	180.01	180.68	0.699	PVC	1.62	182.01	0.4	≤50%
P-497	MH-494	MH-496	8	8		150	179.94	179	179.67	0.627	PVC	2.44	179.98	0.5	≤50%
P-499	MH-496	MH-498	8	8		230	178.93	174.07	174.74	2.113	PVC	3.25	178.97	0.5	≤50%
P-500	MH-498	MH-474	8	8		260	173.93	158.13	158.80	6.077	PVC	4.06	173.97	0.5	≤50%
P-467	MH-465	MH-466	8	8		112	179.62	178.85	179.52	0.688	PVC	0.81	179.64	0.2	≤50%
P-469	MH-466	MH-468	8	8		239	178.85	171.09	171.76	3.247	PVC	1.62	178.88	0.4	≤50%
P-471	MH-468	MH-470	8	8		293	170.92	160.08	160.75	3.7	PVC	2.44	170.95	0.4	≤50%
P-473	MH-470	MH-472	8	8		159	159.94	159.08	159.75	0.541	PVC	3.25	159.98	0.5	≤50%
P-475	MH-472	MH-474	8	8		146	159.03	158.19	158.86	0.575	PVC	4.06	159.08	0.6	≤50%
P-477	MH-474	MH-476	8	8		359	157.88	156.37	157.04	0.421	PVC	8.93	157.95	0.8	≤50%
P-479	MH-476	MH-478	8	8		71	156.21	155.85	156.52	0.507	PVC	9.75	156.28	0.8	≤50%
P-481	MH-478	MH-480	8	8		180	155.85	155.15	155.82	0.389	PVC	10.56	155.93	1.0	≤50%
P-483	MH-480	MH-482	8	8		64	155.02	154.72	155.39	0.469	PVC	11.37	155.1	1.0	≤50%
P-485	MH-482	MH-484	8	8		69	154.72	152.33	153.00	3.464	PVC	12.18	154.79	0.8	≤50%
P-487	MH-484	MH-486	8	8		244	152.33	146.91	147.58	2.221	PVC	13.00	152.41	1.0	≤50%
P-489	MH-486	MH-488	12	12		256	146.6	138.64	139.64	3.109	PVC	13.81	146.67	0.8	≤50%
P-490	MH-488	MH-383	12	12		193	138.5	131.82	132.82	3.461	PVC	14.62	138.57	0.8	≤50%
P-372	MH-370	MH-371	8	8		78	230.75	224.6	225.27	7.885	PVC	0.81	230.77	0.2	≤50%
P-374	MH-371	MH-373	8	8		278	224.43	201.79	202.46	8.144	PVC	1.62	224.46	0.4	≤50%
P-376	MH-373	MH-375	8	8		301	201.7	196.85	197.52	1.611	PVC	2.44	201.73	0.4	≤50%
P-394	MH-393	MH-375	8	8		128	197.93	196.75	197.42	0.922	PVC	0.81	197.95	0.2	≤50%
P-378	MH-375	MH-377	8	8		249	196.72	179.76	180.43	6.811	PVC	4.06	196.76	0.5	≤50%
P-380	MH-377	MH-379	8	8		267	179.56	155.67	156.34	8.948	PVC	4.87	179.61	0.6	≤50%
P-382	MH-379	MH-381	8	8		147	155.55	139.74	140.41	10.755	PVC	5.69	155.6	0.6	≤50%
P-410	MH-409	MH-406	8	8		350	165.94	161.08	161.75	1.389	PVC	0.81	165.96	0.2	≤50%
P-412	MH-411	MH-402	8	8		145	198.2	193.94	194.61	2.938	PVC	0.81	198.22	0.2	≤50%
P-397	MH-395	MH-396	8	8		106	226.27	221.56	222.23	4.443	PVC	0.81	226.29	0.2	≤50%
P-399	MH-396	MH-398	8	8		106	221.36	216.32	216.99	4.755	PVC	1.62	221.39	0.4	≤50%
P-401	MH-398	MH-400	8	8		81	216.08	212.33	213.00	4.63	PVC	2.44	216.11	0.4	≤50%
P-403	MH-400	MH-402	8	8		399	212.21	194.02	194.69	4.559	PVC	3.25	212.25	0.5	≤50%
P-405	MH-402	MH-404	8	8		327	193.84	179.16	179.83	4.489	PVC	4.87	193.89	0.6	≤50%
P-407	MH-404	MH-406	8	8		338	179.02	161.08	161.75	5.308	PVC	5.69	179.07	0.6	≤50%
P-408	MH-406	MH-381	8	8		387	161	139.74	140.41	5.494	PVC	7.31	161.06	0.7	≤50%
P-384	MH-381	MH-383	12	12		219	139.43	131.82	132.82	3.475	PVC	13.81	139.5	0.8	≤50%
P-386	MH-383	MH-385	12	12		20	131.66	131.33	132.33	1.65	PVC	29.24	131.76	1.2	≤50%
P-388	MH-385	MH-387	12	12		62	131.26	125.21	126.21	9.758	PVC	29.24	131.36	1.2	≤50%
P-685	MH-387	WW-COPPER	30	30		23	125.12	122.5	125.00	11.391	PVC	75.12	125.25	1.6	≤50%
P-719	MH-717	MH-718	8	8		32	79.2	79	79.67	0.625	PVC	0.96	79.22	0.2	≤50%
P-721	MH-718	MH-720	8	8		33	79	78.72	79.39	0.848	PVC	1.92	79.03	0.4	≤50%
P-723	MH-720	MH-722	8	8		104	78.71	77.97	78.64	0.712	PVC	2.88	78.75	0.5	≤50%
P-725	MH-722	MH-724	8	8		64	77.87	77.29	77.96	0.906	PVC	14.83	77.95	1.0	≤50%
P-731	MH-724	MH-730	8	8		20	76.31	74.48	75.15	9.15	PVC	15.79	76.39	1.0	≤50%
P-734	MH-732	MH-733	8	8		325	76.9	75.6	76.27	0.4	PVC	46.76	77.07	2.0	≤50%
P-735	MH-733	MH-730	8	8		256	75.5	74.48	75.15	0.398	PVC	47.72	75.78	3.4	≤50%
P-691	MH-730	WW-LINDSTROM	30	30		1	74.48	74.46	76.96	2	PVC	64.47	75.76	15.4	52%
P-1455	MH-1450	MH-1451	6	6		105	45.71	40.8	41.30	4.676	PVC	0.96	45.73	0.2	≤50%
P-1469	MH-1451	MH-1467	8	8		50	40.7	40.2	40.87	1	PVC	1.92	40.73	0.4	≤50%
P-1456	MH-1449	MH-1448	8	8		246	53.16	35.4	36.07	7.22	PVC	0.96	53.18	0.2	≤50%
P-1457	MH-1448	MH-1447	8	8		157	35.3	34.51	35.18	0.503	PVC	1.92	35.33	0.4	≤50%
P-1458	MH-1447	MH-1454	8	8		104	34.41	33.93	34.60	0.462	PVC	2.88	34.45	0.5	≤50%
P-1459	MH-1454	MH-1453	8	8		91	33.83	33.37	34.04	0.505	PVC	3.85	33.88	0.6	≤50%

City of Stanwood
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10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1460	MH-1453	MH-1452	8	8		36	33.27	33.09	33.76	0.5	PVC	4.81	33.32	0.6	≤50%
P-1468	MH-1452	MH-1467	8	8		52	32.99	32.47	33.14	1	PVC	5.77	33.04	0.6	≤50%
P-689	MH-1467	WW-TAYLOR	30	30		1	32.47	32	34.50	47	PVC	8.65	32.51	0.5	≤50%
P-1130	MH-1129	MH-1127	8	8		228	99.66	95.7	96.37	1.737	PVC	1.94	99.69	0.4	≤50%
P-1128	MH-1127	MH-1125	8	8		268	95.6	76.5	77.17	7.127	PVC	3.88	95.64	0.5	≤50%
P-1132	MH-1131	MH-1125	8	8		143	80.16	76.5	77.17	2.559	PVC	1.94	80.19	0.4	≤50%
P-1126	MH-1125	MH-1123	8	8		202	76.4	52.18	52.85	11.99	PVC	7.75	76.46	0.7	≤50%
P-1124	MH-1123	MH-1121	8	8		194	52.08	35.89	36.56	8.345	PVC	9.69	52.15	0.8	≤50%
P-1122	MH-1121	MH-1119	8	8		397	35.79	31.06	31.73	1.191	PVC	11.63	35.86	0.8	≤50%
P-1120	MH-1119	MH-1117	8	8		410	30.96	27.27	27.94	0.9	PVC	13.57	31.04	1.0	≤50%
P-1106	MH-1104	MH-1105	8	8		251	100.83	100.03	100.70	0.319	PVC	1.94	100.87	0.5	≤50%
P-771	MH-1648	MH-686	8	8		174	114	106.68	107.35	4.207	PVC	1.94	114.03	0.4	≤50%
P-1524	MH-686	MH-1105	8	8		285	106.58	103.56	104.23	1.06	PVC	3.88	106.62	0.5	≤50%
P-1108	MH-1105	MH-1107	8	8		264	99.93	98.45	99.12	0.561	PVC	7.75	99.99	0.7	≤50%
P-1110	MH-1107	MH-1109	8	8		182	98.35	97.31	97.98	0.571	PVC	9.69	98.42	0.8	≤50%
P-1112	MH-1109	MH-1111	8	8		237	97.21	92.31	92.98	2.068	PVC	11.63	97.28	0.8	≤50%
P-1114	MH-1111	MH-1113	8	8		313	92.21	75.59	76.26	5.31	PVC	13.57	92.29	1.0	≤50%
P-1116	MH-1113	MH-1115	8	8		289	75.58	38.31	38.98	12.896	PVC	15.51	75.66	1.0	≤50%
P-1118	MH-1115	MH-1117	8	8		50	38.21	27.27	27.94	21.88	PVC	17.45	38.3	1.1	≤50%
P-1138	MH-1117	MH-1134	8	8		126	27.17	26.21	26.88	0.762	PVC	32.96	27.29	1.4	≤50%
P-1135	MH-1133	MH-1134	8	8		212	26.93	26.21	26.88	0.34	PVC	23.17	27.05	1.4	≤50%
P-1137	MH-1134	MH-1136	8	8		34	26.11	26	26.67	0.324	PVC	58.06	26.31	2.4	≤50%
P-682	MH-1136	WW-PIONEER	30	30		88	26	22	24.50	4.545	PVC	60.00	26.12	1.4	≤50%
P-1291	MH-1289	MH-1290	6	6		140	0	-0.89	-0.39	0.636	PVC	10.45	0.08	1.0	≤50%
P-1677	MH-1770	MH-1769	8	8		200	1.19	0.39	1.06	0.4	PVC	0.00	1.19	0.0	≤50%
P-1676	MH-1769	MH-1290	8	8		298	0.29	-0.89	-0.22	0.396	PVC	0.00	0.29	0.0	≤50%
P-1292	MH-1290	MH-1276	8	8	SM6	330	-0.99	-6.99	-6.32	1.818	PVC	13.24	-0.91	1.0	≤50%
P-1319	MH-1317	MH-1318	8	8		209	-0.02	-0.88	-0.21	0.411	Asbestos Cement	2.79	0.02	0.5	≤50%
P-1321	MH-1318	MH-1320	8	8		202	-0.88	-1.48	-0.81	0.297	Asbestos Cement	5.58	-0.82	0.7	≤50%
P-1323	MH-1320	MH-1322	8	8		126	-1.48	-1.92	-1.25	0.349	Asbestos Cement	8.36	-1.41	0.8	≤50%
P-1325	MH-1322	MH-1324	8	8		317	-1.92	-3.01	-2.34	0.344	Asbestos Cement	11.15	-1.83	1.1	≤50%
P-1327	MH-1324	MH-1326	8	8		272	-3.01	-4.06	-3.39	0.386	Asbestos Cement	13.94	-2.92	1.1	≤50%
P-1330	MH-1329	MH-1326	8	8		230	-3.13	-4.06	-3.39	0.404	Asbestos Cement	2.79	-3.09	0.5	≤50%
P-1328	MH-1326	MH-1270	8	8		374	-4.06	-5.5	-4.83	0.385	Asbestos Cement	19.52	-3.95	1.3	≤50%
P-1316	MH-1315	MH-1268	8	8		263	0.12	-0.92	-0.25	0.395	Asbestos Cement	2.79	0.16	0.5	≤50%
P-1312	MH-1311	MH-1262	8	8		197	-1.75	-5.89	-5.22	2.102	Asbestos Cement	2.79	-1.71	0.5	≤50%
P-1309	MH-1307	MH-1308	8	8		341	-0.48	-2.64	-1.97	0.633	Asbestos Cement	2.79	-0.44	0.5	≤50%
P-1310	MH-1308	MH-1262	8	8		29	-2.64	-5.89	-5.22	11.207	Asbestos Cement	5.58	-2.59	0.6	≤50%
P-1306	MH-1305	MH-1260	8	8		316	-1.76	-3.4	-2.73	0.519	Asbestos Cement	2.79	-1.72	0.5	≤50%
P-1298	MH-1297	MH-1258	8	8		383	-0.58	-2.53	-1.86	0.509	Asbestos Cement	2.79	-0.54	0.5	≤50%
P-1296	MH-1295	MH-1258	8	8		341	-1.54	-2.53	-1.86	0.29	Asbestos Cement	2.79	-1.49	0.6	≤50%
P-1294	MH-1293	MH-1256	8	8		339	0.28	-1.38	-0.71	0.49	Asbestos Cement	2.79	0.32	0.5	≤50%
P-1257	MH-1255	MH-1256	8	8		376	0.79	-0.38	0.29	0.311	Asbestos Cement	2.79	0.84	0.6	≤50%
P-1259	MH-1256	MH-1258	8	8		290	-1.38	-2.53	-1.86	0.397	Asbestos Cement	8.36	-1.31	0.8	≤50%
P-1261	MH-1258	MH-1260	8	8		284	-2.53	-3.4	-2.73	0.306	Asbestos Cement	16.73	-2.42	1.3	≤50%
P-1301	MH-1299	MH-1300	8	8		237	-0.93	-1.93	-1.26	0.422	Asbestos Cement	2.79	-0.89	0.5	≤50%
P-1303	MH-1300	MH-1302	8	8		139	-1.93	-2.33	-1.66	0.288	Asbestos Cement	5.58	-1.87	0.7	≤50%
P-1304	MH-1302	MH-1260	8	8		341	-2.4	-3.4	-2.73	0.293	Asbestos Cement	8.36	-2.32	1.0	≤50%
P-1263	MH-1260	MH-1262	8	8		170	-3.4	-3.89	-3.22	0.288	Asbestos Cement	30.67	-3.25	1.8	≤50%
P-1265	MH-1262	MH-1264	8	8		122	-3.89	-4.25	-3.58	0.295	Asbestos Cement	41.82	-3.72	2.0	≤50%
P-1267	MH-1264	MH-1266	8	8		38	-4.25	-4.41	-3.74	0.421	Asbestos Cement	44.61	-4.09	1.9	≤50%
P-1269	MH-1266	MH-1268	8	8		110	-4.41	-4.74	-4.07	0.3	Asbestos Cement	47.40	-4.23	2.2	≤50%
P-1314	MH-1313	MH-1268	8	8		357	0.21	-4.74	-4.07	1.387	Asbestos Cement	2.79	0.25	0.5	≤50%
P-1271	MH-1268	MH-1270	8	8		262	-4.74	-5.54	-4.87	0.305	Asbestos Cement	55.76	-4.55	2.3	≤50%
P-1273	MH-1270	MH-1272	8	8		119	-5.54	-5.95	-5.28	0.345	Asbestos Cement	78.07	-5.32	2.6	≤50%
P-1332	MH-1331	MH-1272	8	8		390	-4.3	-5.95	-5.28	0.423	PVC	2.79	-4.26	0.5	≤50%
P-1275	MH-1272	MH-1274	8	8	SM6	143	-5.95	-6.47	-5.80	0.364	Asbestos Cement	83.65	-5.72	2.8	≤50%
P-1277	MH-1274	MH-1276	8	8	SM6	199	-6.47	-6.99	-6.32	0.261	Asbestos Cement	126.63	-6.15	3.8	≤50%
P-1279	MH-1276	MH-1278	8	8	SM6	302	-6.99	-7.89	-7.22	0.298	Asbestos Cement	142.66	-6.66	4.0	≤50%
P-1287	MH-1285	MH-1286	8	8		242	-1.93	-3.35	-2.68	0.587	Asbestos Cement	2.79	-1.89	0.5	≤50%
P-1288	MH-1286	MH-1278	8	8		291	-3.35	-4.64	-3.97	0.443	Asbestos Cement	5.58	-3.29	0.7	≤50%
P-1281	MH-1278	MH-1280	8	8	SM6	128	-7.89	-8.25	-7.58	0.281	Asbestos Cement	151.02	-7.55	4.1	51%
P-1283	MH-1280	MH-1282	8	8	SM2	393	-8.25	-9.45	-8.78	0.305	Asbestos Cement	153.81	-7.91	4.1	51%
P-1284	MH-1282	MH-1206	8	8	SM2	38	-9.45	-9.62	-8.95	0.447	Asbestos Cement	156.60	-9.14	3.7	≤50%
P-1247	MH-1245	MH-1246	8	8		121	-1.63	-2.16	-1.49	0.438	Asbestos Cement	1.16	-1.6	0.4	≤50%
P-1249	MH-1246	MH-1248	8	8		112	-2.36	-2.8	-2.13	0.393	Asbestos Cement	2.32	-2.32	0.5	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1251	MH-1248	MH-1250	8	8		313	-2.8	-4.05	-3.38	0.399	Asbestos Cement	3.48	-2.75	0.6	≤50%
P-1253	MH-1250	MH-1252	8	8		318	-4.05	-5.29	-4.62	0.39	Asbestos Cement	4.64	-4	0.6	≤50%
P-1254	MH-1252	MH-1200	8	8		152	-5.39	-7.16	-6.49	1.164	Asbestos Cement	5.80	-5.34	0.6	≤50%
P-1528	MH-696	MH-695	8	8		258	2.23	-3.93	-3.26	2.388	PVC	1.16	2.25	0.2	≤50%
P-782	MH-695	MH-1472	10	10		222	-4.03	-4.93	-4.10	0.405	PVC	2.32	-4	0.4	≤50%
P-1527	MH-1472	MH-693	10	10		225	-5.03	-5.93	-5.10	0.4	PVC	3.48	-4.99	0.5	≤50%
P-1526	MH-693	MH-1471	10	10		115	-6.03	-6.6	-5.77	0.496	PVC	4.64	-5.99	0.5	≤50%
P-1244	MH-1243	MH-1194	8	8		109	0.09	-1.89	-1.22	1.817	Asbestos Cement	1.16	0.11	0.2	≤50%
P-1242	MH-1241	MH-1192	8	8		112	0.28	-3.84	-3.17	3.679	Asbestos Cement	1.16	0.3	0.2	≤50%
P-1235	MH-1233	MH-1234	8	8		240	1	-0.9	-0.23	0.792	Asbestos Cement	1.16	1.02	0.2	≤50%
P-1239	MH-1237	MH-1238	8	8		238	4	1.1	1.77	1.218	Asbestos Cement	1.16	4.02	0.2	≤50%
P-1240	MH-1238	MH-1234	8	8		158	1	-0.9	-0.23	1.203	Asbestos Cement	2.32	1.03	0.4	≤50%
P-1236	MH-1234	MH-1190	8	8		164	-1	-2.96	-2.29	1.195	Asbestos Cement	4.64	-0.95	0.6	≤50%
P-1231	MH-1229	MH-1230	8	8		193	-0.42	-1.24	-0.57	0.425	Asbestos Cement	1.16	-0.39	0.4	≤50%
P-1232	MH-1230	MH-1188	8	8		210	-1.24	-2.08	-1.41	0.4	Asbestos Cement	2.32	-1.2	0.5	≤50%
P-1185	MH-1183	MH-1184	8	8		300	0.65	-1.1	-0.43	0.583	Asbestos Cement	1.16	0.68	0.4	≤50%
P-1187	MH-1184	MH-1186	6	6		234	-1.1	-1.21	-0.71	0.047	PVC	2.32	-1.03	0.8	≤50%
P-1227	MH-1225	MH-1226	8	8		206	0.26	-0.5	0.17	0.369	PVC	1.16	0.29	0.4	≤50%
P-1228	MH-1226	MH-1186	8	8		200	-0.58	-1.21	-0.54	0.315	Corrugated HDPE (Smooth Interior)	2.32	-0.54	0.5	≤50%
P-1189	MH-1186	MH-1188	8	8		287	-1.21	-2.08	-1.41	0.303	Asbestos Cement	5.80	-1.15	0.7	≤50%
P-1191	MH-1188	MH-1190	8	8		288	-2.08	-2.96	-2.29	0.306	Asbestos Cement	66.43	-1.87	2.5	≤50%
P-1193	MH-1190	MH-1192	8	8		307	-2.96	-3.84	-3.17	0.287	Asbestos Cement	72.22	-2.73	2.8	≤50%
P-1195	MH-1192	MH-1194	12	12		305	-4.44	-5.77	-4.77	0.436	Asbestos Cement	74.54	-4.26	2.2	≤50%
P-1197	MH-1194	MH-1196	12	12		83	-5.77	-6.16	-5.16	0.47	Asbestos Cement	76.86	-5.59	2.2	≤50%
P-1525	MH-1196	MH-1471	12	12		60	-6.16	-6.6	-5.60	0.733	Concrete	78.02	-5.99	2.0	≤50%
P-778	MH-1471	MH-1198	12	12		344	-6.7	-7.61	-6.61	0.265	Concrete	83.82	-6.48	2.6	≤50%
P-1201	MH-1198	MH-1200	12	12		115	-7.61	-8.16	-7.16	0.478	Asbestos Cement	84.98	-7.42	2.3	≤50%
P-1203	MH-1200	MH-1202	12	12	SM2	174	-8.16	-8.84	-7.84	0.391	Asbestos Cement	91.93	-7.96	2.4	≤50%
P-1205	MH-1202	MH-1204	12	12	SM2	107	-8.84	-9.26	-8.26	0.393	Asbestos Cement	93.09	-8.63	2.5	≤50%
P-1215	MH-1213	MH-1214	6	6		125	1.5	-0.07	0.43	1.256	PVC	1.16	1.52	0.2	≤50%
P-1222	MH-1221	MH-1214	6	6		36	3.82	-0.07	0.43	10.806	PVC	1.16	3.84	0.2	≤50%
P-1217	MH-1214	MH-1216	8	8		196	-0.17	-0.95	-0.28	0.398	PVC	3.48	-0.12	0.6	≤50%
P-1219	MH-1216	MH-1218	8	8		283	-1.05	-2.39	-1.72	0.473	PVC	4.64	-1	0.6	≤50%
P-1220	MH-1218	MH-1204	8	8		56	-2.49	-2.76	-2.09	0.482	PVC	5.80	-2.43	0.7	≤50%
P-1207	MH-1204	MH-1206	12	12	SM2	229	-9.26	-10.15	-9.15	0.389	Asbestos Cement	100.05	-9.05	2.5	≤50%
P-1209	MH-1206	MH-1208	15	15	SM2	388	-10.28	-11.02	-9.77	0.191	Asbestos Cement	258.73	-9.9	4.6	≤50%
P-1757	MH-1846	MH-1845	8	8		96	-0.39	-0.77	-0.10	0.396	PVC	0.00	-0.39	0.0	≤50%
P-1756	MH-1845	MH-1843	8	8		46	-0.87	-1.05	-0.38	0.391	PVC	0.00	-0.87	0.0	≤50%
P-1755	MH-1844	MH-1843	8	8		172	-0.36	-1.05	-0.38	0.401	PVC	0.00	-0.36	0.0	≤50%
P-1754	MH-1843	MH-1842	8	8		128	-1.15	-1.66	-0.99	0.398	PVC	0.00	-1.15	0.0	≤50%
P-1753	MH-1842	MH-1223	8	8		41	-1.66	-1.93	-1.26	0.659	PVC	0.00	-1.66	0.0	≤50%
P-1224	MH-1223	MH-1208	8	8		324	-2.56	-4.66	-3.99	0.648	Asbestos Cement	2.09	-2.53	0.4	≤50%
P-1211	MH-1208	MH-1210	15	15	SM2	365	-11.02	-11.68	-10.43	0.181	Asbestos Cement	262.91	-10.63	4.7	≤50%
P-1212	MH-1210	MH-99	14	14	SM2	313	-11.68	-13.2	-12.03	0.486	PVC	265.00	-11.37	3.7	≤50%
P-1169	MH-1168	MH-1166	8	8		83	-2	-4.1	-3.43	2.53	PVC	4.03	-1.96	0.5	≤50%
P-1167	MH-1166	MH-1164	8	8		234	-4	-6.1	-5.43	0.897	PVC	8.07	-3.94	0.7	≤50%
P-1163	MH-1161	MH-1162	8	8		197	1	-2.1	-1.43	1.574	PVC	4.03	1.04	0.5	≤50%
P-1165	MH-1162	MH-1164	8	8		246	-2	-6.1	-5.43	1.667	PVC	8.07	-1.94	0.7	≤50%
P-1170	MH-1164	MH-95	8	8		367	-6	-10.76	-10.09	1.297	PVC	20.17	-5.9	1.2	≤50%
P-1639	MH-1732	MH-1731	8	8		115	3.23	2.71	3.38	0.452	PVC	0.00	3.23	0.0	≤50%
P-1638	MH-1731	MH-1730	8	8		139	2.61	1.99	2.66	0.446	PVC	0.00	2.61	0.0	≤50%
P-1637	MH-1730	MH-1729	8	8		188	1.89	0.93	1.60	0.511	PVC	0.00	1.89	0.0	≤50%
P-1636	MH-1729	MH-1141	8	8		128	0.83	0.18	0.85	0.508	PVC	0.00	0.83	0.0	≤50%
P-1142(1)	MH-1141	MH-1983	8	8		201	-4	-6.14	-5.47	1.065	PVC	4.03	-3.95	0.6	≤50%
P-1142(2)	MH-1983	MH-87	8	8		164	-4	-6.14	-5.47	1.305	PVC	4.03	-3.96	0.5	≤50%
P-1885	MH-1982	MH-1981	8	8		230	3.8	1.4	2.07	1.043	PVC	0.00	3.8	0.0	≤50%
P-1884	MH-1981	MH-1980	8	8		155	1.4	-3.46	-2.79	3.135	PVC	0.00	1.4	0.0	≤50%
P-1883	MH-1980	MH-87	8	8		15	-3.46	-4.11	-3.44	4.333	PVC	0.00	-3.46	0.0	≤50%
P-950	MH-948	MH-949	8	8		364	-0.39	-1.85	-1.18	0.401	Asbestos Cement	2.24	-0.35	0.5	≤50%
P-951	MH-949	MH-943	8	8		140	-1.85	-2.41	-1.74	0.4	Asbestos Cement	4.48	-1.8	0.6	≤50%
P-1882	MH-1979	MH-1978	8	8		196	-0.07	-2.03	-1.36	1	PVC	0.00	-0.07	0.0	≤50%
P-1881	MH-1978	MH-941	8	8		60	-2.13	-4.73	-4.06	4.333	PVC	0.00	-2.13	0.0	≤50%
P-954	MH-952	MH-953	8	8		102	-2.68	-3.09	-2.42	0.402	Asbestos Cement	2.24	-2.64	0.5	≤50%
P-955	MH-953	MH-939	8	8		52	-3.09	-3.27	-2.60	0.346	Asbestos Cement	4.48	-3.03	0.7	≤50%
P-938	MH-936	MH-937	6	6		73	0	-1.9	-1.40	2.603	PVC	2.24	0.03	0.4	≤50%
P-940	MH-937	MH-939	8	8		153	-1.9	-3.27	-2.60	0.895	PVC	4.48	-1.86	0.5	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-942	MH-939	MH-941	8	8		372	-3.27	-4.78	-4.11	0.406	Asbestos Cement	11.21	-3.19	1.0	≤50%
P-944	MH-941	MH-943	8	8		284	-4.78	-5.91	-5.24	0.398	Asbestos Cement	13.45	-4.69	1.1	≤50%
P-945	MH-943	MH-83	8	8		157	-5.91	-6.43	-5.76	0.331	PVC	21.97	-5.8	1.3	≤50%
P-1643	MH-1733	MH-1037	10	10		45	-2.08	-2.19	-1.36	0.24	PVC	0.00	-2.08	0.0	≤50%
P-1038	MH-1037	MH-1035	10	10		100	-2.29	-2.51	-1.68	0.22	PVC	2.24	-2.25	0.5	≤50%
P-739	MH-1035	MH-1393	10	10		50	-2.61	-2.72	-1.89	0.22	PVC	4.48	-2.56	0.6	≤50%
P-747	MH-1393	MH-75	8	8		187	-2.82	-4.53	-3.86	0.914	Concrete	6.72	-2.77	0.6	≤50%
P-751	MH-676	MH-75	12	12		206	-1	-4.43	-3.43	1.665	PVC	2.24	-0.97	0.4	≤50%
P-78	MH-75	MH-77	14	14		253	-4.53	-5.51	-4.34	0.387	Asbestos Cement	11.21	-4.46	0.8	≤50%
P-80	MH-77	MH-79	14	14		363	-5.51	-6.29	-5.12	0.215	Cast iron	13.45	-5.42	1.1	≤50%
P-82	MH-79	MH-81	14	14		409	-6.29	-6.72	-5.55	0.105	Asbestos Cement	15.69	-6.18	1.3	≤50%
P-947	MH-946	MH-81	8	8		186	-4.52	-6.37	-5.70	0.995	Asbestos Cement	4.03	-4.48	0.5	≤50%
P-84	MH-81	MH-83	14	14		132	-6.72	-7.12	-5.95	0.303	Asbestos Cement	23.76	-6.62	1.2	≤50%
P-86	MH-83	MH-85	14	14		297	-7.12	-7.95	-6.78	0.279	Asbestos Cement	49.76	-6.97	1.8	≤50%
P-88	MH-85	MH-87	14	14		323	-7.95	-8.58	-7.41	0.195	Asbestos Cement	53.79	-7.79	1.9	≤50%
P-1140	MH-1139	MH-87	8	8		152	-4.25	-6.14	-5.47	1.243	PVC	4.03	-4.21	0.5	≤50%
P-90	MH-87	MH-89	14	14		343	-8.27	-9.07	-7.90	0.233	Asbestos Cement	65.90	-8.1	2.0	≤50%
P-92	MH-89	MH-91	14	14		342	-9.07	-10.11	-8.94	0.304	Asbestos Cement	69.93	-8.9	2.0	≤50%
P-1145	MH-1143	MH-1144	8	8		201	-2.18	-4.18	-3.51	0.995	PVC	4.03	-2.14	0.5	≤50%
P-1335	MH-1144	MH-1333	8	8		300	-4.28	-7.28	-6.61	1	PVC	8.07	-4.22	0.7	≤50%
P-1160	MH-1159	MH-1156	6	6		61	2.7	2.3	2.80	0.656	PVC	4.03	2.96	3.1	53%
P-1157	MH-1155	MH-1156	6	6		54	5	2.88	3.38	3.926	PVC	4.03	5.05	0.6	≤50%
P-1158	MH-1156	MH-1150	6	6		118	2.88	-1.92	-1.42	4.068	PVC	12.10	2.96	1.0	≤50%
P-1151	MH-1149	MH-1150	8	8		145	-0.52	-1.92	-1.25	0.966	PVC	4.03	-0.48	0.5	≤50%
P-1338	MH-1150	MH-1336	8	8		209	-2.02	-4.18	-3.51	1.033	PVC	20.17	-1.92	1.2	≤50%
P-1337	MH-1336	MH-1333	8	8		301	-4.28	-7.28	-6.61	0.997	PVC	24.21	-4.17	1.3	≤50%
P-1334	MH-1333	MH-1146	8	8		98	-7.38	-8.13	-7.46	0.765	PVC	36.31	-7.25	1.6	≤50%
P-1148	MH-1146	MH-91	8	8		268	-8.5	-9.48	-8.81	0.366	Asbestos Cement	40.35	-8.34	1.9	≤50%
P-94	MH-91	MH-93	14	14		284	-10.11	-10.32	-9.15	0.074	Asbestos Cement	114.31	-9.81	3.6	≤50%
P-1347	MH-93	MH-95	14	14		167	-10.48	-10.76	-9.59	0.168	Asbestos Cement	118.35	-10.23	3.0	≤50%
P-695	MH-95	MH-97	14	14		152	-10.76	-11.33	-10.16	0.375	Asbestos Cement	142.55	-10.53	2.8	≤50%
P-100	MH-97	MH-99	14	14		291	-11.33	-12.08	-10.91	0.258	Asbestos Cement	146.59	-11.08	3.0	≤50%
P-102	MH-99	MH-101	20	20	SM2	245	-13.2	-13.29	-11.62	0.037	Asbestos Cement	415.62	-12.47	8.8	≤50%
P-1173	MH-1171	MH-1172	8	8		176	0.3	-0.49	0.18	0.449	PVC	4.03	0.35	0.6	≤50%
P-1175	MH-1172	MH-1174	8	8		272	-0.59	-1.82	-1.15	0.452	PVC	8.07	-0.52	0.8	≤50%
P-1177	MH-1174	MH-1176	8	8		205	-1.92	-2.85	-2.18	0.454	PVC	12.10	-1.84	1.0	≤50%
P-1179	MH-1176	MH-1178	8	8		358	-2.95	-4.46	-3.79	0.422	PVC	16.14	-2.85	1.2	≤50%
P-1181	MH-1178	MH-1180	8	8		229	-4.41	-5.76	-5.09	0.59	Asbestos Cement	20.17	-4.31	1.2	≤50%
P-1873	MH-1966	MH-1967	6	6		216	-2.51	-4.67	-4.17	1	PVC	0.00	-2.51	0.0	≤50%
P-1874	MH-1967	MH-1180	6	6		13	-4.67	-5.08	-4.58	3.154	PVC	0.00	-4.67	0.0	≤50%
P-1182	MH-1180	MH-101	12	12		267	-5.61	-8.03	-7.03	0.906	PVC	24.21	-5.52	1.1	≤50%
P-681	MH-101	WW-MAIN	20	20		27	-13.35	-13	-11.33	-1.296	Cast iron	443.86	-12.51	10.1	51%
P-958	MH-956	MH-957	8	8		363	146	141	141.67	1.377	PVC	5.82	146.05	0.6	≤50%
P-960	MH-957	MH-959	8	8		265	140.9	134.4	135.07	2.453	PVC	11.63	140.97	0.8	≤50%
P-962	MH-959	MH-961	8	8		185	134.3	116.3	116.97	9.73	PVC	17.45	134.39	1.1	≤50%
P-964	MH-961	MH-963	8	8		122	116.2	99.2	99.87	13.934	PVC	23.26	116.3	1.2	≤50%
P-966	MH-963	MH-965	8	8		185	99.1	90.1	90.77	4.865	PVC	29.08	99.22	1.4	≤50%
P-968	MH-965	MH-967	8	8		144	90	87.11	87.78	2.007	PVC	34.90	90.13	1.6	≤50%
P-1017	MH-1015	MH-1016	8	8		366	140.2	125.2	125.87	4.098	PVC	5.82	140.25	0.6	≤50%
P-1019	MH-1016	MH-1018	8	8		182	125.1	114.1	114.77	6.044	PVC	11.63	125.17	0.8	≤50%
P-1022	MH-1021	MH-1018	8	8		139	116	114.1	114.77	1.367	PVC	5.82	116.05	0.6	≤50%
P-1020	MH-1018	MH-967	8	8		157	114	90.11	90.78	15.217	PVC	23.26	114.1	1.2	≤50%
P-970	MH-967	MH-969	8	8		96	87.01	80.01	80.68	7.292	PVC	63.98	87.18	2.0	≤50%
P-972	MH-969	MH-971	8	8		83	79.91	72.91	73.58	8.434	PVC	69.79	80.09	2.2	≤50%
P-974	MH-971	MH-973	8	8		69	72.81	68.81	69.48	5.797	PVC	75.61	73	2.3	≤50%
P-976	MH-973	MH-975	8	8		106	68.71	68.31	68.98	0.377	Concrete	81.42	68.93	2.6	≤50%
P-1024	MH-1023	MH-975	8	8		120	74.08	68.21	68.88	4.892	Concrete	5.82	74.13	0.6	≤50%
P-978	MH-975	MH-977	8	8		291	68.11	50.88	51.55	5.921	Concrete	93.06	68.32	2.5	≤50%
P-980	MH-977	MH-979	8	8		170	50.78	44.86	45.53	3.482	Concrete	98.87	51	2.6	≤50%
P-1027	MH-1025	MH-1026	8	8		215	60.8	47.9	48.57	6	Concrete	5.82	60.85	0.6	≤50%
P-1028	MH-1026	MH-979	8	8		115	47.8	44.86	45.53	2.557	Concrete	11.63	47.87	0.8	≤50%
P-982	MH-979	MH-981	8	8		154	44.76	34.76	35.43	6.494	Concrete	116.32	45	2.9	≤50%
P-776	MH-1470	MH-690	8	8		347	178.04	177.39	178.06	0.187	PVC	2.91	178.09	0.6	≤50%
P-775	MH-690	MH-1469	8	8		187	177.29	171.88	172.55	2.893	PVC	5.82	177.34	0.6	≤50%
P-774	MH-1469	MH-688	8	8		164	171.83	167.32	167.99	2.75	PVC	8.72	171.89	0.7	≤50%
P-772	MH-688	MH-1092	8	8		105	167.17	163.64	164.31	3.362	PVC	11.63	167.24	0.8	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1094	MH-1092	MH-1093	8	8		156	163.51	160	160.67	2.25	PVC	14.54	163.59	1.0	≤50%
P-1096	MH-1093	MH-1095	8	8		319	159.9	130.9	131.57	9.091	PVC	17.45	159.99	1.1	≤50%
P-1098	MH-1095	MH-1097	8	8		105	130.9	129.22	129.89	1.6	PVC	20.36	131	1.2	≤50%
P-1100	MH-1097	MH-1099	8	8		112	129.12	125.24	125.91	3.464	PVC	23.26	129.22	1.2	≤50%
P-1102	MH-1099	MH-1101	8	8		399	125.14	112.58	113.25	3.148	PVC	26.17	125.25	1.3	≤50%
P-1103	MH-1101	MH-1056	8	8		358	112.48	104.79	105.46	2.148	PVC	29.08	112.6	1.4	≤50%
P-1087	MH-1086	MH-1070	8	8		138	131.21	130.56	131.23	0.471	PVC	2.91	131.25	0.5	≤50%
P-1085	MH-1084	MH-1072	8	8		270	148.87	147.53	148.20	0.496	PVC	2.91	148.91	0.5	≤50%
P-1083	MH-1082	MH-1080	8	8		180	171.73	168.38	169.05	1.861	PVC	2.91	171.77	0.5	≤50%
P-1081	MH-1080	MH-1078	8	8		89	168.28	163.87	164.54	4.955	PVC	5.82	168.33	0.6	≤50%
P-1079	MH-1078	MH-1076	8	8		217	163.77	154.86	155.53	4.106	PVC	8.72	163.83	0.7	≤50%
P-1077	MH-1076	MH-1074	8	8		95	154.76	152.33	153.00	2.558	PVC	11.63	154.83	0.8	≤50%
P-1075	MH-1074	MH-1072	8	8		119	152.23	147.53	148.20	3.95	PVC	14.54	152.31	1.0	≤50%
P-1073	MH-1072	MH-1070	8	8		284	147.43	130.56	131.23	5.94	PVC	20.36	147.53	1.2	≤50%
P-1071	MH-1070	MH-1068	8	8		104	130.46	126.87	127.54	3.452	PVC	26.17	130.57	1.3	≤50%
P-1069	MH-1068	MH-1066	8	8		111	126.77	121.45	122.12	4.793	PVC	29.08	126.89	1.4	≤50%
P-1863	MH-1956	MH-1955	8	8		394	175.88	156.83	157.50	4.835	PVC	0.00	175.88	0.0	≤50%
P-1862	MH-1955	MH-1954	8	8		250	156.83	146.9	147.57	3.972	PVC	0.00	156.83	0.0	≤50%
P-1861	MH-1954	MH-1947	8	8		250	146.9	129.45	130.12	6.98	PVC	0.00	146.9	0.0	≤50%
P-1860	MH-1953	MH-1952	8	8		203	156.88	147.16	147.83	4.788	PVC	0.00	156.88	0.0	≤50%
P-1859	MH-1952	MH-1951	8	8		87	147.16	134.79	135.46	14.218	PVC	0.00	147.16	0.0	≤50%
P-1871	MH-1964	MH-1965	8	8		349	165.55	151.38	152.05	4.06	PVC	0.00	165.55	0.0	≤50%
P-1872	MH-1965	MH-1961	8	8		105	151.38	148.98	149.65	2.286	PVC	0.00	151.38	0.0	≤50%
P-1864	MH-1957	MH-1958	8	8		256	180.86	179.46	180.13	0.547	PVC	0.00	180.86	0.0	≤50%
P-1865	MH-1958	MH-1959	8	8		235	179.46	169.65	170.32	4.174	PVC	0.00	179.46	0.0	≤50%
P-1866	MH-1959	MH-1960	8	8		86	169.65	162.15	162.82	8.721	PVC	0.00	169.65	0.0	≤50%
P-1867	MH-1960	MH-1961	8	8		133	162.15	148.98	149.65	9.902	PVC	0.00	162.15	0.0	≤50%
P-1868	MH-1961	MH-1962	8	8		202	148.98	136.29	136.96	6.282	PVC	0.00	148.98	0.0	≤50%
P-1869	MH-1962	MH-1963	8	8		153	136.29	135.4	136.07	0.582	PVC	0.00	136.29	0.0	≤50%
P-1870	MH-1963	MH-1951	8	8		98	135.4	134.79	135.46	0.622	PVC	0.00	135.4	0.0	≤50%
P-1858	MH-1951	MH-1950	8	8		96	134.79	134.19	134.86	0.625	PVC	0.00	134.79	0.0	≤50%
P-1857	MH-1950	MH-1949	8	8		107	134.19	133.53	134.20	0.617	PVC	0.00	134.19	0.0	≤50%
P-1856	MH-1949	MH-1948	8	8		255	133.53	132.14	132.81	0.545	PVC	0.00	133.53	0.0	≤50%
P-1855	MH-1948	MH-1947	8	8		256	132.14	129.45	130.12	1.051	PVC	0.00	132.14	0.0	≤50%
P-1854	MH-1947	MH-1088	8	8		169	129.45	123.09	123.76	3.763	PVC	0.00	129.45	0.0	≤50%
P-1089	MH-1088	MH-1066	8	8		357	123.26	121.48	122.15	0.499	PVC	24.77	123.37	1.3	≤50%
P-1067	MH-1066	MH-1064	8	8		161	121.38	117.66	118.33	2.311	PVC	56.75	121.54	1.9	≤50%
P-1065	MH-1064	MH-1062	8	8		119	111.09	109.72	110.39	1.151	PVC	59.66	111.26	2.0	≤50%
P-1091	MH-1090	MH-1062	8	8		149	111.09	109.72	110.39	0.919	PVC	2.91	111.13	0.5	≤50%
P-1063	MH-1062	MH-1060	8	8		108	109.62	108.05	108.72	1.454	PVC	65.48	109.79	2.0	≤50%
P-1061	MH-1060	MH-1058	8	8		200	107.95	105.78	106.45	1.085	PVC	68.39	108.13	2.2	≤50%
P-1059	MH-1058	MH-1056	8	8		182	105.68	104.79	105.46	0.489	PVC	71.29	105.88	2.4	≤50%
P-1057	MH-1056	MH-1054	8	8		262	104.69	103.41	104.08	0.489	PVC	103.28	104.93	2.9	≤50%
P-1055	MH-1054	MH-1052	8	8		293	103.3	101.95	102.62	0.461	PVC	106.19	103.54	2.9	≤50%
P-1053	MH-1052	MH-1050	8	8		309	101.85	97.5	98.17	1.408	PVC	109.10	102.08	2.8	≤50%
P-1051	MH-1050	MH-1048	8	8		91	97.4	90.1	90.77	8.022	PVC	112.01	97.63	2.8	≤50%
P-1049	MH-1048	MH-1046	8	8		361	90	62.95	63.62	7.493	Concrete	114.91	90.23	2.8	≤50%
P-1047	MH-1046	MH-1044	8	8		193	62.95	47.9	48.57	7.798	Concrete	117.82	63.19	2.9	≤50%
P-1045	MH-1044	MH-1042	15	15		18	47.9	47.77	49.02	0.722	PVC	120.73	48.1	2.4	≤50%
P-1043	MH-1042	MH-1040	15	15		412	47.6	46.14	47.39	0.354	PVC	577.38	48.05	5.4	≤50%
P-1041	MH-1040	MH-989	15	15		378	46.14	44.67	45.92	0.389	PVC	580.29	46.59	5.4	≤50%
P-1003	MH-1001	MH-1002	6	6		149	147	145.1	145.60	1.275	PVC	2.91	147.04	0.5	≤50%
P-1005	MH-1002	MH-1004	6	6		199	145	141.1	141.60	1.96	PVC	5.82	145.06	0.7	≤50%
P-1007	MH-1004	MH-1006	6	6		335	141	137.1	137.60	1.164	PVC	8.72	141.07	0.8	≤50%
P-1009	MH-1006	MH-1008	6	6		170	137	119.1	119.60	10.529	PVC	11.63	137.08	1.0	≤50%
P-1011	MH-1008	MH-1010	8	8		232	119	101.1	101.77	7.716	Concrete	14.54	119.08	1.0	≤50%
P-1013	MH-1010	MH-1012	8	8		360	101	95.1	95.77	1.639	Concrete	17.45	101.09	1.1	≤50%
P-1014	MH-1012	MH-991	8	8		240	95	64.12	64.79	12.867	Concrete	62.42	95.17	2.0	≤50%
P-1000	MH-999	MH-997	8	8		267	107.12	106.03	106.70	0.408	Concrete	2.91	107.16	0.5	≤50%
P-998	MH-997	MH-995	8	8		275	106.03	104.94	105.61	0.396	Concrete	5.82	106.09	0.7	≤50%
P-996	MH-995	MH-993	8	8		313	104.94	86.96	87.63	5.744	Concrete	8.72	105	0.7	≤50%
P-994	MH-993	MH-991	8	8		305	86.96	64.02	64.69	7.521	Concrete	11.63	87.03	0.8	≤50%
P-992	MH-991	MH-989	8	8		187	64.02	49.06	49.73	8	Concrete	76.96	64.21	2.3	≤50%
P-990	MH-989	MH-987	15	15		153	44.67	44.07	45.32	0.392	PVC	660.16	45.15	5.8	≤50%
P-988	MH-987	MH-985	15	15		332	44.07	42.75	44.00	0.398	PVC	665.98	44.55	5.8	≤50%
P-986	MH-985	MH-983	15	15		259	42.75	41.7	42.95	0.405	PVC	671.79	43.23	5.8	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-984	MH-983	MH-981	15	15		274	41.7	34.86	36.11	2.496	PVC	677.61	42.19	5.9	≤50%
P-1390	MH-981	MH-1375	12	12		285	34.6	5.04	6.04	10.372	Corrugated HDPE (Smooth Interior)	799.74	35.17	6.8	59%
P-784	MH-1474	MH-65	8	8		227	65.06	43.1	43.77	9.674	Concrete	2.12	65.09	0.4	≤50%
P-68(1)	MH-65	MH-1984	8	8		224	43	41.96	42.63	0.464	Concrete	4.24	43.06	0.7	≤50%
P-68(2)	MH-1984	MH-67	8	8		25	43	41.96	42.63	4.16	Concrete	4.24	43.04	0.5	≤50%
P-688	MH-687	MH-223	8	8		141	93.91	85.51	86.18	5.957	Concrete	1.92	93.94	0.4	≤50%
P-240	MH-238	MH-239	8	8		126	132	130.1	130.77	1.508	PVC	15.33	132.08	1.0	≤50%
P-242	MH-239	MH-241	8	8		337	130	120.1	120.77	2.938	PVC	17.25	130.09	1.1	≤50%
P-1349	MH-241	MH-207	18	18		19	120	119.06	120.56	4.947	PVC	19.17	120.08	1.0	≤50%
P-1789	MH-1884	MH-1883	8	8		129	148.59	148.07	148.74	0.403	PVC	0.00	148.59	0.0	≤50%
P-247	MH-245	MH-246	8	8		365	244.65	240.69	241.36	1.085	PVC	1.92	244.68	0.4	≤50%
P-249	MH-246	MH-248	8	8		98	240.59	230.55	231.22	10.245	PVC	3.85	240.63	0.5	≤50%
P-251	MH-248	MH-250	8	8		400	230.45	219.1	219.77	2.838	PVC	5.77	230.5	0.6	≤50%
P-300	MH-298	MH-299	8	8		253	223.33	213.27	213.94	3.976	PVC	1.92	223.36	0.4	≤50%
P-302	MH-299	MH-301	8	8		93	213.17	212.79	213.46	0.409	PVC	3.85	213.22	0.6	≤50%
P-303	MH-301	MH-250	8	8		159	212.69	210.7	211.37	1.252	PVC	5.77	212.74	0.6	≤50%
P-253	MH-250	MH-252	8	8		288	210.6	208.76	209.43	0.639	PVC	13.46	210.68	1.0	≤50%
P-255	MH-252	MH-254	8	8		263	208.66	194.58	195.25	5.354	PVC	15.38	208.74	1.0	≤50%
P-257	MH-254	MH-256	8	8		230	194.48	182.94	183.61	5.017	PVC	17.31	194.57	1.1	≤50%
P-259	MH-256	MH-258	8	8		360	182.84	181.42	182.09	0.394	PVC	19.23	182.95	1.3	≤50%
P-1764	MH-1853	MH-258	8	8		212	194.79	184.8	185.47	4.712	PVC	0.00	194.79	0.0	≤50%
P-1763	MH-1852	MH-258	8	8		120	185.75	184.8	185.47	0.792	PVC	0.00	185.75	0.0	≤50%
P-261	MH-258	MH-260	10	10		272	181.32	161.9	162.73	7.14	PVC	22.57	181.42	1.2	≤50%
P-263	MH-260	MH-262	10	10		106	161.8	147.91	148.74	13.104	PVC	24.49	161.9	1.2	≤50%
P-297	MH-296	MH-293	8	8		28	154.4	153.53	154.20	3.107	PVC	1.92	154.43	0.4	≤50%
P-292	MH-290	MH-291	8	8		23	160.16	160.04	160.71	0.522	PVC	1.92	160.19	0.4	≤50%
P-294	MH-291	MH-293	8	8		125	159.94	153.99	154.66	4.76	PVC	3.85	159.98	0.5	≤50%
P-295	MH-293	MH-262	8	8		253	153.43	145.67	146.34	3.067	PVC	7.69	153.49	0.7	≤50%
P-265(1)	MH-262	MH-1883	10	10		136	147.66	134.16	134.99	9.926	PVC	34.11	147.78	1.4	≤50%
P-265(2)	MH-1883	MH-264	10	10		185	147.66	134.16	134.99	7.297	PVC	34.11	147.78	1.4	≤50%
P-267	MH-264	MH-266	10	10		324	134.06	125.91	126.74	2.515	PVC	36.03	134.18	1.4	≤50%
P-269	MH-266	MH-268	12	12		271	125.71	124.75	125.75	0.354	Steel	37.95	125.85	1.7	≤50%
P-271	MH-268	MH-270	12	12		307	124.5	123.36	124.36	0.371	Steel	39.88	124.64	1.7	≤50%
P-273	MH-270	MH-272	12	12		401	123.26	121.9	122.90	0.339	Steel	41.80	123.4	1.7	≤50%
P-275	MH-272	MH-274	12	12		401	121.8	120.44	121.44	0.339	Steel	43.72	121.95	1.8	≤50%
P-276	MH-274	MH-207	12	12		375	120.34	119.06	120.06	0.341	Steel	45.64	120.49	1.8	≤50%
P-1361	MH-1360	MH-181	8	8		150	224	214.41	215.08	6.393	PVC	2.70	224.03	0.4	≤50%
P-1704	MH-1798	MH-1797	8	8		222	225.91	225.02	225.69	0.4	PVC	0.00	225.91	0.0	≤50%
P-1703	MH-1797	MH-1789	8	8		81	225.02	224.7	225.37	0.4	PVC	0.00	225.02	0.0	≤50%
P-1702	MH-1796	MH-1794	8	8		198	228.18	227.39	228.06	0.4	PVC	0.00	228.18	0.0	≤50%
P-1701	MH-1795	MH-1794	8	8		405	229.01	227.39	228.06	0.4	PVC	0.00	229.01	0.0	≤50%
P-1700	MH-1794	MH-1791	8	8		261	227.39	226.34	227.01	0.4	PVC	0.00	227.39	0.0	≤50%
P-1699	MH-1793	MH-1791	8	8		112	226.79	226.34	227.01	0.4	PVC	0.00	226.79	0.0	≤50%
P-1698	MH-1792	MH-1791	8	8		119	226.82	226.34	227.01	0.4	PVC	0.00	226.82	0.0	≤50%
P-1697	MH-1791	MH-1790	8	8		333	226.34	225.01	225.68	0.4	PVC	0.00	226.34	0.0	≤50%
P-1696	MH-1790	MH-1789	8	8		78	225.01	224.7	225.37	0.4	PVC	0.00	225.01	0.0	≤50%
P-1695	MH-1789	MH-176	8	8		120	224.7	224.22	224.89	0.4	PVC	0.00	224.7	0.0	≤50%
P-178	MH-176	MH-177	8	8		305	224.22	222.68	223.35	0.505	PVC	17.36	224.32	1.2	≤50%
P-180	MH-177	MH-179	8	8		308	222.68	218.82	219.49	1.253	PVC	20.06	222.78	1.2	≤50%
P-182	MH-179	MH-181	8	8		239	218.82	214.41	215.08	1.845	PVC	22.77	218.92	1.2	≤50%
P-184	MH-181	MH-183	8	8		212	214.41	202.48	203.15	5.627	PVC	28.17	214.52	1.3	≤50%
P-186	MH-183	MH-185	8	8		206	202.48	194.44	195.11	3.903	PVC	30.87	202.6	1.4	≤50%
P-188	MH-185	MH-187	8	8		47	194.44	191.6	192.27	6.043	PVC	33.57	194.56	1.4	≤50%
P-190	MH-187	MH-189	8	8		162	191.6	190.78	191.45	0.506	PVC	36.27	191.74	1.7	≤50%
P-192	MH-189	MH-191	8	8		157	190.78	184.15	184.82	4.223	PVC	38.98	190.91	1.6	≤50%
P-194	MH-191	MH-193	8	8		279	184.15	161.51	162.18	8.115	PVC	41.68	184.29	1.7	≤50%
P-196	MH-193	MH-195	8	8		42	161.51	154.32	154.99	17.119	PVC	44.38	161.65	1.7	≤50%
P-198	MH-195	MH-197	8	8	SM10	128	154.32	143.68	144.35	8.312	PVC	47.08	154.47	1.8	≤50%
P-200	MH-197	MH-199	8	8	SM10	84	143.58	141	141.67	3.071	Concrete	49.78	143.73	1.8	≤50%
P-202	MH-199	MH-201	8	8	SM10	324	139.9	131.1	131.77	2.716	Concrete	52.48	140.06	1.9	≤50%
P-204	MH-201	MH-203	8	8	SM10	476	131	124.76	125.43	1.311	Concrete	55.19	131.16	1.9	≤50%
P-288	MH-286	MH-287	8	8		300	127.72	126.43	127.10	0.43	PVC	2.70	127.76	0.5	≤50%
P-289	MH-287	MH-203	8	8		300	126.43	124.76	125.43	0.557	PVC	5.40	126.48	0.6	≤50%
P-206	MH-203	MH-205	8	8	SM10	276	124.66	119.6	120.27	1.833	Concrete	63.29	124.83	2.0	≤50%
P-208	MH-205	MH-207	8	8	SM10	23	119.5	119.06	119.73	1.913	PVC	65.21	119.67	2.0	≤50%
P-210	MH-207	MH-209	12	12		263	118.96	117.37	118.37	0.605	PVC	131.95	119.18	2.6	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-212	MH-209	MH-211	12	12		275	117.27	115.62	116.62	0.6	PVC	133.87	117.49	2.6	≤50%
P-230	MH-228	MH-229	8	8		308	126.83	125.31	125.98	0.494	Concrete	1.92	126.86	0.4	≤50%
P-232(1)	MH-229	MH-1946	8	8		265	123.21	123.14	123.81	0.026	Concrete	3.85	123.32	1.3	≤50%
P-232(2)	MH-1946	MH-231	8	8		144	123.21	123.14	123.81	0.049	Concrete	3.85	123.29	1.0	≤50%
P-234	MH-231	MH-233	8	8		205	123.04	119.5	120.17	1.727	PVC	5.77	123.09	0.6	≤50%
P-236	MH-233	MH-235	8	8		218	119.4	116.1	116.77	1.514	PVC	7.69	119.46	0.7	≤50%
P-237	MH-235	MH-211	8	8		30	116	115.62	116.29	1.267	PVC	9.61	116.07	0.8	≤50%
P-214	MH-211	MH-213	12	12		366	115.52	113.3	114.30	0.607	PVC	145.41	115.75	2.8	≤50%
P-279	MH-277	MH-278	6	6		464	124	116	116.50	1.724	PVC	1.92	124.03	0.4	≤50%
P-1356	MH-1355	MH-284	8	8	SM10	218	122.87	121.91	122.58	0.44	Concrete	1.92	122.91	0.5	≤50%
P-741	MH-284	MH-282	8	8	SM10	274	121.91	120.84	121.51	0.391	Concrete	3.85	121.96	0.6	≤50%
P-743	MH-282	MH-280	8	8	SM10	224	120.84	116.32	116.99	2.018	PVC	5.77	120.89	0.6	≤50%
P-745	MH-280	MH-278	8	8	SM10	154	116.32	115.58	116.25	0.481	PVC	7.69	116.39	0.8	≤50%
P-697	MH-278	MH-213	8	8		16	115.9	113.3	113.97	16.25	Concrete	11.54	115.97	0.8	≤50%
P-216	MH-213	MH-215	12	12		278	113.2	105.58	106.58	2.741	PVC	158.87	113.45	3.0	≤50%
P-1342	MH-1341	MH-215	8	8		11	105.7	105.58	106.25	1.091	Steel	1.92	105.73	0.4	≤50%
P-218	MH-215	MH-217	12	12		353	105.48	101.95	102.95	1	PVC	162.72	105.73	3.0	≤50%
P-220	MH-217	MH-219	12	12		15	101.7	101.6	102.60	0.667	PVC	164.64	101.95	3.0	≤50%
P-222	MH-219	MH-221	8	8		72	101.5	94.51	95.18	9.708	Concrete	166.56	101.78	3.4	≤50%
P-690	MH-689	MH-221	8	8		217	95.43	94.51	95.18	0.424	Concrete	1.92	95.47	0.5	≤50%
P-759	MH-221	MH-223	8	8		291	94.41	85.51	86.18	3.058	PVC	170.41	94.7	3.5	≤50%
P-1422	MH-223	MH-1421	8	8		133	85.41	72.4	73.07	9.782	Concrete	174.26	85.7	3.5	≤50%
P-1425	MH-1421	MH-1417	8	8		27	72.06	69.69	70.36	8.778	PVC	176.18	72.35	3.5	≤50%
P-104	MH-103	MH-25	8	8		119	190.8	188.81	189.48	1.672	PVC	1.15	190.82	0.2	≤50%
P-21	MH-19	MH-20	8	8		131	234.62	228.59	229.26	4.603	PVC	1.15	234.64	0.2	≤50%
P-23	MH-20	MH-22	8	8		209	228.49	215.96	216.63	5.995	PVC	2.31	228.52	0.4	≤50%
P-26	MH-22	MH-25	8	8		232	215.86	188.81	189.48	11.659	PVC	3.46	215.9	0.5	≤50%
P-28	MH-25	MH-27	8	8		109	179.83	164.06	164.73	14.468	PVC	5.77	179.88	0.6	≤50%
P-30	MH-27	MH-29	8	8		124	164.06	151.94	152.61	9.774	PVC	6.92	164.12	0.7	≤50%
P-32	MH-29	MH-31	8	8		100	151.84	139.99	140.66	11.85	PVC	8.08	151.9	0.7	≤50%
P-34	MH-31	MH-33	8	8		113	139.99	139.89	140.56	0.088	PVC	9.23	140.1	1.3	≤50%
P-36	MH-33	MH-35	8	8		166	139.89	133.12	133.79	4.078	PVC	10.38	139.96	0.8	≤50%
P-38	MH-35	MH-37	8	8		195	133.02	127.2	127.87	2.985	PVC	11.54	133.09	0.8	≤50%
P-40	MH-37	MH-39	8	8		186	126	121.64	122.31	2.344	PVC	12.69	126.08	1.0	≤50%
P-166	MH-164	MH-165	8	8		191	123.49	122.73	123.40	0.398	PVC	1.15	123.52	0.4	≤50%
P-168	MH-165	MH-167	8	8		124	122.63	122.15	122.82	0.387	PVC	2.31	122.67	0.5	≤50%
P-169	MH-167	MH-39	8	8		328	122.05	120.77	121.44	0.39	PVC	3.46	122.1	0.6	≤50%
P-42	MH-39	MH-41	8	8		271	121.54	120.21	120.88	0.491	PVC	17.31	121.64	1.2	≤50%
P-172	MH-170	MH-171	8	8		301	122.82	121.62	122.29	0.399	PVC	1.15	122.85	0.4	≤50%
P-174	MH-171	MH-173	8	8		167	121.52	120.85	121.52	0.401	PVC	2.31	121.56	0.5	≤50%
P-175	MH-173	MH-41	8	8		286	120.85	120.21	120.88	0.224	PVC	3.46	120.9	0.6	≤50%
P-44	MH-41	MH-43	8	8		267	120.11	118.75	119.42	0.509	PVC	21.92	120.22	1.3	≤50%
P-306	MH-304	MH-43	8	8		304	126.25	118.75	119.42	2.467	PVC	1.15	126.27	0.2	≤50%
P-46	MH-43	MH-45	8	8		84	118.65	118.22	118.89	0.512	PVC	24.23	118.76	1.3	≤50%
P-48	MH-45	MH-47	8	8		211	118.12	117.06	117.73	0.502	PVC	25.38	118.24	1.4	≤50%
P-50	MH-47	MH-49	8	10	SM7	18	116.96	116.8	117.63	0.889	PVC	26.54	117.5	6.5	69%
P-1809	MH-1906	MH-1905	8	8		101	203.82	196.29	196.96	7.455	PVC	0.00	203.82	0.0	≤50%
P-1807	MH-1903	MH-1904	8	8		257	214.92	204.15	204.82	4.191	PVC	0.00	214.92	0.0	≤50%
P-1808	MH-1904	MH-1905	8	8		249	204.15	196.29	196.96	3.157	PVC	0.00	204.15	0.0	≤50%
P-1811	MH-1905	MH-1895	8	8		361	196.29	193.05	193.72	0.898	PVC	0.00	196.29	0.0	≤50%
P-1806	MH-1902	MH-1894	8	8		313	199.97	194.48	195.15	1.754	PVC	0.00	199.97	0.0	≤50%
P-1797	MH-1893	MH-1892	8	8		204	213.75	205.28	205.95	4.152	PVC	0.00	213.75	0.0	≤50%
P-1796	MH-1892	MH-1891	8	8		98	205.28	200.53	201.20	4.847	PVC	0.00	205.28	0.0	≤50%
P-1795	MH-1891	MH-1890	8	8		33	200.53	199.27	199.94	3.818	PVC	0.00	200.53	0.0	≤50%
P-1794	MH-1889	MH-1890	8	8		110	200.6	199.27	199.94	1.209	PVC	0.00	200.6	0.0	≤50%
P-1798	MH-1890	MH-1894	8	8		284	199.27	194.48	195.15	1.687	PVC	0.00	199.27	0.0	≤50%
P-1799	MH-1894	MH-1895	8	8		250	194.48	193.05	193.72	0.572	PVC	0.00	194.48	0.0	≤50%
P-1800	MH-1895	MH-1896	8	8		139	193.05	192.11	192.78	0.676	PVC	0.00	193.05	0.0	≤50%
P-1801	MH-1896	MH-1897	8	8		203	192.11	190.71	191.38	0.69	PVC	0.00	192.11	0.0	≤50%
P-1802	MH-1897	MH-1898	8	8		71	190.71	189.7	190.37	1.423	PVC	0.00	190.71	0.0	≤50%
P-1803	MH-1898	MH-1899	8	8		241	189.7	187.7	188.37	0.83	PVC	0.00	189.7	0.0	≤50%
P-1804	MH-1899	MH-1900	8	8		290	187.7	185.69	186.36	0.693	PVC	0.00	187.7	0.0	≤50%
P-1805	MH-1900	MH-133	8	8		252	185.69	184.29	184.96	0.556	PVC	0.00	185.69	0.0	≤50%
P-124	MH-122	MH-123	8	8		343	240.58	237.2	237.87	0.985	PVC	1.15	240.6	0.2	≤50%
P-1687	MH-1780	MH-1779	8	8		203	239.68	238.87	239.54	0.4	PVC	0.00	239.68	0.0	≤50%
P-1686	MH-1779	MH-1778	8	8		45	238.87	238.69	239.36	0.4	PVC	0.00	238.87	0.0	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1685	MH-1778	MH-1772	8	8		228	238.69	237.78	238.45	0.4	PVC	0.00	238.69	0.0	≤50%
P-1684	MH-1777	MH-1776	8	8		264	241	239.94	240.61	0.4	PVC	0.00	241	0.0	≤50%
P-1683	MH-1776	MH-1775	8	8		65	239.94	239.68	240.35	0.4	PVC	0.00	239.94	0.0	≤50%
P-1682	MH-1775	MH-1774	8	8		133	239.68	239.15	239.82	0.4	PVC	0.00	239.68	0.0	≤50%
P-1681	MH-1774	MH-1773	8	8		87	239.15	238.8	239.47	0.4	PVC	0.00	239.15	0.0	≤50%
P-1680	MH-1773	MH-1772	8	8		257	238.8	237.78	238.45	0.4	PVC	0.00	238.8	0.0	≤50%
P-1679	MH-1772	MH-1771	8	8		113	237.78	237.32	237.99	0.4	PVC	0.00	237.78	0.0	≤50%
P-1678	MH-1771	MH-123	8	8		31	237.32	237.2	237.87	0.4	PVC	0.00	237.6	3.4	≤50%
P-126	MH-123	MH-125	8	8		305	237.2	225.96	226.63	3.685	PVC	320.02	237.6	4.8	63%
P-128	MH-125	MH-127	8	8		400	225.8	206.99	207.66	4.703	PVC	321.17	226.2	4.8	63%
P-130	MH-127	MH-129	8	8		400	206.87	196.08	196.75	2.698	PVC	322.33	207.27	4.8	63%
P-132	MH-129	MH-131	8	8		362	196.08	184.48	185.15	3.204	PVC	323.48	196.48	4.8	63%
P-134	MH-131	MH-133	8	8		42	184.38	183.38	184.05	2.381	PVC	338.73	184.79	4.9	65%
P-136(1)	MH-133	MH-1901	15	15		105	182.62	174.75	176.00	7.495	PVC	339.88	182.96	4.1	≤50%
P-136(2)	MH-1901	MH-135	15	15		208	182.62	174.75	176.00	3.784	PVC	339.88	182.96	4.1	≤50%
P-138	MH-135	MH-137	15	15		327	174.68	173.14	174.39	0.471	PVC	341.04	175.03	4.2	≤50%
P-1749	SSMH #24 - Westchester	SSMH #23 - Westchester	8	8		150	196.51	195.91	196.58	0.4	PVC	0.00	196.51	0.0	≤50%
P-1748	SSMH #25 - Westchester	SSMH #23 - Westchester	8	8		113	196.36	195.91	196.58	0.398	PVC	0.00	196.36	0.0	≤50%
P-1747	SSMH #23 - Westchester	SSMH #20 - Westchester	8	8		219	195.81	194.93	195.60	0.402	PVC	0.00	195.81	0.0	≤50%
P-1735	SSMH #22 - Westchester	SSMH #20 - Westchester	8	8		223	207.55	194.93	195.60	5.659	PVC	0.00	207.55	0.0	≤50%
P-1734	SSMH #20 - Westchester	SSMH #19 - Westchester	8	8		153	194.93	186.24	186.91	5.68	PVC	0.00	194.93	0.0	≤50%
P-1733	SSMH #19 - Westchester	SSMH #18 - Westchester	8	8		356	186.14	173.29	173.96	3.61	PVC	0.00	186.14	0.0	≤50%
P-1732	SSMH #18 - Westchester	MH-137	8	8		46	173.19	173.14	173.81	0.109	PVC	0.00	173.41	2.6	≤50%
P-140	MH-137	MH-139	15	15		252	173.06	171.81	173.06	0.496	PVC	342.19	173.41	4.2	≤50%
P-142	MH-139	MH-141	15	15		401	171.74	169.66	170.91	0.519	PVC	378.60	172.1	4.3	≤50%
P-1737	SSMH #15 - Westchester	SSMH #14 - Westchester	8	8		144	182.09	181.41	182.08	0.472	PVC	0.00	182.09	0.0	≤50%
P-1736	SSMH #14 - Westchester	SSMH #3 - Westchester	8	8		400	181.31	179.71	180.38	0.4	PVC	0.00	181.31	0.0	≤50%
P-1739	SSMH #17 - Westchester	SSMH #16 - Westchester	8	8		150	198.79	195.9	196.57	1.927	PVC	0.00	198.79	0.0	≤50%
P-1738	SSMH #16 - Westchester	SSMH #4 - Westchester	8	8		400	195.8	194.2	194.87	0.4	PVC	0.00	195.8	0.0	≤50%
P-1745	SSMH #13 - Westchester	SSMH #8 - Westchester	8	8		213	221.35	216.28	216.95	2.38	PVC	0.00	221.35	0.0	≤50%
P-1746	SSMH #12 - Westchester	SSMH #9 - Westchester	8	8		270	229.81	221.99	222.66	2.896	PVC	0.00	229.81	0.0	≤50%
P-1744	SSMH #11 - Westchester	SSMH #10 - Westchester	8	8		284	235.15	227.63	228.30	2.648	PVC	0.00	235.15	0.0	≤50%
P-1743	SSMH #10 - Westchester	SSMH #9 - Westchester	8	8		149	227.53	221.99	222.66	3.718	PVC	0.00	227.53	0.0	≤50%
P-1742	SSMH #9 - Westchester	SSMH #8 - Westchester	8	8		131	221.89	216.28	216.95	4.282	PVC	0.00	221.89	0.0	≤50%
P-1741	SSMH #8 - Westchester	SSMH #7 - Westchester	8	8		138	216.18	215.46	216.13	0.522	PVC	0.00	216.18	0.0	≤50%
P-1740	SSMH #7 - Westchester	SSMH #6 - Westchester	8	8		352	215.36	213.95	214.62	0.401	PVC	0.00	215.36	0.0	≤50%
P-1731	SSMH #6 - Westchester	SSMH #5 - Westchester	8	8		76	213.85	207.89	208.56	7.842	PVC	0.00	213.85	0.0	≤50%
P-1730	SSMH #5 - Westchester	SSMH #4 - Westchester	8	8		169	207.79	194.2	194.87	8.041	PVC	0.00	207.79	0.0	≤50%
P-1729	SSMH #4 - Westchester	SSMH #3 - Westchester	8	8		242	194.1	179.71	180.38	5.946	PVC	0.00	194.1	0.0	≤50%
P-1728	SSMH #3 - Westchester	SSMH #2 - Westchester	8	8		73	179.61	178.88	179.55	1	PVC	0.00	179.61	0.0	≤50%
P-1727	SSMH #2 - Westchester	SSMH #1 - Westchester	8	8		92	178.78	178.02	178.69	0.826	PVC	0.00	178.78	0.0	≤50%
P-1726	SSMH #1 - Westchester	MH-141	8	8		134	177.92	169.66	170.33	6.164	PVC	0.00	177.92	0.0	≤50%
P-144	MH-141	MH-143	15	15		205	169.58	168.74	169.99	0.41	PVC	391.32	169.97	4.7	≤50%
P-146	MH-143	MH-145	15	15		291	168.72	167.22	168.47	0.515	PVC	392.48	169.09	4.4	≤50%
P-148	MH-145	MH-147	15	15		397	167.18	139.79	141.04	6.899	PVC	393.63	167.55	4.4	≤50%
P-150	MH-147	MH-149	15	15		336	139.66	136.31	137.56	0.997	PVC	394.79	140.03	4.4	≤50%
P-152	MH-149	MH-151	15	15		100	136.22	135.04	136.29	1.18	PVC	395.94	136.59	4.4	≤50%
P-154	MH-151	MH-153	15	15		134	134.87	131.93	133.18	2.194	PVC	397.09	135.24	4.4	≤50%
P-162	MH-160	MH-161	12	12		242	132.95	132.4	133.40	0.227	PVC	1.15	132.98	0.4	≤50%
P-163	MH-161	MH-153	12	12		72	132.4	132.25	133.25	0.208	PVC	2.31	132.44	0.5	≤50%
P-156	MH-153	MH-155	15	15		100	131.83	131.09	132.34	0.74	PVC	400.55	132.2	4.4	≤50%
P-158	MH-155	MH-157	15	15		249	130.99	122.09	123.34	3.574	PVC	401.71	131.36	4.4	≤50%
P-159	MH-157	MH-49	15	15		310	122.09	117.19	118.44	1.581	PVC	402.86	122.46	4.4	≤50%
P-52	MH-49	MH-51	8	10	SM7	147	117.07	114.49	115.32	1.755	PVC	430.55	117.5	5.2	52%
P-54	MH-51	MH-53	8	10	SM7	277	114.49	110.02	110.85	1.614	PVC	431.70	114.93	5.3	54%
P-679	MH-677	MH-678	8	8		269	125.79	121.09	121.76	1.747	Concrete	1.15	125.81	0.2	≤50%
P-680	MH-678	MH-53	8	8		293	121.09	110.25	110.92	3.7	Concrete	2.31	121.12	0.4	≤50%
P-56	MH-53	MH-55	8	10	SM7	50	110.02	106.76	107.59	6.52	PVC	435.17	110.46	5.3	54%
P-58	MH-55	MH-57	8	10	SM7	157	106.76	95.81	96.64	6.975	PVC	436.32	107.2	5.3	54%
P-60	MH-57	MH-59	8	10	SM7	125	95.81	85.38	86.21	8.344	PVC	437.47	96.25	5.3	54%
P-62	MH-59	MH-61	8	10	SM7	136	85.38	72.78	73.61	9.265	PVC	438.63	85.82	5.3	54%
P-683	MH-681	MH-682	8	8		324	109	83.64	84.31	7.827	Concrete	1.15	109.02	0.2	≤50%
P-684	MH-682	MH-61	8	8		219	83.28	72.78	73.45	4.795	Concrete	2.31	83.31	0.4	≤50%
P-64	MH-61	MH-63	8	10	SM7	87	72.78	66.2	67.03	7.563	PVC	442.09	73.22	5.3	54%
P-753	MH-63	MH-1417	15	15		313	66.1	64.57	65.82	0.489	PVC	444.01	66.49	4.7	≤50%
P-755	MH-1417	MH-225	15	15		157	64.47	57.05	58.30	4.726	PVC	622.11	64.94	5.6	≤50%

City of Stanwood
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10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-757	MH-225	MH-67	15	15	SM3	100	56.95	41.96	43.21	14.99	PVC	624.03	57.42	5.6	≤50%
P-70	MH-67	MH-69	15	15	SM3	202	41.86	26.06	27.31	7.822	PVC	630.40	42.33	5.6	≤50%
P-716	MH-715	MH-69	8	8		383	28.38	26.84	27.51	0.402	Concrete	2.12	28.42	0.5	≤50%
P-72	MH-69	MH-71	15	15	SM3	78	25.96	19.77	21.02	7.936	PVC	634.65	26.43	5.6	≤50%
P-930	MH-928	MH-929	8	8		303	115.97	103.16	103.83	4.228	PVC	1.70	116	0.4	≤50%
P-932	MH-929	MH-931	8	8		301	102.98	85.22	85.89	5.9	PVC	3.40	103.02	0.5	≤50%
P-934	MH-931	MH-933	8	8		297	85.05	59.9	60.57	8.468	PVC	5.09	85.1	0.6	≤50%
P-935	MH-933	MH-837	8	8		302	59.25	32	32.67	9.023	PVC	6.79	59.31	0.7	≤50%
P-866	MH-864	MH-865	8	8		128	83.22	82.97	83.64	0.195	PVC	0.77	83.25	0.4	≤50%
P-867	MH-865	MH-799	8	8		253	82.87	81.42	82.09	0.573	PVC	1.54	82.9	0.4	≤50%
P-760	MH-759	MH-757	8	8		108	98	95.1	95.77	2.685	PVC	0.77	98.02	0.2	≤50%
P-758	MH-757	MH-755	8	8		123	95	92	92.67	2.439	PVC	1.54	95.03	0.4	≤50%
P-756	MH-755	MH-753	8	8		160	91.9	89.1	89.77	1.75	PVC	2.31	91.93	0.4	≤50%
P-762	MH-761	MH-753	8	8		127	91	89.1	89.77	1.496	PVC	0.77	91.02	0.2	≤50%
P-754	MH-753	MH-751	8	8		331	89	83.8	84.47	1.571	PVC	3.86	89.04	0.5	≤50%
P-752	MH-751	MH-749	8	8		74	83.7	82.27	82.94	1.932	PVC	4.63	83.75	0.6	≤50%
P-750	MH-749	MH-747	8	8		35	82.17	82.01	82.68	0.457	PVC	5.40	82.34	2.0	≤50%
P-765	MH-763	MH-764	8	8		245	107.25	95.23	95.90	4.906	PVC	0.77	107.27	0.2	≤50%
P-767	MH-764	MH-766	8	8		190	95.13	92.22	92.89	1.532	PVC	1.54	95.16	0.4	≤50%
P-773	MH-771	MH-772	8	8		76	93.33	92.99	93.66	0.447	PVC	0.77	93.35	0.2	≤50%
P-1348	MH-772	MH-766	8	8		103	92.89	92.22	92.89	0.65	PVC	1.54	92.92	0.4	≤50%
P-1351	MH-766	MH-768	8	8		188	92.22	91.58	92.25	0.34	PVC	3.86	92.27	0.6	≤50%
P-770	MH-768	MH-741	8	8		40	84.93	84.65	85.32	0.7	PVC	12.50	85.01	1.0	≤50%
P-738	MH-736	MH-737	8	8		107	87.23	86.66	87.33	0.533	Steel	0.77	87.25	0.2	≤50%
P-740	MH-737	MH-739	8	8		60	86.34	86.01	86.68	0.55	PVC	174.64	86.65	3.7	≤50%
P-742	MH-739	MH-741	8	8		305	86.01	84.65	85.32	0.446	PVC	175.41	86.34	4.0	≤50%
P-798	MH-797	MH-794	8	8		201	86.83	85.65	86.32	0.587	PVC	13.25	86.91	1.0	≤50%
P-777	MH-775	MH-776	8	8		233	99.74	98.69	99.36	0.451	PVC	0.77	99.76	0.2	≤50%
P-779	MH-776	MH-778	8	8		131	98.69	98.22	98.89	0.359	PVC	1.54	98.72	0.4	≤50%
P-781	MH-778	MH-780	8	8		298	98.22	97.09	97.76	0.379	PVC	2.31	98.26	0.5	≤50%
P-783	MH-780	MH-782	8	8		278	96.99	90.47	91.14	2.345	PVC	3.08	97.03	0.5	≤50%
P-785	MH-782	MH-784	8	8		85	90.47	89.85	90.52	0.729	PVC	3.86	90.51	0.5	≤50%
P-787	MH-784	MH-786	8	8		199	89.75	88.85	89.52	0.452	PVC	4.63	89.8	0.6	≤50%
P-789	MH-786	MH-788	8	8		298	88.8	88	88.67	0.268	PVC	5.40	88.86	0.7	≤50%
P-791	MH-788	MH-790	8	8		121	87.9	87.03	87.70	0.719	PVC	6.17	87.95	0.6	≤50%
P-793	MH-790	MH-792	8	8		85	86.93	86.55	87.22	0.447	PVC	6.94	86.99	0.7	≤50%
P-352	MH-350	MH-351	8	8		92	144	141.69	142.36	2.511	PVC	2.03	144.03	0.4	≤50%
P-354	MH-351	MH-353	8	8		201	141.61	133.61	134.28	3.98	PVC	4.06	141.65	0.5	≤50%
P-356	MH-353	MH-355	8	8		269	133.6	126.19	126.86	2.755	PVC	6.09	133.65	0.6	≤50%
P-358	MH-355	MH-357	8	8		187	126.15	120.57	121.24	2.984	PVC	8.12	126.21	0.7	≤50%
P-363	MH-362	MH-357	8	8		170	124.05	120.22	120.89	2.253	PVC	2.03	124.08	0.4	≤50%
P-360	MH-357	MH-359	8	8		142	120.26	116.05	116.72	2.965	PVC	12.18	120.33	0.8	≤50%
P-361	MH-359	MH-322	8	8		132	115.93	108.45	109.12	5.667	PVC	14.21	116.01	1.0	≤50%
P-366	MH-364	MH-365	8	8		221	142.26	134.78	135.45	3.385	PVC	2.03	142.29	0.4	≤50%
P-368	MH-365	MH-367	8	8		231	134.73	128.57	129.24	2.667	PVC	4.06	134.77	0.5	≤50%
P-369	MH-367	MH-322	8	8		207	128.57	108.47	109.14	9.71	PVC	6.09	128.62	0.6	≤50%
P-344	MH-342	MH-343	8	8		69	151.34	149.82	150.49	2.203	PVC	2.03	151.37	0.4	≤50%
P-346	MH-343	MH-345	8	8		264	149.65	134.49	135.16	5.742	PVC	4.06	149.69	0.5	≤50%
P-348	MH-345	MH-347	8	8		151	134.49	127.94	128.61	4.338	PVC	6.09	134.54	0.6	≤50%
P-349	MH-347	MH-318	8	8		227	127.84	109.89	110.56	7.907	PVC	8.12	127.9	0.7	≤50%
P-328	MH-326	MH-327	8	8		162	135.65	129.51	130.18	3.79	PVC	2.03	135.68	0.4	≤50%
P-330	MH-327	MH-329	8	8		78	129.35	127.37	128.04	2.538	PVC	4.06	129.39	0.5	≤50%
P-331	MH-329	MH-310	8	8		124	127.3	125.92	126.59	1.113	PVC	6.09	127.35	0.6	≤50%
P-309	MH-307	MH-308	8	8		90	143.9	141.24	141.91	2.956	PVC	2.03	143.93	0.4	≤50%
P-311	MH-308	MH-310	8	8		312	141.2	125.96	126.63	4.885	PVC	4.06	141.24	0.5	≤50%
P-313	MH-310	MH-312	8	8		282	125.74	116.72	117.39	3.199	PVC	12.18	125.81	0.8	≤50%
P-315	MH-312	MH-314	8	8		58	116.62	116.19	116.86	0.741	PVC	14.21	116.7	1.0	≤50%
P-317	MH-314	MH-316	8	8		189	116.14	113.49	114.16	1.402	PVC	16.25	116.23	1.1	≤50%
P-334	MH-332	MH-333	8	8		145	155.87	148.67	149.34	4.966	PVC	2.03	155.9	0.4	≤50%
P-336	MH-333	MH-335	8	8		223	148.6	134.6	135.27	6.278	PVC	4.06	148.64	0.5	≤50%
P-338	MH-335	MH-337	8	8		150	134.54	129.68	130.35	3.24	PVC	6.09	134.59	0.6	≤50%
P-340	MH-337	MH-339	8	8		206	129.66	118.75	119.42	5.296	PVC	8.12	129.72	0.7	≤50%
P-341	MH-339	MH-316	8	8		94	118.72	113.43	114.10	5.628	PVC	10.15	118.79	0.8	≤50%
P-319	MH-316	MH-318	8	8		227	113.26	109.89	110.56	1.485	PVC	28.43	113.37	1.3	≤50%
P-321	MH-318	MH-320	8	8		54	109.82	109.48	110.15	0.63	PVC	38.58	109.95	1.6	≤50%
P-323	MH-320	MH-322	8	8		220	109.45	108.34	109.01	0.505	PVC	40.61	109.6	1.8	≤50%

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Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-325	MH-322	MH-324	8	8		180	108.28	107.47	108.14	0.45	PVC	62.95	108.47	2.3	≤50%
P-687	MH-324	MH-1739	8	8		66	107.47	107.23	107.90	0.364	PVC	64.98	107.67	2.4	≤50%
P-1771	MH-1863	MH-1862	8	8		248	169.55	160.86	161.53	3.504	PVC	0.00	169.55	0.0	≤50%
P-1623	MH-1718	MH-1717	8	8		126	208.78	206.38	207.05	1.905	PVC	0.00	208.78	0.0	≤50%
P-1622	MH-1717	MH-1716	8	8		351	206.28	184.8	185.47	6.12	PVC	0.00	206.28	0.0	≤50%
P-1853	MH-1945	MH-1944	8	8		292	210.58	192.78	193.45	6.096	PVC	0.00	210.58	0.0	≤50%
P-1852	MH-1944	MH-1721	8	8		163	192.78	191.71	192.38	0.656	0	0.00	192.78	0.0	≤50%
P-1626	MH-1721	MH-1720	8	8		125	191.71	191.08	191.75	0.504	PVC	0.00	191.71	0.0	≤50%
P-1628	MH-1723	MH-1722	8	8		166	211.79	210.13	210.80	1	PVC	0.00	211.79	0.0	≤50%
P-1629	MH-1724	MH-1722	8	8		124	211.84	210.13	210.80	1.379	PVC	0.00	211.84	0.0	≤50%
P-1627	MH-1722	MH-1720	8	8		312	210.03	191.08	191.75	6.074	PVC	0.00	210.03	0.0	≤50%
P-1625	MH-1720	MH-1719	8	8		45	190.98	187.2	187.87	8.4	PVC	0.00	190.98	0.0	≤50%
P-1624	MH-1719	MH-1716	8	8		387	187.1	184.8	185.47	0.594	PVC	0.00	187.1	0.0	≤50%
P-1621	MH-1716	MH-1715	8	8		199	184.7	167.24	167.91	8.774	PVC	0.00	184.7	0.0	≤50%
P-1620	MH-1715	MH-1714	8	8		67	167.14	166.39	167.06	1.119	PVC	0.00	167.14	0.0	≤50%
P-645	MH-643	MH-644	8	8		196	169.21	167.81	168.48	0.714	PVC	6.54	169.27	0.7	≤50%
P-1618	MH-644	MH-1714	8	8		121	167.26	166.29	166.96	0.802	PVC	20.96	167.36	1.2	≤50%
P-1619	MH-1714	MH-646	8	12	SM12	131	166.19	165.55	166.55	0.489	PVC	20.96	166.82	7.6	66%
P-649	MH-646	MH-648	8	8		172	166.72	164.43	165.10	1.331	PVC	23.80	166.82	1.2	≤50%
P-669	MH-667	MH-668	8	8		113	199.97	196.79	197.46	2.814	PVC	2.84	200.01	0.5	≤50%
P-671	MH-668	MH-670	8	8		267	196.69	180.94	181.61	5.899	PVC	5.69	196.74	0.6	≤50%
P-673	MH-670	MH-672	8	8		124	180.84	172.51	173.18	6.718	PVC	8.53	180.9	0.7	≤50%
P-674	MH-672	MH-648	8	8		134	172.41	164.43	165.10	5.955	PVC	11.37	172.48	0.8	≤50%
P-651	MH-648	MH-650	8	8		244	164.33	162.57	163.24	0.721	PVC	38.01	164.46	1.6	≤50%
P-653(1)	MH-650	MH-1862	8	8		46	162.47	158.81	159.48	7.957	PVC	40.86	162.61	1.7	≤50%
P-653(2)	MH-1862	MH-652	8	8		194	162.47	158.81	159.48	1.887	PVC	40.86	162.61	1.7	≤50%
P-655	MH-652	MH-654	8	8		360	158.71	143.06	143.73	4.347	PVC	46.26	158.86	1.8	≤50%
P-657	MH-654	MH-656	8	8		89	142.96	140.35	141.02	2.933	PVC	49.10	143.11	1.8	≤50%
P-659(1)	MH-656	MH-1700	8	8		75	140.25	136.45	137.12	5.067	PVC	51.94	140.41	1.9	≤50%
P-659(2)	MH-1700	MH-658	8	8		73	140.25	136.45	137.12	5.205	PVC	51.94	140.41	1.9	≤50%
P-660	MH-658	MH-459	8	8		140	136.36	135.79	136.46	0.407	PVC	54.79	136.54	2.2	≤50%
P-627	MH-625	MH-626	8	8		400	143.5	139.83	140.50	0.917	PVC	2.84	143.54	0.5	≤50%
P-635	MH-633	MH-634	8	8		153	157.79	156.13	156.80	1.085	PVC	2.84	157.83	0.5	≤50%
P-637	MH-634	MH-636	8	8		348	156.04	146.32	146.99	2.793	PVC	5.69	156.09	0.6	≤50%
P-638	MH-636	MH-626	8	8		187	146.26	139.92	140.59	3.39	PVC	8.53	146.32	0.7	≤50%
P-629	MH-626	MH-628	8	8		86	139.75	136.93	137.60	3.279	PVC	14.21	139.83	1.0	≤50%
P-631	MH-628	MH-630	8	8		107	136.87	136.04	136.71	0.776	PVC	17.06	136.96	1.1	≤50%
P-632	MH-630	MH-457	8	12	SM4	104	135.99	135.25	136.25	0.712	PVC	19.90	136.6	7.3	64%
P-623	MH-621	MH-622	8	8		304	154.04	140.78	141.45	4.362	PVC	2.84	154.08	0.5	≤50%
P-624	MH-622	MH-453	8	8		78	140.62	137.71	138.38	3.731	PVC	5.69	140.67	0.6	≤50%
P-663	MH-661	MH-662	8	8		118	156.46	154.06	154.73	2.034	PVC	2.84	156.5	0.5	≤50%
P-665	MH-662	MH-664	8	8		374	153.96	144.93	145.60	2.414	PVC	5.69	154.01	0.6	≤50%
P-666	MH-664	MH-451	8	8		42	144.84	144.31	144.98	1.262	PVC	8.53	144.96	1.4	≤50%
P-613	MH-611	MH-612	6	6		14	163.36	161.87	162.37	10.643	PVC	2.84	163.4	0.5	≤50%
P-640	MH-639	MH-612	6	6		72	164.36	161.87	162.37	3.458	PVC	2.84	164.4	0.5	≤50%
P-615	MH-612	MH-614	8	8		239	161.77	154.19	154.86	3.172	PVC	8.53	161.83	0.7	≤50%
P-617	MH-614	MH-616	8	8		243	154.09	153.13	153.80	0.395	PVC	11.37	154.17	1.0	≤50%
P-642	MH-641	MH-616	8	8		110	159.22	153.13	153.80	5.536	PVC	2.84	159.26	0.5	≤50%
P-619	MH-616	MH-618	8	8		125	153.03	152.46	153.13	0.456	PVC	17.06	153.13	1.2	≤50%
P-620	MH-618	MH-447	8	8		128	152.36	149.04	149.71	2.594	PVC	19.90	152.46	1.2	≤50%
P-1823	MH-1919	MH-1918	12	12		400	158.52	157.52	158.52	0.25	PVC	0.00	158.52	0.0	≤50%
P-1848	MH-1940	MH-1914	8	8		166	175.57	171.65	172.32	2.361	PVC	0.00	175.57	0.0	≤50%
P-1818	MH-1914	MH-1911	8	8		180	171.65	167.4	168.07	2.361	PVC	0.00	171.65	0.0	≤50%
P-1815	MH-1911	MH-1910	8	8		36	167.4	158.13	158.80	25.75	PVC	0.00	167.4	0.0	≤50%
P-1830	MH-1925	MH-1924	8	8		142	186.01	183.03	183.70	2.099	PVC	0.00	186.01	0.0	≤50%
P-1829	MH-1924	MH-1923	8	8		25	183.03	182	182.67	4.12	PVC	0.00	183.03	0.0	≤50%
P-1828	MH-1923	MH-1921	8	8		124	182	179.6	180.27	1.935	PVC	0.00	182	0.0	≤50%
P-1827(2)	MH-1921	MH-1922	8	8		318	179.6	172.79	173.46	2.142	PVC	0.00	179.6	0.0	≤50%
P-1827(1)	MH-1922	MH-1909	8	8		57	172.79	171.4	172.07	2.439	PVC	0.00	172.79	0.0	≤50%
P-1812	MH-1907	MH-1908	8	8		41	172.43	171.99	172.66	1.073	PVC	0.00	172.43	0.0	≤50%
P-1813	MH-1908	MH-1909	8	8		98	171.99	171.4	172.07	0.602	PVC	0.00	171.99	0.0	≤50%
P-1814	MH-1909	MH-1910	8	8		261	171.4	158.13	158.80	5.084	PVC	0.00	171.4	0.0	≤50%
P-1819	MH-1915	MH-1912	8	8		122	159.83	159.06	159.73	0.631	PVC	0.00	159.83	0.0	≤50%
P-1842	MH-1937	MH-1936	8	8		70	167.1	165.45	166.12	2.357	PVC	0.00	167.1	0.0	≤50%
P-1839	MH-1933	MH-1934	8	8		297	180.75	178.87	179.54	0.633	PVC	0.00	180.75	0.0	≤50%
P-1840	MH-1934	MH-1935	8	8		322	178.87	166.92	167.59	3.711	PVC	0.00	178.87	0.0	≤50%

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= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1841	MH-1935	MH-1936	8	8		80	166.92	165.45	166.12	1.838	PVC	0.00	166.92	0.0	≤50%
P-1844	MH-1936	MH-1938	8	8		77	165.45	164.54	165.21	1.182	PVC	0.00	165.45	0.0	≤50%
P-1846	MH-1938	MH-1931	8	8		109	164.54	163.94	164.61	0.55	PVC	0.00	164.54	0.0	≤50%
P-1837	MH-1931	MH-1913	8	8		309	163.94	161.81	162.48	0.689	PVC	0.00	163.94	0.0	≤50%
P-1836	MH-1930	MH-1928	12	12		119	184.83	179.31	180.31	4.639	PVC	0.00	184.83	0.0	≤50%
P-1831	MH-1926	MH-1927	8	8		113	185.8	183.16	183.83	2.336	PVC	0.00	185.8	0.0	≤50%
P-1832	MH-1927	MH-1928	8	8		401	183.16	179.31	179.98	0.96	PVC	0.00	183.16	0.0	≤50%
P-1835	MH-1928	MH-1929	8	8		204	179.31	173.56	174.23	2.819	PVC	0.00	179.31	0.0	≤50%
P-1834	MH-1929	MH-1913	8	8		387	173.56	161.81	162.48	3.036	PVC	0.00	173.56	0.0	≤50%
P-1817	MH-1913	MH-1912	12	12		95	161.81	159.06	160.06	2.895	PVC	0.00	161.81	0.0	≤50%
P-1816	MH-1912	MH-1910	12	12		420	159.06	158.13	159.13	0.221	PVC	0.00	159.06	0.0	≤50%
P-1847	MH-1910	MH-1918	12	12		271	158.13	157.52	158.52	0.225	PVC	0.00	158.13	0.0	≤50%
P-1822	MH-1918	MH-1917	12	12		168	157.52	157.09	158.09	0.256	PVC	0.00	157.52	0.0	≤50%
P-1821	MH-1916	MH-1917	8	8		273	167.39	157.09	157.76	3.773	PVC	0.00	167.39	0.0	≤50%
P-1826	MH-1917	MH-1920	12	12		133	157.09	156.68	157.68	0.308	0	0.00	157.09	0.0	≤50%
P-1825	MH-1920	MH-600	12	12		32	156.68	156.62	157.62	0.188	PVC	0.00	156.71	0.4	≤50%
P-601	MH-599	MH-600	8	8		393	158.18	156.69	157.36	0.379	PVC	31.03	158.32	1.7	≤50%
P-603	MH-600	MH-602	8	8		158	156.59	154.76	155.43	1.158	PVC	33.87	156.71	1.4	≤50%
P-605	MH-602	MH-604	8	8		31	154.66	154.21	154.88	1.452	PVC	36.71	154.79	1.6	≤50%
P-607	MH-604	MH-606	8	8		28	154.11	152.05	152.72	7.357	PVC	39.56	154.24	1.6	≤50%
P-609	MH-606	MH-608	8	8		188	152.05	149.86	150.53	1.165	PVC	42.40	152.19	1.7	≤50%
P-610	MH-608	MH-445	8	8		41	149.86	149.66	150.33	0.488	PVC	45.24	150.04	2.2	≤50%
P-1768	MH-1858	MH-1857	8	8		144	204.01	203.29	203.96	0.5	PVC	0.00	204.01	0.0	≤50%
P-559	MH-557	MH-558	8	8		76	206.81	206.41	207.08	0.526	PVC	2.84	206.85	0.5	≤50%
P-561	MH-558	MH-560	8	8		400	206.41	204.57	205.24	0.46	PVC	5.69	206.47	0.7	≤50%
P-1851	MH-1943	MH-597	8	8		165	240.45	233.77	234.44	4.048	PVC	0.00	240.45	0.0	≤50%
P-1850	MH-1942	MH-1941	8	8		93	234.23	233.77	234.44	0.495	PVC	0.00	234.23	0.0	≤50%
P-1849	MH-1941	MH-597	8	8		129	233.67	223.05	223.72	8.233	PVC	0.00	233.67	0.0	≤50%
P-598	MH-597	MH-560	8	8		287	222.95	204.57	205.24	6.404	PVC	2.84	222.99	0.5	≤50%
P-589	MH-587	MH-588	8	8		168	234.47	214.64	215.31	11.804	PVC	2.84	234.51	0.5	≤50%
P-591	MH-588	MH-590	8	8		47	214.54	213.28	213.95	2.681	PVC	5.69	214.59	0.6	≤50%
P-593	MH-590	MH-592	8	8		210	213.18	209.06	209.73	1.962	PVC	8.53	213.24	0.7	≤50%
P-595	MH-592	MH-594	8	8		109	208.96	208.37	209.04	0.541	PVC	11.37	209.04	1.0	≤50%
P-596	MH-594	MH-560	8	8		80	208.27	204.57	205.24	4.625	PVC	14.21	208.35	1.0	≤50%
P-563(1)	MH-560	MH-1857	8	8		294	204.47	203.29	203.96	0.4	PVC	25.59	204.57	1.2	≤50%
P-563(2)	MH-1857	MH-562	8	8		52	203.19	202.98	203.65	0.4	PVC	25.59	203.3	1.3	≤50%
P-565	MH-562	MH-564	8	8		77	202.88	202.57	203.24	0.4	PVC	28.43	203.01	1.6	≤50%
P-567	MH-564	MH-566	8	8		375	202.47	200.97	201.64	0.4	PVC	31.27	202.61	1.7	≤50%
P-569	MH-566	MH-568	8	8		86	200.87	200.6	201.27	0.314	PVC	34.11	201.02	1.8	≤50%
P-571	MH-568	MH-570	8	8		288	200.5	199.35	200.02	0.399	PVC	36.96	200.65	1.8	≤50%
P-1693	MH-1786	MH-1785	8	8		213	255.4	254.54	255.21	0.4	PVC	0.00	255.4	0.0	≤50%
P-1692	MH-1785	MH-1784	8	8		46	254.54	254.36	255.03	0.4	PVC	0.00	254.54	0.0	≤50%
P-1691	MH-1784	MH-1783	8	8		160	254.36	253.72	254.39	0.4	PVC	0.00	254.36	0.0	≤50%
P-1690	MH-1783	MH-1782	8	8		68	253.72	253.45	254.12	0.4	PVC	0.00	253.72	0.0	≤50%
P-1689	MH-1782	MH-1781	8	8		122	253.45	252.96	253.63	0.4	PVC	0.00	253.45	0.0	≤50%
P-1688	MH-1781	MH-577	8	8		10	252.96	252.92	253.59	0.4	PVC	0.00	253	0.5	≤50%
P-579	MH-577	MH-578	8	8		240	252.92	241.07	241.74	4.938	PVC	13.00	253	1.0	≤50%
P-581	MH-578	MH-580	8	8		152	240.97	227.6	228.27	8.796	PVC	15.84	241.05	1.0	≤50%
P-586	MH-585	MH-580	8	8		174	233.68	227.6	228.27	3.494	PVC	2.84	233.72	0.5	≤50%
P-583	MH-580	MH-582	8	8		400	227.5	202.51	203.18	6.248	PVC	21.52	227.6	1.2	≤50%
P-584	MH-582	MH-570	8	8		57	202.41	199.45	200.12	5.193	PVC	24.37	202.52	1.3	≤50%
P-573	MH-570	MH-572	8	8		373	199.35	176.21	176.88	6.204	PVC	64.17	199.52	2.0	≤50%
P-575	MH-572	MH-574	8	8		281	176.11	173.45	174.12	0.947	PVC	67.01	176.29	2.2	≤50%
P-576	MH-574	MH-441	8	8		400	173.35	171.25	171.92	0.525	PVC	69.85	173.54	2.3	≤50%
P-1770	MH-1861	MH-1860	8	8		156	185.33	184.6	185.27	0.468	PVC	0.00	185.33	0.0	≤50%
P-1769	MH-1860	MH-1859	8	8		366	184.5	181.12	181.79	0.923	PVC	0.00	184.5	0.0	≤50%
P-539(2)	MH-1859	MH-538	8	8		193	181.02	179.99	180.66	0.534	PVC	0.00	181.02	0.0	≤50%
P-541	MH-538	MH-540	8	8		218	179.89	177.66	178.33	1.023	PVC	2.84	179.93	0.5	≤50%
P-543	MH-540	MH-542	8	8		58	177.56	177.25	177.92	0.534	PVC	5.69	177.62	0.7	≤50%
P-545	MH-542	MH-544	8	8		141	177.15	175.1	175.77	1.454	PVC	8.53	177.21	0.7	≤50%
P-547	MH-544	MH-546	8	8		324	175	172.2	172.87	0.864	PVC	11.37	175.07	0.8	≤50%
P-551	MH-549	MH-550	8	8		97	180.72	178.72	179.39	2.062	PVC	2.84	180.76	0.5	≤50%
P-553	MH-550	MH-552	8	8		148	178.62	177.73	178.40	0.601	PVC	5.69	178.67	0.6	≤50%
P-555	MH-552	MH-554	8	8		169	177.63	176.62	177.29	0.598	PVC	8.53	177.7	0.8	≤50%
P-556	MH-554	MH-546	8	8		278	176.52	172.2	172.87	1.554	PVC	11.37	176.59	0.8	≤50%
P-548	MH-546	MH-437	8	8		345	171.98	169.85	170.52	0.617	PVC	25.59	172.09	1.3	≤50%

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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-513	MH-511	MH-512	8	8		276	186.12	183.48	184.15	0.957	PVC	2.84	186.16	0.5	≤50%
P-515	MH-512	MH-514	8	8		382	183.18	181.06	181.73	0.555	PVC	5.69	183.24	0.7	≤50%
P-532	MH-531	MH-514	8	8		343	192.81	189.44	190.11	0.983	PVC	2.84	192.85	0.5	≤50%
P-517	MH-514	MH-516	8	8		166	180.95	179.74	180.41	0.729	PVC	11.37	181.02	0.8	≤50%
P-1429	MH-1428	MH-675	10	10		390	188.2	186.64	187.47	0.4	PVC	2.84	188.24	0.5	≤50%
P-676	MH-675	MH-516	10	10		164	186.18	179.89	180.72	3.835	PVC	5.69	186.23	0.6	≤50%
P-519	MH-516	MH-518	10	10		401	179.7	177.06	177.89	0.658	PVC	19.90	179.79	1.1	≤50%
P-520	MH-518	MH-431	10	10		399	176.97	174.58	175.41	0.599	PVC	22.74	177.07	1.2	≤50%
P-536	MH-535	MH-429	8	8		348	186.97	186.26	186.93	0.204	PVC	2.84	187.02	0.6	≤50%
P-530	MH-529	MH-524	8	8		101	190.75	181.73	182.40	8.931	PVC	2.84	190.79	0.5	≤50%
P-523	MH-521	MH-522	8	8		268	185.31	182.26	182.93	1.138	PVC	2.84	185.35	0.5	≤50%
P-525	MH-522	MH-524	8	8		65	182.16	181.63	182.30	0.815	PVC	5.69	182.21	0.6	≤50%
P-527	MH-524	MH-526	8	8		250	181.63	179.85	180.52	0.712	PVC	11.37	181.7	0.8	≤50%
P-528	MH-526	MH-427	8	8		249	179.75	177.61	178.28	0.859	PVC	14.21	179.83	1.0	≤50%
P-534	MH-533	MH-425	8	8		173	182.49	178.79	179.46	2.139	PVC	2.84	182.53	0.5	≤50%
P-1532	MH-1477	MH-703	8	8		325	197.73	196.43	197.10	0.4	PVC	2.84	197.77	0.5	≤50%
P-790	MH-703	MH-702	8	8		67	196.33	196.06	196.73	0.403	PVC	5.69	196.38	0.6	≤50%
P-1531	MH-702	MH-1475	8	8		256	195.96	194.94	195.61	0.398	PVC	8.53	196.02	0.7	≤50%
P-788	MH-701	MH-1476	8	8		183	205.13	203.15	203.82	1.082	PVC	2.84	205.17	0.5	≤50%
P-1530	MH-1476	MH-699	8	8		66	203.05	202.35	203.02	1.061	PVC	5.69	203.1	0.6	≤50%
P-786	MH-699	MH-1475	8	8		148	202.25	194.94	195.61	4.939	PVC	8.53	202.31	0.7	≤50%
P-803	MH-1481	MH-413	8	8		238	210.13	207.36	208.03	1.164	PVC	2.84	210.17	0.5	≤50%
P-1529	MH-413	MH-1475	8	8		235	207.26	194.94	195.61	5.243	PVC	5.69	207.31	0.6	≤50%
P-792	MH-1475	MH-417	8	8		186	194.84	194.1	194.77	0.398	PVC	25.59	194.95	1.3	≤50%
P-698	MH-417	MH-419	8	8		90	183.23	182.87	183.54	0.4	PVC	28.43	183.36	1.6	≤50%
P-694	MH-419	MH-421	8	8		192	182.77	181.92	182.59	0.443	PVC	31.27	182.9	1.6	≤50%
P-700	MH-421	MH-423	8	8		285	181.82	180.68	181.35	0.4	PVC	34.11	181.96	1.7	≤50%
P-706	MH-423	MH-425	8	8		400	180.58	178.79	179.46	0.448	PVC	36.96	180.72	1.7	≤50%
P-708	MH-425	MH-427	8	8		269	178.69	177.61	178.28	0.401	PVC	42.64	178.85	1.9	≤50%
P-710	MH-427	MH-429	8	8		308	177.51	176.16	176.83	0.438	PVC	59.70	177.69	2.2	≤50%
P-712	MH-429	MH-431	8	8		170	176.06	175.14	175.81	0.541	PVC	65.39	176.24	2.2	≤50%
P-715	MH-431	MH-433	10	10		372	174.51	172.5	173.33	0.54	PVC	90.97	174.71	2.4	≤50%
P-717	MH-433	MH-435	10	10		392	172.5	170.07	170.90	0.62	PVC	123.39	172.73	2.8	≤50%
P-718	MH-435	MH-437	10	10		91	170.02	169.7	170.53	0.352	PVC	126.23	170.28	3.1	≤50%
P-720	MH-437	MH-439	8	8		112	169.7	169.13	169.80	0.509	PVC	154.66	169.99	3.5	≤50%
P-722	MH-439	MH-441	8	8		175	169.13	167.9	168.57	0.703	PVC	157.50	169.41	3.4	≤50%
P-724	MH-441	MH-443	8	8		244	167.9	164.82	165.49	1.262	PVC	230.20	168.24	4.1	51%
P-726	MH-443	MH-445	8	8		280	164.72	157.16	157.83	2.7	PVC	233.04	165.06	4.1	51%
P-728	MH-445	MH-447	8	8		47	149.66	149.1	149.77	1.191	PVC	281.13	150.03	4.4	57%
P-729	MH-447	MH-449	8	8		217	149	145.9	146.57	1.429	PVC	303.87	149.39	4.7	61%
P-730	MH-449	MH-451	8	10	SM4	258	145.8	144.66	145.49	0.442	PVC	306.71	146.16	4.3	≤50%
P-732	MH-451	MH-453	8	8	SM4	308	144.56	137.93	138.60	2.153	PVC	318.09	144.96	4.8	63%
P-1776	MH-1868	MH-1867	8	8		30	142.07	141.93	142.60	0.467	PVC	0.00	142.21	1.7	≤50%
P-1775	MH-1867	MH-1866	8	8		188	141.93	141.07	141.74	0.457	PVC	163.11	142.21	3.4	≤50%
P-1774	MH-1866	MH-1865	8	8		290	141.07	139.69	140.36	0.476	PVC	163.11	141.35	3.4	≤50%
P-1773	MH-1865	MH-1864	8	8		138	139.56	138.87	139.54	0.5	PVC	163.11	139.84	3.4	≤50%
P-1772	MH-1864	MH-453	8	8		68	138.82	138.47	139.14	0.515	PVC	163.11	139.1	3.4	≤50%
P-733	MH-453	MH-455	8	10	SM4	265	137.93	136.8	137.63	0.426	PVC	489.72	138.39	5.5	57%
P-736	MH-455	MH-457	8	10	SM4	175	136.7	136.1	136.93	0.343	PVC	492.57	137.19	5.9	61%
P-737	MH-457	MH-459	8	10	SM4	51	136.1	135.92	136.75	0.353	PVC	515.31	136.6	6.0	63%
P-1657	MH-459	MH-1751	12	12		323	135.69	134.64	135.64	0.325	PVC	592.39	136.19	6.0	≤50%
P-1656	MH-1751	MH-1750	12	12		204	134.64	131.6	132.60	1.49	PVC	592.39	135.13	5.9	≤50%
P-1655	MH-1750	MH-1749	12	12		222	131.13	126.79	127.79	1.955	PVC	592.39	131.62	5.9	≤50%
P-1654	MH-1749	MH-1748	12	12		237	126.61	120.78	121.78	2.46	PVC	592.39	127.1	5.9	≤50%
P-1653	MH-1748	MH-1747	12	12		29	120.66	119.4	120.40	4.345	PVC	592.39	121.15	5.9	≤50%
P-1652	MH-1747	MH-1746	12	12		157	119.29	116.44	117.44	1.815	PVC	592.39	119.78	5.9	≤50%
P-1651	MH-1746	MH-1745	12	12		308	116.33	111.05	112.05	1.714	PVC	592.39	116.82	5.9	≤50%
P-1650	MH-1745	MH-1744	12	12		113	110.86	109.73	110.73	1	PVC	592.39	111.35	5.9	≤50%
P-1649	MH-1744	MH-1743	12	12		146	109.6	108.85	109.85	0.514	PVC	592.39	110.09	5.9	≤50%
P-1648	MH-1743	MH-1742	12	12		121	108.85	107.8	108.80	0.868	PVC	592.39	109.34	5.9	≤50%
P-1646	MH-1742	MH-1741	15	15		8	107.7	107.65	108.90	0.625	PVC	592.39	108.15	5.4	≤50%
P-1606(1)(1)(1)(2)	MH-1741	MH-1739	15	15		53	107.55	107.23	108.48	0.604	PVC	592.39	108	5.4	≤50%
P-1606(1)(1)(2)	MH-1739	MH-1738	15	15		6	107.13	107.1	108.35	0.5	PVC	657.37	107.61	5.8	≤50%
P-1606(1)(2)	MH-1738	MH-1737	15	15		172	107	105.98	107.23	0.593	PVC	657.37	107.48	5.8	≤50%
P-1606(2)	MH-1737	MH-1703	15	15		315	105.88	103.99	105.24	0.6	PVC	657.37	106.36	5.8	≤50%
P-1607	MH-1703	MH-1704	15	15		128	103.89	103.12	104.37	0.602	PVC	657.37	104.37	5.8	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
10-Year (2034) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1608	MH-1704	MH-1705	15	15		220	103.02	101.7	102.95	0.6	PVC	657.37	103.5	5.8	≤50%
P-1609	MH-1705	MH-1706	15	15		341	101.6	99.55	100.80	0.601	PVC	657.37	102.08	5.8	≤50%
P-1610	MH-1706	MH-1707	15	15		63	99.45	99.07	100.32	0.603	PVC	657.37	99.93	5.8	≤50%
P-1611(1)(1)	MH-1707	MH-1972	15	15		142	98.97	98.1	99.35	0.613	PVC	657.37	99.45	5.8	≤50%
P-1611(1)(2)	MH-1972	MH-1736	15	15		172	98.97	98.1	99.35	0.506	PVC	657.37	99.45	5.8	≤50%
P-1611(2)	MH-1736	MH-1708	15	15		67	98.1	94.69	95.94	5.09	PVC	657.37	98.58	5.8	≤50%
P-1612	MH-1708	MH-1709	12	12		16	92.69	90.73	91.73	12.25	PVC	678.38	93.21	6.2	53%
P-1613	MH-1709	MH-1710	12	12		104	90.63	90.18	91.18	0.433	PVC	678.38	91.15	6.2	53%
P-1614	MH-1710	MH-1711	12	12		58	90.08	89.87	90.87	0.362	PVC	678.38	90.6	6.2	53%
P-1615	MH-1711	MH-1712	12	12		65	89.77	89.49	90.49	0.431	PVC	678.38	90.29	6.2	53%
P-1616	MH-1712	MH-792	12	12		246	89.39	88.41	89.41	0.398	PVC	678.38	89.91	6.2	53%
P-795	MH-792	MH-794	10	12	SM1	309	86.28	85.19	86.19	0.353	PVC	686.09	86.81	6.4	54%
P-796	MH-794	MH-741	10	12	SM1	297	85.11	84.31	85.31	0.269	PVC	700.11	85.7	7.1	61%
P-744	MH-741	MH-743	10	12	SM1	237	84.1	83.26	84.26	0.354	PVC	888.79	84.73	7.6	66%
P-746	MH-743	MH-745	10	15	SM1	252	83.18	82.48	83.73	0.278	PVC	889.56	83.77	7.1	≤50%
P-748	MH-745	MH-747	10	15	SM1	243	82.4	81.84	83.09	0.23	PVC	918.28	83.03	7.6	51%
P-800	MH-747	MH-799	10	15	SM1	173	81.74	81.25	82.50	0.283	PVC	924.45	82.34	7.2	≤50%
P-1750	MH-799	MH-1839	12	12	SM1	18	81.07	80.98	81.98	0.5	PVC	926.76	81.68	7.3	64%
P-1751	MH-1839	MH-1840	12	12	SM1	42	80.88	80.68	81.68	0.476	PVC	926.76	81.49	7.3	64%
P-1752	MH-1840	MH-1760	12	12	SM1	298	80.58	79.09	80.09	0.5	PVC	926.76	81.19	7.3	64%
P-848	MH-846	MH-847	8	8		53	82.12	81.71	82.38	0.774	PVC	0.77	82.14	0.2	≤50%
P-850	MH-847	MH-849	8	8		136	81.71	71.09	71.76	7.809	PVC	1.54	81.74	0.4	≤50%
P-852	MH-849	MH-851	8	8		65	80.95	80.69	81.36	0.4	PVC	2.31	80.99	0.5	≤50%
P-853	MH-851	MH-803	8	8		324	80.59	79.29	79.96	0.401	PVC	3.08	80.63	0.5	≤50%
P-861(2)	MH-803	MH-1760	15	15		16	79.09	78.95	80.20	0.875	PVC	3.86	79.49	4.8	≤50%
P-863	MH-862	MH-855	8	8		100	81.5	81.15	81.82	0.35	PVC	14.10	81.6	1.2	≤50%
P-856	MH-854	MH-855	8	8		149	81.7	81.15	81.82	0.369	PVC	0.77	81.72	0.2	≤50%
P-858	MH-855	MH-857	8	8		150	81.15	80.36	81.03	0.527	PVC	15.64	81.24	1.1	≤50%
P-860	MH-857	MH-859	8	8		66	80.36	79.83	80.50	0.803	PVC	16.42	80.45	1.1	≤50%
P-861(1)	MH-859	MH-1760	8	8		52	79.58	79.32	79.99	0.5	PVC	17.19	79.68	1.2	≤50%
P-1666	MH-1760	MH-1758	15	15		355	78.91	77.43	78.68	0.417	PVC	947.80	79.49	7.0	≤50%
P-1665	MH-1758	MH-1757	15	15		165	72.77	70.54	71.79	1.352	PVC	947.80	73.35	7.0	≤50%
P-1664	MH-1757	MH-1756	15	15		278	70.44	69.26	70.51	0.424	PVC	947.80	71.02	7.0	≤50%
P-1663	MH-1756	MH-1755	15	15		400	69.16	67.46	68.71	0.425	PVC	947.80	69.74	7.0	≤50%
P-1662	MH-1755	MH-1754	15	15		400	67.36	65.66	66.91	0.425	PVC	947.80	67.94	7.0	≤50%
P-1660	MH-1754	MH-711	15	15		23	65.65	65.56	66.81	0.391	PVC	947.80	66.23	7.0	≤50%
P-845	MH-844	MH-811	8	8		276	68.3	66.85	67.52	0.525	PVC	0.77	68.32	0.2	≤50%
P-808	MH-805	MH-807	8	8		285	79.06	77.63	78.30	0.502	PVC	0.77	79.08	0.2	≤50%
P-870	MH-868	MH-869	8	8		138	82.98	81.93	82.60	0.761	PVC	0.77	83	0.2	≤50%
P-871	MH-869	MH-807	8	8		281	81.83	76.84	77.51	1.776	PVC	1.54	81.86	0.4	≤50%
P-810	MH-807	MH-809	8	8		300	77.53	68.78	69.45	2.917	PVC	3.08	77.57	0.5	≤50%
P-812	MH-809	MH-811	8	8		155	68.1	66.85	67.52	0.806	PVC	12.27	68.17	0.8	≤50%
P-1538	MH-811	MH-711	15	15		37	65.75	65.56	66.81	0.514	PVC	13.81	66.04	3.5	≤50%
P-801	MH-711	MH-1480	15	15		252	65.46	64.21	65.46	0.496	PVC	962.39	66.04	7.0	≤50%
P-1537	MH-1480	MH-709	15	15		249	64.1	61.73	62.98	0.952	PVC	995.41	64.69	7.1	≤50%
P-799	MH-709	MH-1479	15	15		398	61.63	55.94	57.19	1.43	PVC	996.14	62.22	7.1	≤50%
P-1536	MH-1479	MH-1444	15	18	SM11	19	55.84	55.74	57.24	0.526	PVC	996.87	56.7	10.3	59%
P-1446	MH-1444	MH-1436	12	15	SM11	114	56.11	55.4	56.65	0.623	PVC	997.60	56.71	7.2	≤50%
P-1440	MH-1436	MH-817	12	15	SM11	16	55.3	55.25	56.50	0.312	PVC	998.33	55.91	7.3	≤50%
P-820	MH-817	MH-819	12	15	SM8	175	55.15	54.68	55.93	0.269	PVC	999.06	55.78	7.6	51%
P-874	MH-872	MH-873	8	8		160	114	106.35	107.02	4.781	PVC	0.73	114.02	0.2	≤50%
P-891	MH-890	MH-873	8	8		313	109.05	106.35	107.02	0.863	PVC	0.73	109.07	0.2	≤50%
P-876	MH-873	MH-875	8	8		310	106.25	94.71	95.38	3.723	PVC	2.19	106.28	0.4	≤50%
P-894	MH-892	MH-893	8	8		144	102	96.51	97.18	3.813	PVC	0.73	102.02	0.2	≤50%
P-895	MH-893	MH-875	8	8		330	96.41	94.71	95.38	0.515	PVC	1.46	96.44	0.4	≤50%
P-878	MH-875	MH-877	8	8		186	94.61	86.76	87.43	4.22	PVC	4.39	94.65	0.5	≤50%
P-880	MH-877	MH-879	8	8		255	86.66	58.71	59.38	10.961	PVC	5.12	86.71	0.6	≤50%
P-889	MH-888	MH-879	8	8		160	60.28	58.71	59.38	0.981	PVC	0.73	60.3	0.2	≤50%
P-882	MH-879	MH-881	8	8		112	58.61	56.75	57.42	1.661	PVC	6.58	58.66	0.6	≤50%
P-886	MH-884	MH-885	8	8		300	60.5	58.23	58.90	0.757	PVC	0.73	60.52	0.2	≤50%
P-887	MH-885	MH-881	8	8		273	58.13	56.75	57.42	0.505	PVC	1.46	58.16	0.4	≤50%
P-883	MH-881	MH-819	8	8		140	56.65	55.01	55.68	1.171	PVC	8.77	56.71	0.7	≤50%
P-822	MH-819	MH-821	12	15	SM8	302	54.58	53.51	54.76	0.354	PVC	1,008.57	55.18	7.2	≤50%
P-1431	MH-821	MH-1430	12	15	SM8	301	53.41	52.33	53.58	0.359	PVC	1,160.07	54.05	7.7	52%
P-1659	MH-1430	MH-1752	15	18	SM11	297	52.23	51.79	53.29	0.148	PVC	1,160.80	52.97	8.9	≤50%
P-1673	MH-1752	MH-1766	15	15		27	51.69	51.47	52.72	0.815	PVC	1,160.80	52.33	7.7	52%

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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe DS Crown El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1672	MH-1766	MH-1765	15	15		178	51.37	49.73	50.98	0.921	PVC	1,160.80	52.01	7.7	52%
P-1671	MH-1765	MH-1764	15	15		154	49.63	48.25	49.50	0.896	PVC	1,160.80	50.27	7.7	52%
P-1670	MH-1764	MH-1763	15	15		154	48.15	46.73	47.98	0.922	PVC	1,160.80	48.79	7.7	52%
P-1669	MH-1763	MH-707	15	15		154	46.63	45.22	46.47	0.916	PVC	1,160.80	47.27	7.7	52%
P-908	MH-907	MH-905	8	8		208	110	102.67	103.34	3.524	PVC	0.73	110.02	0.2	≤50%
P-904	MH-902	MH-903	8	8		103	105	104	104.67	0.971	PVC	0.73	105.02	0.2	≤50%
P-906	MH-903	MH-905	8	8		122	103.9	102.67	103.34	1.008	PVC	1.46	103.93	0.4	≤50%
P-911	MH-909	MH-910	8	8		91	113	109	109.67	4.396	PVC	0.73	113.02	0.2	≤50%
P-912	MH-910	MH-905	8	8		474	108.9	102.65	103.32	1.319	PVC	1.46	108.93	0.4	≤50%
P-914	MH-905	MH-913	8	8		135	102.55	101.85	102.52	0.519	PVC	4.39	102.6	0.6	≤50%
P-916	MH-913	MH-915	8	8		338	101.75	85.11	85.78	4.923	PVC	5.12	101.8	0.6	≤50%
P-924	MH-922	MH-923	8	8		148	104.5	98.1	98.77	4.324	PVC	0.73	104.52	0.2	≤50%
P-926	MH-923	MH-925	8	8		107	98	92.1	92.77	5.514	PVC	1.46	98.03	0.4	≤50%
P-927	MH-925	MH-915	8	8		212	92	85.11	85.78	3.25	PVC	2.19	92.03	0.4	≤50%
P-918	MH-915	MH-917	8	8		163	85.01	71.6	72.27	8.227	PVC	8.04	85.07	0.7	≤50%
P-920	MH-917	MH-919	8	8		81	71.5	66.18	66.85	6.568	PVC	8.77	71.56	0.7	≤50%
P-921	MH-919	MH-831	8	8		190	66.08	45.52	46.19	10.821	PVC	9.51	66.15	0.8	≤50%
P-898	MH-896	MH-897	8	8		165	65.5	63.1	63.77	1.455	PVC	0.73	65.52	0.2	≤50%
P-900	MH-897	MH-899	8	8		217	63	59	59.67	1.843	PVC	1.46	63.03	0.4	≤50%
P-901	MH-899	MH-827	8	8		131	58.9	48.33	49.00	8.069	PVC	2.19	58.93	0.4	≤50%
P-828	MH-825	MH-827	8	8		246	50.37	48.23	48.90	0.87	PVC	0.73	50.39	0.2	≤50%
P-830	MH-827	MH-829	8	8		42	48.23	47.76	48.43	1.119	PVC	3.66	48.27	0.5	≤50%
P-832	MH-829	MH-831	8	8		300	47.71	45.52	46.19	0.73	PVC	4.39	47.76	0.6	≤50%
P-1535	MH-831	MH-707	15	15		38	45.42	45.22	46.47	0.526	PVC	14.62	45.77	4.2	≤50%
P-1534	MH-707	MH-1478	15	15		393	45.12	38.98	40.23	1.562	PVC	1,176.16	45.77	7.8	53%
P-794	MH-1478	MH-705	15	15		412	38.88	32.71	33.96	1.498	PVC	1,176.89	39.53	7.8	53%
P-1533	MH-705	MH-837	18	18		64	32.17	32	33.50	0.266	PVC	1,178.59	32.8	7.6	≤50%
P-840	MH-837	MH-839	10	18	SM5	239	31.9	28.41	29.91	1.46	PVC	1,187.08	32.52	7.4	≤50%
P-842	MH-839	MH-841	10	18	SM5	116	28.32	27.63	29.13	0.595	PVC	1,189.20	28.94	7.4	≤50%
P-1668	MH-841	MH-1762	18	18		45	27.6	27.45	28.95	0.337	PVC	1,191.32	28.22	7.4	≤50%
P-699	MH-697	MH-698	8	8		351	113	105.3	105.97	2.194	PVC	2.12	113.03	0.4	≤50%
P-701	MH-698	MH-700	8	8		426	105.2	103.2	103.87	0.469	Concrete	4.24	105.25	0.6	≤50%
P-702	MH-700	MH-692	8	8		442	103.1	80.1	80.77	5.204	Concrete	6.37	103.15	0.6	≤50%
P-693	MH-691	MH-692	8	8		190	99.5	80.2	80.87	10.158	Concrete	2.44	99.53	0.4	≤50%
P-703	MH-692	MH-1473	8	8		164	80	71.3	71.97	5.305	Concrete	10.93	80.07	0.8	≤50%
P-696	MH-694	MH-1473	8	8		224	82.5	71.2	71.87	5.045	Concrete	2.12	82.53	0.4	≤50%
P-705(1)	MH-1473	MH-1762	8	8		330	71.1	32.83	33.50	11.597	Concrete	15.17	71.18	1.0	≤50%
P-1667	MH-1762	MH-1761	18	18		51	27.35	27.18	28.68	0.333	PVC	1,206.49	27.97	7.4	≤50%
P-707(2)	MH-1761	MH-706	18	18		303	27.08	26.02	27.52	0.35	PVC	1,206.49	27.7	7.4	≤50%
P-709	MH-706	MH-708	18	18		233	25.92	25.11	26.61	0.348	PVC	1,208.61	26.54	7.4	≤50%
P-711	MH-708	MH-710	15	15		59	25.01	24.59	25.84	0.712	PVC	1,210.74	25.67	7.9	54%
P-713	MH-710	MH-712	15	15		363	24.49	22.22	23.47	0.625	PVC	1,212.86	25.15	7.9	54%
P-714	MH-712	MH-71	15	15		376	22.12	19.77	21.02	0.625	PVC	1,251.74	22.79	8.0	55%
P-749	MH-71	MH-1391	12	18	SM3	144	19.67	10.5	12.00	6.368	PVC	1,888.51	20.46	9.5	53%
P-1392	MH-1391	MH-1375	12	18	SM3	76	10.4	5.14	6.64	6.921	PVC	1,890.75	11.19	9.5	53%
P-1389	MH-1375	MH-1374	18	18	SM3	440	4.94	-2.16	-0.66	1.614	PVC	2,692.73	5.89	11.4	67%
P-1388	MH-1374	MH-1373	24	24		162	-2.26	-4.29	-2.29	1.253	PVC	2,694.98	-1.39	10.4	≤50%
P-1387	MH-1373	MH-1372	27	27		150	-4.49	-4.51	-2.26	0.013	PVC	2,697.22	-3.15	16.1	62%
P-1386	MH-1372	MH-1371	27	27		409	-4.51	-4.66	-2.41	0.037	PVC	2,699.46	-3.25	15.1	58%
P-1385	MH-1371	MH-1370	27	27		151	-4.76	-5.08	-2.83	0.212	PVC	2,703.49	-3.88	10.6	≤50%
P-1384	MH-1370	MH-1369	27	27		325	-5.08	-5.46	-3.21	0.117	PVC	2,707.53	-4.04	12.5	≤50%
P-1383	MH-1369	MH-1368	27	27		302	-5.46	-5.89	-3.64	0.142	PVC	2,711.56	-4.46	12.0	≤50%
P-1382	MH-1368	MH-1367	27	27		371	-5.89	-6.21	-3.96	0.086	PVC	2,715.60	-4.78	13.3	≤50%
P-1381	MH-1367	MH-1366	27	27		302	-6.31	-6.75	-4.50	0.146	PVC	2,719.63	-5.33	11.8	≤50%
P-1380	MH-1366	MH-1365	27	27		599	-6.85	-7.55	-5.30	0.117	PVC	2,723.67	-5.8	12.6	≤50%
P-704	MH-1365	MH-1364	27	27		89	-7.65	-7.98	-5.73	0.371	PVC	2,727.70	-6.7	11.4	≤50%
P-1378	MH-1364	MH-1363	27	27		263	-7.98	-8.01	-5.76	0.011	PVC	2,731.73	-6.65	16.0	62%
P-1377	MH-1363	MH-1362	27	27		230	-8.01	-8.2	-5.95	0.083	PVC	2,735.77	-6.91	13.2	≤50%
P-1641	MH-1362	WW-MAIN	24	24		23	-8.4	-8.8	-6.80	1.739	Ductile Iron	2,739.80	-7.53	10.4	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1784	MH-1878	MH-1879	8	8		161	137.88	134.41	2.155	PVC	0.00	137.88	0.0	≤50%
P-1785	MH-1879	MH-1880	8	8		200	134.31	130.85	1.73	PVC	0.00	134.31	0.0	≤50%
P-1786	MH-1880	MH-1881	8	8		200	130.75	128.93	0.91	PVC	0.00	130.75	0.0	≤50%
P-1787	MH-1881	MH-1882	8	8		142	128.83	127.4	1.007	PVC	0.00	128.83	0.0	≤50%
P-1788	MH-1882	MH-1877	8	8		217	127.28	125.58	0.783	PVC	0.00	127.28	0.0	≤50%
P-1782	MH-1876	MH-1877	8	8		371	134.3	125.58	2.35	PVC	0.00	134.3	0.0	≤50%
P-1783	MH-1877	MH-1874	8	8		122	125.58	124.94	0.525	PVC	0.00	125.58	0.0	≤50%
P-1777	MH-1870	MH-1871	8	8		66	135.03	133.42	2.439	PVC	0.00	135.03	0.0	≤50%
P-1778	MH-1871	MH-1872	8	8		169	133.34	129.04	2.544	PVC	0.00	133.34	0.0	≤50%
P-1779	MH-1872	MH-1873	8	8		144	128.94	125.65	2.285	PVC	0.00	128.94	0.0	≤50%
P-1780	MH-1873	MH-1874	8	8		69	125.55	124.94	0.884	PVC	0.00	125.55	0.0	≤50%
P-1781	MH-1874	MH-1875	8	8		283	124.84	123.18	0.587	PVC	0.00	124.84	0.0	≤50%
P-1875	MH-1875	WW-10	8	8		10	123	123	0	PVC	0.00	123	0.0	≤50%
P-390	MH-389	MH-387	12	12		58	125.59	125.21	0.655	PVC	52.47	125.73	1.7	≤50%
P-493	MH-491	MH-492	8	8		282	191.11	182.09	3.199	PVC	1.03	191.13	0.2	≤50%
P-495	MH-492	MH-494	8	8		282	181.98	180.01	0.699	PVC	2.06	182.01	0.4	≤50%
P-497	MH-494	MH-496	8	8		150	179.94	179	0.627	PVC	3.09	179.98	0.5	≤50%
P-499	MH-496	MH-498	8	8		230	178.93	174.07	2.113	PVC	4.12	178.97	0.5	≤50%
P-500	MH-498	MH-474	8	8		260	173.93	158.13	6.077	PVC	5.14	173.98	0.6	≤50%
P-467	MH-465	MH-466	8	8		112	179.62	178.85	0.688	PVC	1.03	179.64	0.2	≤50%
P-469	MH-466	MH-468	8	8		239	178.85	171.09	3.247	PVC	2.06	178.88	0.4	≤50%
P-471	MH-468	MH-470	8	8		293	170.92	160.08	3.7	PVC	3.09	170.96	0.5	≤50%
P-473	MH-470	MH-472	8	8		159	159.94	159.08	0.541	PVC	4.12	159.99	0.6	≤50%
P-475	MH-472	MH-474	8	8		146	159.03	158.19	0.575	PVC	5.14	159.08	0.6	≤50%
P-477	MH-474	MH-476	8	8		359	157.88	156.37	0.421	PVC	11.32	157.96	1.0	≤50%
P-479	MH-476	MH-478	8	8		71	156.21	155.85	0.507	PVC	12.35	156.29	1.0	≤50%
P-481	MH-478	MH-480	8	8		180	155.85	155.15	0.389	PVC	13.37	155.94	1.1	≤50%
P-483	MH-480	MH-482	8	8		64	155.02	154.72	0.469	PVC	14.40	155.11	1.1	≤50%
P-485	MH-482	MH-484	8	8		69	154.72	152.33	3.464	PVC	15.43	154.8	1.0	≤50%
P-487	MH-484	MH-486	8	8		244	152.33	146.91	2.221	PVC	16.46	152.42	1.1	≤50%
P-489	MH-486	MH-488	12	12		256	146.6	138.64	3.109	PVC	17.49	146.68	1.0	≤50%
P-490	MH-488	MH-383	12	12		193	138.5	131.82	3.461	PVC	18.52	138.58	1.0	≤50%
P-372	MH-370	MH-371	8	8		78	230.75	224.6	7.885	PVC	1.03	230.77	0.2	≤50%
P-374	MH-371	MH-373	8	8		278	224.43	201.79	8.144	PVC	2.06	224.46	0.4	≤50%
P-376	MH-373	MH-375	8	8		301	201.7	196.85	1.611	PVC	3.09	201.74	0.5	≤50%
P-394	MH-393	MH-375	8	8		128	197.93	196.75	0.922	PVC	1.03	197.95	0.2	≤50%
P-378	MH-375	MH-377	8	8		249	196.72	179.76	6.811	PVC	5.14	196.77	0.6	≤50%
P-380	MH-377	MH-379	8	8		267	179.56	155.67	8.948	PVC	6.17	179.61	0.6	≤50%
P-382	MH-379	MH-381	8	8		147	155.55	139.74	10.755	PVC	7.20	155.61	0.7	≤50%
P-410	MH-409	MH-406	8	8		350	165.94	161.08	1.389	PVC	1.03	165.96	0.2	≤50%
P-412	MH-411	MH-402	8	8		145	198.2	193.94	2.938	PVC	1.03	198.22	0.2	≤50%
P-397	MH-395	MH-396	8	8		106	226.27	221.56	4.443	PVC	1.03	226.29	0.2	≤50%
P-399	MH-396	MH-398	8	8		106	221.36	216.32	4.755	PVC	2.06	221.39	0.4	≤50%
P-401	MH-398	MH-400	8	8		81	216.08	212.33	4.63	PVC	3.09	216.12	0.5	≤50%
P-403	MH-400	MH-402	8	8		399	212.21	194.02	4.559	PVC	4.12	212.25	0.5	≤50%
P-405	MH-402	MH-404	8	8		327	193.84	179.16	4.489	PVC	6.17	193.89	0.6	≤50%
P-407	MH-404	MH-406	8	8		338	179.02	161.08	5.308	PVC	7.20	179.08	0.7	≤50%
P-408	MH-406	MH-381	8	8		387	161	139.74	5.494	PVC	9.26	161.06	0.7	≤50%
P-384	MH-381	MH-383	12	12		219	139.43	131.82	3.475	PVC	17.49	139.51	1.0	≤50%
P-386	MH-383	MH-385	12	12		20	131.66	131.33	1.65	PVC	37.04	131.78	1.4	≤50%
P-388	MH-385	MH-387	12	12		62	131.26	125.21	9.758	PVC	37.04	131.38	1.4	≤50%
P-685	MH-387	WW-COPPER	30	30		23	125.12	122.5	11.391	PVC	89.51	125.26	1.7	≤50%
P-719	MH-717	MH-718	8	8		32	79.2	79	0.625	PVC	1.52	79.23	0.4	≤50%
P-721	MH-718	MH-720	8	8		33	79	78.72	0.848	PVC	3.04	79.04	0.5	≤50%
P-723	MH-720	MH-722	8	8		104	78.71	77.97	0.712	PVC	4.56	78.76	0.6	≤50%
P-725	MH-722	MH-724	8	8		64	77.87	77.29	0.906	PVC	12.58	77.95	1.0	≤50%
P-731	MH-724	MH-730	8	8		20	76.31	74.48	9.15	PVC	14.10	76.39	1.0	≤50%
P-734	MH-732	MH-733	8	8		325	76.9	75.6	0.4	PVC	49.03	77.07	2.0	≤50%
P-735	MH-733	MH-730	8	8		256	75.5	74.48	0.398	PVC	50.55	75.78	3.4	≤50%
P-691	MH-730	WW-LINDSTROM	30	30		1	74.48	74.46	2	PVC	66.17	75.76	15.4	52%
P-1455	MH-1450	MH-1451	6	6		105	45.71	40.8	4.676	PVC	1.52	45.74	0.4	≤50%
P-1469	MH-1451	MH-1467	8	8		50	40.7	40.2	1	PVC	3.04	40.74	0.5	≤50%
P-1456	MH-1449	MH-1448	8	8		246	53.16	35.4	7.22	PVC	1.52	53.19	0.4	≤50%
P-1457	MH-1448	MH-1447	8	8		157	35.3	34.51	0.503	PVC	3.04	35.34	0.5	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1458	MH-1447	MH-1454	8	8		104	34.41	33.93	0.462	PVC	4.56	34.46	0.6	≤50%
P-1459	MH-1454	MH-1453	8	8		91	33.83	33.37	0.505	PVC	6.08	33.89	0.7	≤50%
P-1460	MH-1453	MH-1452	8	8		36	33.27	33.09	0.5	PVC	7.60	33.34	0.8	≤50%
P-1468	MH-1452	MH-1467	8	8		52	32.99	32.47	1	PVC	9.12	33.05	0.7	≤50%
P-689	MH-1467	WW-TAYLOR	30	30		1	32.47	32	47	PVC	13.67	32.53	0.7	≤50%
P-1130	MH-1129	MH-1127	8	8		228	99.66	95.7	1.737	PVC	2.31	99.69	0.4	≤50%
P-1128	MH-1127	MH-1125	8	8		268	95.6	76.5	7.127	PVC	4.62	95.65	0.6	≤50%
P-1132	MH-1131	MH-1125	8	8		143	80.16	76.5	2.559	PVC	2.31	80.19	0.4	≤50%
P-1126	MH-1125	MH-1123	8	8		202	76.4	52.18	11.99	PVC	9.24	76.46	0.7	≤50%
P-1124	MH-1123	MH-1121	8	8		194	52.08	35.89	8.345	PVC	11.56	52.15	0.8	≤50%
P-1122	MH-1121	MH-1119	8	8		397	35.79	31.06	1.191	PVC	13.87	35.87	1.0	≤50%
P-1120	MH-1119	MH-1117	8	8		410	30.96	27.27	0.9	PVC	16.18	31.05	1.1	≤50%
P-1106	MH-1104	MH-1105	8	8		251	100.83	100.03	0.319	PVC	2.31	100.87	0.5	≤50%
P-771	MH-1648	MH-686	8	8		174	114	106.68	4.207	PVC	2.31	114.03	0.4	≤50%
P-1524	MH-686	MH-1105	8	8		285	106.58	103.56	1.06	PVC	4.62	106.63	0.6	≤50%
P-1108	MH-1105	MH-1107	8	8		264	99.93	98.45	0.561	PVC	9.24	100	0.8	≤50%
P-1110	MH-1107	MH-1109	8	8		182	98.35	97.31	0.571	PVC	11.56	98.43	1.0	≤50%
P-1112	MH-1109	MH-1111	8	8		237	97.21	92.31	2.068	PVC	13.87	97.29	1.0	≤50%
P-1114	MH-1111	MH-1113	8	8		313	92.21	75.59	5.31	PVC	16.18	92.3	1.1	≤50%
P-1116	MH-1113	MH-1115	8	8		289	75.58	38.31	12.896	PVC	18.49	75.67	1.1	≤50%
P-1118	MH-1115	MH-1117	8	8		50	38.21	27.27	21.88	PVC	20.80	38.31	1.2	≤50%
P-1138	MH-1117	MH-1134	8	8		126	27.17	26.21	0.762	PVC	39.29	27.3	1.6	≤50%
P-1135	MH-1133	MH-1134	8	8		212	26.93	26.21	0.34	PVC	97.62	27.18	3.0	≤50%
P-1137	MH-1134	MH-1136	8	8		34	26.11	26	0.324	PVC	139.22	26.42	3.7	≤50%
P-682	MH-1136	WW-PIONEER	30	30		88	26	22	4.545	PVC	141.53	26.18	2.2	≤50%
P-1291	MH-1289	MH-1290	6	6		140	0	-0.89	0.636	PVC	12.62	0.08	1.0	≤50%
P-1677	MH-1770	MH-1769	8	8		200	1.19	0.39	0.4	PVC	7.75	1.25	0.7	≤50%
P-1676	MH-1769	MH-1290	8	8		298	0.29	-0.89	0.396	PVC	7.75	0.35	0.7	≤50%
P-1292	MH-1290	MH-1276	8	8	SM6	330	-0.99	-6.99	1.818	PVC	23.74	-0.89	1.2	≤50%
P-1319	MH-1317	MH-1318	8	8		209	-0.02	-0.88	0.411	Asbestos Cement	3.37	0.03	0.6	≤50%
P-1321	MH-1318	MH-1320	8	8		202	-0.88	-1.48	0.297	Asbestos Cement	6.73	-0.81	0.8	≤50%
P-1323	MH-1320	MH-1322	8	8		126	-1.48	-1.92	0.349	Asbestos Cement	10.10	-1.4	1.0	≤50%
P-1325	MH-1322	MH-1324	8	8		317	-1.92	-3.01	0.344	Asbestos Cement	13.47	-1.83	1.1	≤50%
P-1327	MH-1324	MH-1326	8	8		272	-3.01	-4.06	0.386	Asbestos Cement	16.83	-2.91	1.2	≤50%
P-1330	MH-1329	MH-1326	8	8		230	-3.13	-4.06	0.404	Asbestos Cement	3.37	-3.08	0.6	≤50%
P-1328	MH-1326	MH-1270	8	8		374	-4.06	-5.5	0.385	Asbestos Cement	23.57	-3.94	1.4	≤50%
P-1316	MH-1315	MH-1268	8	8		263	0.12	-0.92	0.395	Asbestos Cement	3.37	0.17	0.6	≤50%
P-1312	MH-1311	MH-1262	8	8		197	-1.75	-5.89	2.102	Asbestos Cement	3.37	-1.71	0.5	≤50%
P-1309	MH-1307	MH-1308	8	8		341	-0.48	-2.64	0.633	Asbestos Cement	3.37	-0.44	0.5	≤50%
P-1310	MH-1308	MH-1262	8	8		29	-2.64	-5.89	11.207	Asbestos Cement	6.73	-2.59	0.6	≤50%
P-1306	MH-1305	MH-1260	8	8		316	-1.76	-3.4	0.519	Asbestos Cement	3.37	-1.72	0.5	≤50%
P-1298	MH-1297	MH-1258	8	8		383	-0.58	-2.53	0.509	Asbestos Cement	3.37	-0.54	0.5	≤50%
P-1296	MH-1295	MH-1258	8	8		341	-1.54	-2.53	0.29	Asbestos Cement	3.37	-1.49	0.6	≤50%
P-1294	MH-1293	MH-1256	8	8		339	0.28	-1.38	0.49	Asbestos Cement	3.37	0.32	0.5	≤50%
P-1257	MH-1255	MH-1256	8	8		376	0.79	-0.38	0.311	Asbestos Cement	3.37	0.84	0.6	≤50%
P-1259	MH-1256	MH-1258	8	8		290	-1.38	-2.53	0.397	Asbestos Cement	10.10	-1.3	1.0	≤50%
P-1261	MH-1258	MH-1260	8	8		284	-2.53	-3.4	0.306	Asbestos Cement	20.20	-2.41	1.4	≤50%
P-1301	MH-1299	MH-1300	8	8		237	-0.93	-1.93	0.422	Asbestos Cement	3.37	-0.88	0.6	≤50%
P-1303	MH-1300	MH-1302	8	8		139	-1.93	-2.33	0.288	Asbestos Cement	6.73	-1.86	0.8	≤50%
P-1304	MH-1302	MH-1260	8	8		341	-2.4	-3.4	0.293	Asbestos Cement	10.10	-2.32	1.0	≤50%
P-1263	MH-1260	MH-1262	8	8		170	-3.4	-3.89	0.288	Asbestos Cement	37.04	-3.24	1.9	≤50%
P-1265	MH-1262	MH-1264	8	8		122	-3.89	-4.25	0.295	Asbestos Cement	50.50	-3.7	2.3	≤50%
P-1267	MH-1264	MH-1266	8	8		38	-4.25	-4.41	0.421	Asbestos Cement	53.87	-4.07	2.2	≤50%
P-1269	MH-1266	MH-1268	8	8		110	-4.41	-4.74	0.3	Asbestos Cement	57.24	-4.21	2.4	≤50%
P-1314	MH-1313	MH-1268	8	8		357	0.21	-4.74	1.387	Asbestos Cement	3.37	0.25	0.5	≤50%
P-1271	MH-1268	MH-1270	8	8		262	-4.74	-5.54	0.305	Asbestos Cement	67.34	-4.53	2.5	≤50%
P-1273	MH-1270	MH-1272	8	8		119	-5.54	-5.95	0.345	Asbestos Cement	94.27	-5.29	3.0	≤50%
P-1332	MH-1331	MH-1272	8	8		390	-4.3	-5.95	0.423	PVC	3.37	-4.25	0.6	≤50%
P-1275	MH-1272	MH-1274	8	8	SM6	143	-5.95	-6.47	0.364	Asbestos Cement	101.01	-5.7	3.0	≤50%
P-1277	MH-1274	MH-1276	8	8	SM6	199	-6.47	-6.99	0.261	Asbestos Cement	152.91	-6.12	4.2	53%
P-1279	MH-1276	MH-1278	8	8	SM6	302	-6.99	-7.89	0.298	Asbestos Cement	180.02	-6.61	4.6	59%
P-1287	MH-1285	MH-1286	8	8		242	-1.93	-3.35	0.587	Asbestos Cement	3.37	-1.89	0.5	≤50%
P-1288	MH-1286	MH-1278	8	8		291	-3.35	-4.64	0.443	Asbestos Cement	6.73	-3.29	0.7	≤50%
P-1281	MH-1278	MH-1280	8	8	SM6	128	-7.89	-8.25	0.281	Asbestos Cement	190.12	-7.49	4.8	63%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1283	MH-1280	MH-1282	8	8	SM2	393	-8.25	-9.45	0.305	Asbestos Cement	193.48	-7.86	4.7	61%
P-1284	MH-1282	MH-1206	8	8	SM2	38	-9.45	-9.62	0.447	Asbestos Cement	196.85	-9.1	4.2	53%
P-1247	MH-1245	MH-1246	8	8		121	-1.63	-2.16	0.438	Asbestos Cement	1.40	-1.6	0.4	≤50%
P-1249	MH-1246	MH-1248	8	8		112	-2.36	-2.8	0.393	Asbestos Cement	2.80	-2.32	0.5	≤50%
P-1251	MH-1248	MH-1250	8	8		313	-2.8	-4.05	0.399	Asbestos Cement	4.20	-2.75	0.6	≤50%
P-1253	MH-1250	MH-1252	8	8		318	-4.05	-5.29	0.39	Asbestos Cement	5.60	-3.99	0.7	≤50%
P-1254	MH-1252	MH-1200	8	8		152	-5.39	-7.16	1.164	Asbestos Cement	7.00	-5.33	0.7	≤50%
P-1528	MH-696	MH-695	8	8		258	2.23	-3.93	2.388	PVC	1.40	2.26	0.4	≤50%
P-782	MH-695	MH-1472	10	10		222	-4.03	-4.93	0.405	PVC	2.80	-3.99	0.5	≤50%
P-1527	MH-1472	MH-693	10	10		225	-5.03	-5.93	0.4	PVC	4.20	-4.99	0.5	≤50%
P-1526	MH-693	MH-1471	10	10		115	-6.03	-6.6	0.496	PVC	5.60	-5.98	0.6	≤50%
P-1244	MH-1243	MH-1194	8	8		109	0.09	-1.89	1.817	Asbestos Cement	1.40	0.12	0.4	≤50%
P-1242	MH-1241	MH-1192	8	8		112	0.28	-3.84	3.679	Asbestos Cement	1.40	0.31	0.4	≤50%
P-1235	MH-1233	MH-1234	8	8		240	1	-0.9	0.792	Asbestos Cement	1.40	1.03	0.4	≤50%
P-1239	MH-1237	MH-1238	8	8		238	4	1.1	1.218	Asbestos Cement	1.40	4.03	0.4	≤50%
P-1240	MH-1238	MH-1234	8	8		158	1	-0.9	1.203	Asbestos Cement	2.80	1.04	0.5	≤50%
P-1236	MH-1234	MH-1190	8	8		164	-1	-2.96	1.195	Asbestos Cement	5.60	-0.95	0.6	≤50%
P-1231	MH-1229	MH-1230	8	8		193	-0.42	-1.24	0.425	Asbestos Cement	1.40	-0.39	0.4	≤50%
P-1232	MH-1230	MH-1188	8	8		210	-1.24	-2.08	0.4	Asbestos Cement	2.80	-1.2	0.5	≤50%
P-1185	MH-1183	MH-1184	8	8		300	0.65	-1.1	0.583	Asbestos Cement	16.30	0.74	1.1	≤50%
P-1187	MH-1184	MH-1186	6	6		234	-1.1	-1.21	0.047	PVC	17.70	-0.91	2.3	≤50%
P-1227	MH-1225	MH-1226	8	8		206	0.26	-0.5	0.369	PVC	1.40	0.29	0.4	≤50%
P-1228	MH-1226	MH-1186	8	8		200	-0.58	-1.21	0.315	Corrugated HDPE (Smooth Interior)	2.80	-0.53	0.6	≤50%
P-1189	MH-1186	MH-1188	8	8		287	-1.21	-2.08	0.303	Asbestos Cement	21.90	-1.09	1.4	≤50%
P-1191	MH-1188	MH-1190	8	8		288	-2.08	-2.96	0.306	Asbestos Cement	95.11	-1.82	3.1	≤50%
P-1193	MH-1190	MH-1192	8	8		307	-2.96	-3.84	0.287	Asbestos Cement	102.11	-2.69	3.2	≤50%
P-1195	MH-1192	MH-1194	12	12		305	-4.44	-5.77	0.436	Asbestos Cement	104.91	-4.23	2.5	≤50%
P-1197	MH-1194	MH-1196	12	12		83	-5.77	-6.16	0.47	Asbestos Cement	107.71	-5.56	2.5	≤50%
P-1525	MH-1196	MH-1471	12	12		60	-6.16	-6.6	0.733	Concrete	109.11	-5.96	2.4	≤50%
P-778	MH-1471	MH-1198	12	12		344	-6.7	-7.61	0.265	Concrete	116.11	-6.45	3.0	≤50%
P-1201	MH-1198	MH-1200	12	12		115	-7.61	-8.16	0.478	Asbestos Cement	117.51	-7.39	2.6	≤50%
P-1203	MH-1200	MH-1202	12	12	SM2	174	-8.16	-8.84	0.391	Asbestos Cement	125.91	-7.92	2.9	≤50%
P-1205	MH-1202	MH-1204	12	12	SM2	107	-8.84	-9.26	0.393	Asbestos Cement	127.31	-8.6	2.9	≤50%
P-1215	MH-1213	MH-1214	6	6		125	1.5	-0.07	1.256	PVC	1.40	1.53	0.4	≤50%
P-1222	MH-1221	MH-1214	6	6		36	3.82	-0.07	10.806	PVC	1.40	3.85	0.4	≤50%
P-1217	MH-1214	MH-1216	8	8		196	-0.17	-0.95	0.398	PVC	4.20	-0.12	0.6	≤50%
P-1219	MH-1216	MH-1218	8	8		283	-1.05	-2.39	0.473	PVC	5.60	-0.99	0.7	≤50%
P-1220	MH-1218	MH-1204	8	8		56	-2.49	-2.76	0.482	PVC	7.00	-2.43	0.7	≤50%
P-1207	MH-1204	MH-1206	12	12	SM2	229	-9.26	-10.15	0.389	Asbestos Cement	135.71	-9.01	3.0	≤50%
P-1209	MH-1206	MH-1208	15	15	SM2	388	-10.28	-11.02	0.191	Asbestos Cement	335.08	-9.84	5.3	≤50%
P-1757	MH-1846	MH-1845	8	8		96	-0.39	-0.77	0.396	PVC	0.00	-0.39	0.0	≤50%
P-1756	MH-1845	MH-1843	8	8		46	-0.87	-1.05	0.391	PVC	0.00	-0.87	0.0	≤50%
P-1755	MH-1844	MH-1843	8	8		172	-0.36	-1.05	0.401	PVC	0.00	-0.36	0.0	≤50%
P-1754	MH-1843	MH-1842	8	8		128	-1.15	-1.66	0.398	PVC	0.00	-1.15	0.0	≤50%
P-1753	MH-1842	MH-1223	8	8		41	-1.66	-1.93	0.659	PVC	0.00	-1.66	0.0	≤50%
P-1224	MH-1223	MH-1208	8	8		324	-2.56	-4.66	0.648	Asbestos Cement	2.52	-2.52	0.5	≤50%
P-1211	MH-1208	MH-1210	15	15	SM2	365	-11.02	-11.68	0.181	Asbestos Cement	340.13	-10.57	5.4	≤50%
P-1212	MH-1210	MH-99	14	14	SM2	313	-11.68	-13.2	0.486	PVC	342.65	-11.33	4.2	≤50%
P-1169	MH-1168	MH-1166	8	8		83	-2	-4.1	2.53	PVC	5.24	-1.95	0.6	≤50%
P-1167	MH-1166	MH-1164	8	8		234	-4	-6.1	0.897	PVC	10.48	-3.93	0.8	≤50%
P-1163	MH-1161	MH-1162	8	8		197	1	-2.1	1.574	PVC	5.24	1.05	0.6	≤50%
P-1165	MH-1162	MH-1164	8	8		246	-2	-6.1	1.667	PVC	10.48	-1.93	0.8	≤50%
P-1170	MH-1164	MH-95	8	8		367	-6	-10.76	1.297	PVC	26.20	-5.89	1.3	≤50%
P-1639	MH-1732	MH-1731	8	8		115	3.23	2.71	0.452	PVC	0.00	3.23	0.0	≤50%
P-1638	MH-1731	MH-1730	8	8		139	2.61	1.99	0.446	PVC	0.00	2.61	0.0	≤50%
P-1637	MH-1730	MH-1729	8	8		188	1.89	0.93	0.511	PVC	0.00	1.89	0.0	≤50%
P-1636	MH-1729	MH-1141	8	8		128	0.83	0.18	0.508	PVC	0.00	0.83	0.0	≤50%
P-1142(1)	MH-1141	MH-1983	8	8		201	-4	-6.14	1.065	PVC	5.24	-3.94	0.7	≤50%
P-1142(2)	MH-1983	MH-87	8	8		164	-4	-6.14	1.305	PVC	5.24	-3.95	0.6	≤50%
P-1885	MH-1982	MH-1981	8	8		230	3.8	1.4	1.043	PVC	0.00	3.8	0.0	≤50%
P-1884	MH-1981	MH-1980	8	8		155	1.4	-3.46	3.135	PVC	0.00	1.4	0.0	≤50%
P-1883	MH-1980	MH-87	8	8		15	-3.46	-4.11	4.333	PVC	0.00	-3.46	0.0	≤50%
P-950	MH-948	MH-949	8	8		364	-0.39	-1.85	0.401	Asbestos Cement	2.91	-0.35	0.5	≤50%
P-951	MH-949	MH-943	8	8		140	-1.85	-2.41	0.4	Asbestos Cement	5.82	-1.79	0.7	≤50%

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2025 General Sewer Plan
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20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1882	MH-1979	MH-1978	8	8		196	-0.07	-2.03	1	PVC	0.00	-0.07	0.0	≤50%
P-1881	MH-1978	MH-941	8	8		60	-2.13	-4.73	4.333	PVC	0.00	-2.13	0.0	≤50%
P-954	MH-952	MH-953	8	8		102	-2.68	-3.09	0.402	Asbestos Cement	2.91	-2.64	0.5	≤50%
P-955	MH-953	MH-939	8	8		52	-3.09	-3.27	0.346	Asbestos Cement	5.82	-3.03	0.7	≤50%
P-938	MH-936	MH-937	6	6		73	0	-1.9	2.603	PVC	2.91	0.04	0.5	≤50%
P-940	MH-937	MH-939	8	8		153	-1.9	-3.27	0.895	PVC	5.82	-1.85	0.6	≤50%
P-942	MH-939	MH-941	8	8		372	-3.27	-4.78	0.406	Asbestos Cement	14.56	-3.18	1.1	≤50%
P-944	MH-941	MH-943	8	8		284	-4.78	-5.91	0.398	Asbestos Cement	17.47	-4.68	1.2	≤50%
P-945	MH-943	MH-83	8	8		157	-5.91	-6.43	0.331	PVC	28.53	-5.79	1.4	≤50%
P-1643	MH-1733	MH-1037	10	10		45	-2.08	-2.19	0.24	PVC	0.00	-2.08	0.0	≤50%
P-1038	MH-1037	MH-1035	10	10		100	-2.29	-2.51	0.22	PVC	2.91	-2.25	0.5	≤50%
P-739	MH-1035	MH-1393	10	10		50	-2.61	-2.72	0.22	PVC	5.82	-2.55	0.7	≤50%
P-747	MH-1393	MH-75	8	8		187	-2.82	-4.53	0.914	Concrete	8.73	-2.76	0.7	≤50%
P-751	MH-676	MH-75	12	12		206	-1	-4.43	1.665	PVC	2.91	-0.97	0.4	≤50%
P-78	MH-75	MH-77	14	14		253	-4.53	-5.51	0.387	Asbestos Cement	14.56	-4.46	0.8	≤50%
P-80	MH-77	MH-79	14	14		363	-5.51	-6.29	0.215	Cast iron	17.47	-5.41	1.2	≤50%
P-82	MH-79	MH-81	14	14		409	-6.29	-6.72	0.105	Asbestos Cement	20.38	-6.17	1.4	≤50%
P-947	MH-946	MH-81	8	8		186	-4.52	-6.37	0.995	Asbestos Cement	5.24	-4.47	0.6	≤50%
P-84	MH-81	MH-83	14	14		132	-6.72	-7.12	0.303	Asbestos Cement	30.86	-6.61	1.3	≤50%
P-86	MH-83	MH-85	14	14		297	-7.12	-7.95	0.279	Asbestos Cement	64.62	-6.96	1.9	≤50%
P-88	MH-85	MH-87	14	14		323	-7.95	-8.58	0.195	Asbestos Cement	69.86	-7.76	2.3	≤50%
P-1140	MH-1139	MH-87	8	8		152	-4.25	-6.14	1.243	PVC	5.24	-4.2	0.6	≤50%
P-90	MH-87	MH-89	14	14		343	-8.27	-9.07	0.233	Asbestos Cement	85.58	-8.07	2.4	≤50%
P-92	MH-89	MH-91	14	14		342	-9.07	-10.11	0.304	Asbestos Cement	90.82	-8.88	2.3	≤50%
P-1145	MH-1143	MH-1144	8	8		201	-2.18	-4.18	0.995	PVC	5.24	-2.13	0.6	≤50%
P-1335	MH-1144	MH-1333	8	8		300	-4.28	-7.28	1	PVC	10.48	-4.21	0.8	≤50%
P-1160	MH-1159	MH-1156	6	6		61	2.7	2.3	0.656	PVC	5.24	2.97	3.2	55%
P-1157	MH-1155	MH-1156	6	6		54	5	2.88	3.926	PVC	5.24	5.05	0.6	≤50%
P-1158	MH-1156	MH-1150	6	6		118	2.88	-1.92	4.068	PVC	15.72	2.97	1.1	≤50%
P-1151	MH-1149	MH-1150	8	8		145	-0.52	-1.92	0.966	PVC	5.24	-0.47	0.6	≤50%
P-1338	MH-1150	MH-1336	8	8		209	-2.02	-4.18	1.033	PVC	26.20	-1.91	1.3	≤50%
P-1337	MH-1336	MH-1333	8	8		301	-4.28	-7.28	0.997	PVC	31.44	-4.16	1.4	≤50%
P-1334	MH-1333	MH-1146	8	8		98	-7.38	-8.13	0.765	PVC	47.16	-7.23	1.8	≤50%
P-1148	MH-1146	MH-91	8	8		268	-8.5	-9.48	0.366	Asbestos Cement	52.40	-8.32	2.2	≤50%
P-94	MH-91	MH-93	14	14		284	-10.11	-10.32	0.074	Asbestos Cement	148.46	-9.76	4.2	≤50%
P-1347	MH-93	MH-95	14	14		167	-10.48	-10.76	0.168	Asbestos Cement	153.70	-10.19	3.5	≤50%
P-695	MH-95	MH-97	14	14		152	-10.76	-11.33	0.375	Asbestos Cement	185.14	-10.5	3.1	≤50%
P-100	MH-97	MH-99	14	14		291	-11.33	-12.08	0.258	Asbestos Cement	190.38	-11.04	3.5	≤50%
P-102	MH-99	MH-101	20	20	SM2	245	-13.2	-13.29	0.037	Asbestos Cement	538.27	-12.39	9.7	≤50%
P-1173	MH-1171	MH-1172	8	8		176	0.3	-0.49	0.449	PVC	5.24	0.36	0.7	≤50%
P-1175	MH-1172	MH-1174	8	8		272	-0.59	-1.82	0.452	PVC	10.48	-0.51	1.0	≤50%
P-1177	MH-1174	MH-1176	8	8		205	-1.92	-2.85	0.454	PVC	15.72	-1.83	1.1	≤50%
P-1179	MH-1176	MH-1178	8	8		358	-2.95	-4.46	0.422	PVC	20.96	-2.84	1.3	≤50%
P-1181	MH-1178	MH-1180	8	8		229	-4.41	-5.76	0.59	Asbestos Cement	26.20	-4.3	1.3	≤50%
P-1873	MH-1966	MH-1967	6	6		216	-2.51	-4.67	1	PVC	0.00	-2.51	0.0	≤50%
P-1874	MH-1967	MH-1180	6	6		13	-4.67	-5.08	3.154	PVC	0.00	-4.67	0.0	≤50%
P-1182	MH-1180	MH-101	12	12		267	-5.61	-8.03	0.906	PVC	31.44	-5.5	1.3	≤50%
P-681	MH-101	WW-MAIN	20	20		27	-13.35	-13	-1.296	Cast iron	574.95	-12.44	10.9	56%
P-958	MH-956	MH-957	8	8		363	146	141	1.377	PVC	6.93	146.06	0.7	≤50%
P-960	MH-957	MH-959	8	8		265	140.9	134.4	2.453	PVC	13.87	140.98	1.0	≤50%
P-962	MH-959	MH-961	8	8		185	134.3	116.3	9.73	PVC	20.80	134.4	1.2	≤50%
P-964	MH-961	MH-963	8	8		122	116.2	99.2	13.934	PVC	27.73	116.31	1.3	≤50%
P-966	MH-963	MH-965	8	8		185	99.1	90.1	4.865	PVC	34.67	99.23	1.6	≤50%
P-968	MH-965	MH-967	8	8		144	90	87.11	2.007	PVC	41.60	90.14	1.7	≤50%
P-1017	MH-1015	MH-1016	8	8		366	140.2	125.2	4.098	PVC	6.93	140.26	0.7	≤50%
P-1019	MH-1016	MH-1018	8	8		182	125.1	114.1	6.044	PVC	13.87	125.18	1.0	≤50%
P-1022	MH-1021	MH-1018	8	8		139	116	114.1	1.367	PVC	6.93	116.06	0.7	≤50%
P-1020	MH-1018	MH-967	8	8		157	114	90.11	15.217	PVC	27.73	114.11	1.3	≤50%
P-970	MH-967	MH-969	8	8		96	87.01	80.01	7.292	PVC	76.27	87.2	2.3	≤50%
P-972	MH-969	MH-971	8	8		83	79.91	72.91	8.434	PVC	83.20	80.11	2.4	≤50%
P-974	MH-971	MH-973	8	8		69	72.81	68.81	5.797	PVC	90.13	73.02	2.5	≤50%
P-976	MH-973	MH-975	8	8		106	68.71	68.31	0.377	Concrete	97.07	68.96	3.0	≤50%
P-1024	MH-1023	MH-975	8	8		120	74.08	68.21	4.892	Concrete	6.93	74.14	0.7	≤50%
P-978	MH-975	MH-977	8	8		291	68.11	50.88	5.921	Concrete	110.93	68.34	2.8	≤50%

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Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-980	MH-977	MH-979	8	8		170	50.78	44.86	3.482	Concrete	117.87	51.02	2.9	≤50%
P-1027	MH-1025	MH-1026	8	8		215	60.8	47.9	6	Concrete	6.93	60.86	0.7	≤50%
P-1028	MH-1026	MH-979	8	8		115	47.8	44.86	2.557	Concrete	13.87	47.88	1.0	≤50%
P-982	MH-979	MH-981	8	8		154	44.76	34.76	6.494	Concrete	138.67	45.02	3.1	≤50%
P-776	MH-1470	MH-690	8	8		347	178.04	177.39	0.187	PVC	3.47	178.09	0.6	≤50%
P-775	MH-690	MH-1469	8	8		187	177.29	171.88	2.893	PVC	6.93	177.35	0.7	≤50%
P-774	MH-1469	MH-688	8	8		164	171.83	167.32	2.75	PVC	10.40	171.9	0.8	≤50%
P-772	MH-688	MH-1092	8	8		105	167.17	163.64	3.362	PVC	13.87	167.25	1.0	≤50%
P-1094	MH-1092	MH-1093	8	8		156	163.51	160	2.25	PVC	17.33	163.6	1.1	≤50%
P-1096	MH-1093	MH-1095	8	8		319	159.9	130.9	9.091	PVC	20.80	160	1.2	≤50%
P-1098	MH-1095	MH-1097	8	8		105	130.9	129.22	1.6	PVC	24.27	131.01	1.3	≤50%
P-1100	MH-1097	MH-1099	8	8		112	129.12	125.24	3.464	PVC	27.73	129.23	1.3	≤50%
P-1102	MH-1099	MH-1101	8	8		399	125.14	112.58	3.148	PVC	31.20	125.26	1.4	≤50%
P-1103	MH-1101	MH-1056	8	8		358	112.48	104.79	2.148	PVC	34.67	112.61	1.6	≤50%
P-1087	MH-1086	MH-1070	8	8		138	131.21	130.56	0.471	PVC	3.47	131.26	0.6	≤50%
P-1085	MH-1084	MH-1072	8	8		270	148.87	147.53	0.496	PVC	3.47	148.92	0.6	≤50%
P-1083	MH-1082	MH-1080	8	8		180	171.73	168.38	1.861	PVC	3.47	171.77	0.5	≤50%
P-1081	MH-1080	MH-1078	8	8		89	168.28	163.87	4.955	PVC	6.93	168.34	0.7	≤50%
P-1079	MH-1078	MH-1076	8	8		217	163.77	154.86	4.106	PVC	10.40	163.84	0.8	≤50%
P-1077	MH-1076	MH-1074	8	8		95	154.76	152.33	2.558	PVC	13.87	154.84	1.0	≤50%
P-1075	MH-1074	MH-1072	8	8		119	152.23	147.53	3.95	PVC	17.33	152.32	1.1	≤50%
P-1073	MH-1072	MH-1070	8	8		284	147.43	130.56	5.94	PVC	24.27	147.54	1.3	≤50%
P-1071	MH-1070	MH-1068	8	8		104	130.46	126.87	3.452	PVC	31.20	130.58	1.4	≤50%
P-1069	MH-1068	MH-1066	8	8		111	126.77	121.45	4.793	PVC	34.67	126.9	1.6	≤50%
P-1863	MH-1956	MH-1955	8	8		394	175.88	156.83	4.835	PVC	0.00	175.88	0.0	≤50%
P-1862	MH-1955	MH-1954	8	8		250	156.83	146.9	3.972	PVC	0.00	156.83	0.0	≤50%
P-1861	MH-1954	MH-1947	8	8		250	146.9	129.45	6.98	PVC	0.00	146.9	0.0	≤50%
P-1860	MH-1953	MH-1952	8	8		203	156.88	147.16	4.788	PVC	0.00	156.88	0.0	≤50%
P-1859	MH-1952	MH-1951	8	8		87	147.16	134.79	14.218	PVC	0.00	147.16	0.0	≤50%
P-1871	MH-1964	MH-1965	8	8		349	165.55	151.38	4.06	PVC	0.00	165.55	0.0	≤50%
P-1872	MH-1965	MH-1961	8	8		105	151.38	148.98	2.286	PVC	0.00	151.38	0.0	≤50%
P-1864	MH-1957	MH-1958	8	8		256	180.86	179.46	0.547	PVC	0.00	180.86	0.0	≤50%
P-1865	MH-1958	MH-1959	8	8		235	179.46	169.65	4.174	PVC	0.00	179.46	0.0	≤50%
P-1866	MH-1959	MH-1960	8	8		86	169.65	162.15	8.721	PVC	0.00	169.65	0.0	≤50%
P-1867	MH-1960	MH-1961	8	8		133	162.15	148.98	9.902	PVC	0.00	162.15	0.0	≤50%
P-1868	MH-1961	MH-1962	8	8		202	148.98	136.29	6.282	PVC	0.00	148.98	0.0	≤50%
P-1869	MH-1962	MH-1963	8	8		153	136.29	135.4	0.582	PVC	0.00	136.29	0.0	≤50%
P-1870	MH-1963	MH-1951	8	8		98	135.4	134.79	0.622	PVC	0.00	135.4	0.0	≤50%
P-1858	MH-1951	MH-1950	8	8		96	134.79	134.19	0.625	PVC	0.00	134.79	0.0	≤50%
P-1857	MH-1950	MH-1949	8	8		107	134.19	133.53	0.617	PVC	0.00	134.19	0.0	≤50%
P-1856	MH-1949	MH-1948	8	8		255	133.53	132.14	0.545	PVC	0.00	133.53	0.0	≤50%
P-1855	MH-1948	MH-1947	8	8		256	132.14	129.45	1.051	PVC	0.00	132.14	0.0	≤50%
P-1854	MH-1947	MH-1088	8	8		169	129.45	123.09	3.763	PVC	0.00	129.45	0.0	≤50%
P-1089	MH-1088	MH-1066	8	8		357	123.26	121.48	0.499	PVC	29.52	123.39	1.6	≤50%
P-1067	MH-1066	MH-1064	8	8		161	121.38	117.66	2.311	PVC	67.66	121.56	2.2	≤50%
P-1065	MH-1064	MH-1062	8	8		119	111.09	109.72	1.151	PVC	71.12	111.27	2.2	≤50%
P-1091	MH-1090	MH-1062	8	8		149	111.09	109.72	0.919	PVC	3.47	111.13	0.5	≤50%
P-1063	MH-1062	MH-1060	8	8		108	109.62	108.05	1.454	PVC	78.06	109.81	2.3	≤50%
P-1061	MH-1060	MH-1058	8	8		200	107.95	105.78	1.085	PVC	81.52	108.15	2.4	≤50%
P-1059	MH-1058	MH-1056	8	8		182	105.68	104.79	0.489	PVC	84.99	105.89	2.5	≤50%
P-1057	MH-1056	MH-1054	8	8		262	104.69	103.41	0.489	PVC	123.12	104.95	3.1	≤50%
P-1055	MH-1054	MH-1052	8	8		293	103.3	101.95	0.461	PVC	126.59	103.57	3.2	≤50%
P-1053	MH-1052	MH-1050	8	8		309	101.85	97.5	1.408	PVC	130.06	102.1	3.0	≤50%
P-1051	MH-1050	MH-1048	8	8		91	97.4	90.1	8.022	PVC	133.52	97.65	3.0	≤50%
P-1049	MH-1048	MH-1046	8	8		361	90	62.95	7.493	Concrete	136.99	90.26	3.1	≤50%
P-1047	MH-1046	MH-1044	8	8		193	62.95	47.9	7.798	Concrete	140.46	63.21	3.1	≤50%
P-1045	MH-1044	MH-1042	15	15		18	47.9	47.77	0.722	PVC	143.92	48.12	2.6	≤50%
P-1043	MH-1042	MH-1040	15	15		412	47.6	46.14	0.354	PVC	601.13	48.06	5.5	≤50%
P-1041	MH-1040	MH-989	15	15		378	46.14	44.67	0.389	PVC	604.60	46.6	5.5	≤50%
P-1003	MH-1001	MH-1002	6	6		149	147	145.1	1.275	PVC	3.47	147.04	0.5	≤50%
P-1005	MH-1002	MH-1004	6	6		199	145	141.1	1.96	PVC	6.93	145.06	0.7	≤50%
P-1007	MH-1004	MH-1006	6	6		335	141	137.1	1.164	PVC	10.40	141.07	0.8	≤50%
P-1009	MH-1006	MH-1008	6	6		170	137	119.1	10.529	PVC	13.87	137.09	1.1	≤50%
P-1011	MH-1008	MH-1010	8	8		232	119	101.1	7.716	Concrete	17.33	119.09	1.1	≤50%

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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1013	MH-1010	MH-1012	8	8		360	101	95.1	1.639	Concrete	20.80	101.1	1.2	≤50%
P-1014	MH-1012	MH-991	8	8		240	95	64.12	12.867	Concrete	74.42	95.19	2.3	≤50%
P-1000	MH-999	MH-997	8	8		267	107.12	106.03	0.408	Concrete	3.47	107.17	0.6	≤50%
P-998	MH-997	MH-995	8	8		275	106.03	104.94	0.396	Concrete	6.93	106.1	0.8	≤50%
P-996	MH-995	MH-993	8	8		313	104.94	86.96	5.744	Concrete	10.40	105.01	0.8	≤50%
P-994	MH-993	MH-991	8	8		305	86.96	64.02	7.521	Concrete	13.87	87.04	1.0	≤50%
P-992	MH-991	MH-989	8	8		187	64.02	49.06	8	Concrete	91.75	64.23	2.5	≤50%
P-990	MH-989	MH-987	15	15		153	44.67	44.07	0.392	PVC	699.82	45.16	5.9	≤50%
P-988	MH-987	MH-985	15	15		332	44.07	42.75	0.398	PVC	706.75	44.57	6.0	≤50%
P-986	MH-985	MH-983	15	15		259	42.75	41.7	0.405	PVC	713.68	43.25	6.0	≤50%
P-984	MH-983	MH-981	15	15		274	41.7	34.86	2.496	PVC	720.62	42.2	6.0	≤50%
P-1390	MH-981	MH-1375	12	12		285	34.6	5.04	10.372	Corrugated HDPE (Smooth Interior)	866.21	35.19	7.1	61%
P-784	MH-1474	MH-65	8	8		227	65.06	43.1	9.674	Concrete	2.76	65.1	0.5	≤50%
P-68(1)	MH-65	MH-1984	8	8		224	43	41.96	0.464	Concrete	5.51	43.07	0.8	≤50%
P-68(2)	MH-1984	MH-67	8	8		25	43	41.96	4.16	Concrete	5.51	43.05	0.6	≤50%
P-688	MH-687	MH-223	8	8		141	93.91	85.51	5.957	Concrete	2.44	93.94	0.4	≤50%
P-240	MH-238	MH-239	8	8		126	132	130.1	1.508	PVC	19.41	132.09	1.1	≤50%
P-242	MH-239	MH-241	8	8		337	130	120.1	2.938	PVC	21.85	130.1	1.2	≤50%
P-1349	MH-241	MH-207	18	18		19	120	119.06	4.947	PVC	24.28	120.08	1.0	≤50%
P-1789	MH-1884	MH-1883	8	8		129	148.59	148.07	0.403	PVC	0.00	148.59	0.0	≤50%
P-247	MH-245	MH-246	8	8		365	244.65	240.69	1.085	PVC	2.44	244.68	0.4	≤50%
P-249	MH-246	MH-248	8	8		98	240.59	230.55	10.245	PVC	4.87	240.64	0.6	≤50%
P-251	MH-248	MH-250	8	8		400	230.45	219.1	2.838	PVC	7.31	230.51	0.7	≤50%
P-300	MH-298	MH-299	8	8		253	223.33	213.27	3.976	PVC	2.44	223.36	0.4	≤50%
P-302	MH-299	MH-301	8	8		93	213.17	212.79	0.409	PVC	4.87	213.23	0.7	≤50%
P-303	MH-301	MH-250	8	8		159	212.69	210.7	1.252	PVC	7.31	212.75	0.7	≤50%
P-253	MH-250	MH-252	8	8		288	210.6	208.76	0.639	PVC	17.05	210.69	1.1	≤50%
P-255	MH-252	MH-254	8	8		263	208.66	194.58	5.354	PVC	19.48	208.75	1.1	≤50%
P-257	MH-254	MH-256	8	8		230	194.48	182.94	5.017	PVC	21.92	194.58	1.2	≤50%
P-259	MH-256	MH-258	8	8		360	182.84	181.42	0.394	PVC	24.35	182.96	1.4	≤50%
P-1764	MH-1853	MH-258	8	8		212	194.79	184.8	4.712	PVC	0.00	194.79	0.0	≤50%
P-1763	MH-1852	MH-258	8	8		120	185.75	184.8	0.792	PVC	0.00	185.75	0.0	≤50%
P-261	MH-258	MH-260	10	10		272	181.32	161.9	7.14	PVC	28.59	181.43	1.3	≤50%
P-263	MH-260	MH-262	10	10		106	161.8	147.91	13.104	PVC	31.02	161.91	1.3	≤50%
P-297	MH-296	MH-293	8	8		28	154.4	153.53	3.107	PVC	2.44	154.43	0.4	≤50%
P-292	MH-290	MH-291	8	8		23	160.16	160.04	0.522	PVC	2.44	160.2	0.5	≤50%
P-294	MH-291	MH-293	8	8		125	159.94	153.99	4.76	PVC	4.87	159.99	0.6	≤50%
P-295	MH-293	MH-262	8	8		253	153.43	145.67	3.067	PVC	9.74	153.5	0.8	≤50%
P-265(1)	MH-262	MH-1883	10	10		136	147.66	134.16	9.926	PVC	43.20	147.79	1.6	≤50%
P-265(2)	MH-1883	MH-264	10	10		185	147.66	134.16	7.297	PVC	43.20	147.79	1.6	≤50%
P-267	MH-264	MH-266	10	10		324	134.06	125.91	2.515	PVC	45.64	134.2	1.7	≤50%
P-269	MH-266	MH-268	12	12		271	125.71	124.75	0.354	Steel	48.07	125.86	1.8	≤50%
P-271	MH-268	MH-270	12	12		307	124.5	123.36	0.371	Steel	50.51	124.65	1.8	≤50%
P-273	MH-270	MH-272	12	12		401	123.26	121.9	0.339	Steel	52.94	123.42	1.9	≤50%
P-275	MH-272	MH-274	12	12		401	121.8	120.44	0.339	Steel	55.38	121.97	2.0	≤50%
P-276	MH-274	MH-207	12	12		375	120.34	119.06	0.341	Steel	57.81	120.51	2.0	≤50%
P-1361	MH-1360	MH-181	8	8		150	224	214.41	6.393	PVC	3.42	224.04	0.5	≤50%
P-1704	MH-1798	MH-1797	8	8		222	225.91	225.02	0.4	PVC	0.00	225.91	0.0	≤50%
P-1703	MH-1797	MH-1789	8	8		81	225.02	224.7	0.4	PVC	0.00	225.02	0.0	≤50%
P-1702	MH-1796	MH-1794	8	8		198	228.18	227.39	0.4	PVC	0.00	228.18	0.0	≤50%
P-1701	MH-1795	MH-1794	8	8		405	229.01	227.39	0.4	PVC	0.00	229.01	0.0	≤50%
P-1700	MH-1794	MH-1791	8	8		261	227.39	226.34	0.4	PVC	0.00	227.39	0.0	≤50%
P-1699	MH-1793	MH-1791	8	8		112	226.79	226.34	0.4	PVC	0.00	226.79	0.0	≤50%
P-1698	MH-1792	MH-1791	8	8		119	226.82	226.34	0.4	PVC	0.00	226.82	0.0	≤50%
P-1697	MH-1791	MH-1790	8	8		333	226.34	225.01	0.4	PVC	0.00	226.34	0.0	≤50%
P-1696	MH-1790	MH-1789	8	8		78	225.01	224.7	0.4	PVC	0.00	225.01	0.0	≤50%
P-1695	MH-1789	MH-176	8	8		120	224.7	224.22	0.4	PVC	0.00	224.7	0.0	≤50%
P-178	MH-176	MH-177	8	8		305	224.22	222.68	0.505	PVC	21.99	224.33	1.3	≤50%
P-180	MH-177	MH-179	8	8		308	222.68	218.82	1.253	PVC	25.41	222.79	1.3	≤50%
P-182	MH-179	MH-181	8	8		239	218.82	214.41	1.845	PVC	28.84	218.93	1.3	≤50%
P-184	MH-181	MH-183	8	8		212	214.41	202.48	5.627	PVC	35.68	214.54	1.6	≤50%
P-186	MH-183	MH-185	8	8		206	202.48	194.44	3.903	PVC	39.10	202.61	1.6	≤50%
P-188	MH-185	MH-187	8	8		47	194.44	191.6	6.043	PVC	42.52	194.58	1.7	≤50%
P-190	MH-187	MH-189	8	8		162	191.6	190.78	0.506	PVC	45.94	191.76	1.9	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-192	MH-189	MH-191	8	8		157	190.78	184.15	4.223	PVC	49.37	190.93	1.8	≤50%
P-194	MH-191	MH-193	8	8		279	184.15	161.51	8.115	PVC	52.79	184.31	1.9	≤50%
P-196	MH-193	MH-195	8	8		42	161.51	154.32	17.119	PVC	56.21	161.67	1.9	≤50%
P-198	MH-195	MH-197	8	8	SM10	128	154.32	143.68	8.312	PVC	59.63	154.49	2.0	≤50%
P-200	MH-197	MH-199	8	8	SM10	84	143.58	141	3.071	Concrete	63.05	143.75	2.0	≤50%
P-202	MH-199	MH-201	8	8	SM10	324	139.9	131.1	2.716	Concrete	66.48	140.08	2.2	≤50%
P-204	MH-201	MH-203	8	8	SM10	476	131	124.76	1.311	Concrete	69.90	131.18	2.2	≤50%
P-288	MH-286	MH-287	8	8		300	127.72	126.43	0.43	PVC	3.42	127.77	0.6	≤50%
P-289	MH-287	MH-203	8	8		300	126.43	124.76	0.557	PVC	6.84	126.49	0.7	≤50%
P-206	MH-203	MH-205	8	8	SM10	276	124.66	119.6	1.833	Concrete	80.16	124.85	2.3	≤50%
P-208	MH-205	MH-207	8	8	SM10	23	119.5	119.06	1.913	PVC	82.60	119.7	2.4	≤50%
P-210	MH-207	MH-209	12	12		263	118.96	117.37	0.605	PVC	167.13	119.21	3.0	≤50%
P-212	MH-209	MH-211	12	12		275	117.27	115.62	0.6	PVC	169.56	117.52	3.0	≤50%
P-230	MH-228	MH-229	8	8		308	126.83	125.31	0.494	Concrete	2.44	126.87	0.5	≤50%
P-232(1)	MH-229	MH-1946	8	8		265	123.21	123.14	0.026	Concrete	4.87	123.33	1.4	≤50%
P-232(2)	MH-1946	MH-231	8	8		144	123.21	123.14	0.049	Concrete	4.87	123.3	1.1	≤50%
P-234	MH-231	MH-233	8	8		205	123.04	119.5	1.727	PVC	7.31	123.1	0.7	≤50%
P-236	MH-233	MH-235	8	8		218	119.4	116.1	1.514	PVC	9.74	119.47	0.8	≤50%
P-237	MH-235	MH-211	8	8		30	116	115.62	1.267	PVC	12.18	116.07	0.8	≤50%
P-214	MH-211	MH-213	12	12		366	115.52	113.3	0.607	PVC	184.18	115.78	3.1	≤50%
P-279	MH-277	MH-278	6	6		464	124	116	1.724	PVC	2.44	124.04	0.5	≤50%
P-1356	MH-1355	MH-284	8	8	SM10	218	122.87	121.91	0.44	Concrete	2.44	122.91	0.5	≤50%
P-741	MH-284	MH-282	8	8	SM10	274	121.91	120.84	0.391	Concrete	4.87	121.97	0.7	≤50%
P-743	MH-282	MH-280	8	8	SM10	224	120.84	116.32	2.018	PVC	7.31	120.9	0.7	≤50%
P-745	MH-280	MH-278	8	8	SM10	154	116.32	115.58	0.481	PVC	9.74	116.39	0.8	≤50%
P-697	MH-278	MH-213	8	8		16	115.9	113.3	16.25	Concrete	14.61	115.98	1.0	≤50%
P-216	MH-213	MH-215	12	12		278	113.2	105.58	2.741	PVC	201.23	113.48	3.4	≤50%
P-1342	MH-1341	MH-215	8	8		11	105.7	105.58	1.091	Steel	2.44	105.76	0.7	≤50%
P-218	MH-215	MH-217	12	12		353	105.48	101.95	1	PVC	206.10	105.76	3.4	≤50%
P-220	MH-217	MH-219	12	12		15	101.7	101.6	0.667	PVC	208.53	101.98	3.4	≤50%
P-222	MH-219	MH-221	8	8		72	101.5	94.51	9.708	Concrete	210.97	101.82	3.8	≤50%
P-690	MH-689	MH-221	8	8		217	95.43	94.51	0.424	Concrete	2.44	95.47	0.5	≤50%
P-759	MH-221	MH-223	8	8		291	94.41	85.51	3.058	PVC	215.84	94.73	3.8	≤50%
P-1422	MH-223	MH-1421	8	8		133	85.41	72.4	9.782	Concrete	220.71	85.74	4.0	≤50%
P-1425	MH-1421	MH-1417	8	8		27	72.06	69.69	8.778	PVC	223.15	72.39	4.0	≤50%
P-104	MH-103	MH-25	8	8		119	190.8	188.81	1.672	PVC	1.46	190.83	0.4	≤50%
P-21	MH-19	MH-20	8	8		131	234.62	228.59	4.603	PVC	1.46	234.65	0.4	≤50%
P-23	MH-20	MH-22	8	8		209	228.49	215.96	5.995	PVC	2.92	228.53	0.5	≤50%
P-26	MH-22	MH-25	8	8		232	215.86	188.81	11.659	PVC	4.38	215.9	0.5	≤50%
P-28	MH-25	MH-27	8	8		109	179.83	164.06	14.468	PVC	7.31	179.89	0.7	≤50%
P-30	MH-27	MH-29	8	8		124	164.06	151.94	9.774	PVC	8.77	164.12	0.7	≤50%
P-32	MH-29	MH-31	8	8		100	151.84	139.99	11.85	PVC	10.23	151.91	0.8	≤50%
P-34	MH-31	MH-33	8	8		113	139.99	139.89	0.088	PVC	11.69	140.11	1.4	≤50%
P-36	MH-33	MH-35	8	8		166	139.89	133.12	4.078	PVC	13.15	139.97	1.0	≤50%
P-38	MH-35	MH-37	8	8		195	133.02	127.2	2.985	PVC	14.61	133.1	1.0	≤50%
P-40	MH-37	MH-39	8	8		186	126	121.64	2.344	PVC	16.07	126.09	1.1	≤50%
P-166	MH-164	MH-165	8	8		191	123.49	122.73	0.398	PVC	1.46	123.52	0.4	≤50%
P-168	MH-165	MH-167	8	8		124	122.63	122.15	0.387	PVC	2.92	122.67	0.5	≤50%
P-169	MH-167	MH-39	8	8		328	122.05	120.77	0.39	PVC	4.38	122.1	0.6	≤50%
P-42	MH-39	MH-41	8	8		271	121.54	120.21	0.491	PVC	21.92	121.65	1.3	≤50%
P-172	MH-170	MH-171	8	8		301	122.82	121.62	0.399	PVC	1.46	122.85	0.4	≤50%
P-174	MH-171	MH-173	8	8		167	121.52	120.85	0.401	PVC	2.92	121.56	0.5	≤50%
P-175	MH-173	MH-41	8	8		286	120.85	120.21	0.224	PVC	4.38	120.91	0.7	≤50%
P-44	MH-41	MH-43	8	8		267	120.11	118.75	0.509	PVC	27.76	120.23	1.4	≤50%
P-306	MH-304	MH-43	8	8		304	126.25	118.75	2.467	PVC	1.46	126.28	0.4	≤50%
P-46	MH-43	MH-45	8	8		84	118.65	118.22	0.512	PVC	30.69	118.78	1.6	≤50%
P-48	MH-45	MH-47	8	8		211	118.12	117.06	0.502	PVC	32.15	118.25	1.6	≤50%
P-50	MH-47	MH-49	8	12	SM7	18	116.96	116.8	0.889	PVC	33.61	117.52	6.7	58%
P-1809	MH-1906	MH-1905	8	8		101	203.82	196.29	7.455	PVC	0.00	203.82	0.0	≤50%
P-1807	MH-1903	MH-1904	8	8		257	214.92	204.15	4.191	PVC	0.00	214.92	0.0	≤50%
P-1808	MH-1904	MH-1905	8	8		249	204.15	196.29	3.157	PVC	0.00	204.15	0.0	≤50%
P-1811	MH-1905	MH-1895	8	8		361	196.29	193.05	0.898	PVC	0.00	196.29	0.0	≤50%
P-1806	MH-1902	MH-1894	8	8		313	199.97	194.48	1.754	PVC	0.00	199.97	0.0	≤50%
P-1797	MH-1893	MH-1892	8	8		204	213.75	205.28	4.152	PVC	0.00	213.75	0.0	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1796	MH-1892	MH-1891	8	8		98	205.28	200.53	4.847	PVC	0.00	205.28	0.0	≤50%
P-1795	MH-1891	MH-1890	8	8		33	200.53	199.27	3.818	PVC	0.00	200.53	0.0	≤50%
P-1794	MH-1889	MH-1890	8	8		110	200.6	199.27	1.209	PVC	0.00	200.6	0.0	≤50%
P-1798	MH-1890	MH-1894	8	8		284	199.27	194.48	1.687	PVC	0.00	199.27	0.0	≤50%
P-1799	MH-1894	MH-1895	8	8		250	194.48	193.05	0.572	PVC	0.00	194.48	0.0	≤50%
P-1800	MH-1895	MH-1896	8	8		139	193.05	192.11	0.676	PVC	0.00	193.05	0.0	≤50%
P-1801	MH-1896	MH-1897	8	8		203	192.11	190.71	0.69	PVC	0.00	192.11	0.0	≤50%
P-1802	MH-1897	MH-1898	8	8		71	190.71	189.7	1.423	PVC	0.00	190.71	0.0	≤50%
P-1803	MH-1898	MH-1899	8	8		241	189.7	187.7	0.83	PVC	0.00	189.7	0.0	≤50%
P-1804	MH-1899	MH-1900	8	8		290	187.7	185.69	0.693	PVC	0.00	187.7	0.0	≤50%
P-1805	MH-1900	MH-133	8	8		252	185.69	184.29	0.556	PVC	0.00	185.69	0.0	≤50%
P-124	MH-122	MH-123	8	8		343	240.58	237.2	0.985	PVC	1.46	240.61	0.4	≤50%
P-1687	MH-1780	MH-1779	8	8		203	239.68	238.87	0.4	PVC	0.00	239.68	0.0	≤50%
P-1686	MH-1779	MH-1778	8	8		45	238.87	238.69	0.4	PVC	0.00	238.87	0.0	≤50%
P-1685	MH-1778	MH-1772	8	8		228	238.69	237.78	0.4	PVC	0.00	238.69	0.0	≤50%
P-1684	MH-1777	MH-1776	8	8		264	241	239.94	0.4	PVC	0.00	241	0.0	≤50%
P-1683	MH-1776	MH-1775	8	8		65	239.94	239.68	0.4	PVC	0.00	239.94	0.0	≤50%
P-1682	MH-1775	MH-1774	8	8		133	239.68	239.15	0.4	PVC	0.00	239.68	0.0	≤50%
P-1681	MH-1774	MH-1773	8	8		87	239.15	238.8	0.4	PVC	0.00	239.15	0.0	≤50%
P-1680	MH-1773	MH-1772	8	8		257	238.8	237.78	0.4	PVC	0.00	238.8	0.0	≤50%
P-1679	MH-1772	MH-1771	8	8		113	237.78	237.32	0.4	PVC	0.00	237.78	0.0	≤50%
P-1678	MH-1771	MH-123	8	8		31	237.32	237.2	0.4	PVC	0.00	237.6	3.4	≤50%
P-126	MH-123	MH-125	8	8		305	237.2	225.96	3.685	PVC	325.30	237.6	4.8	63%
P-128	MH-125	MH-127	8	8		400	225.8	206.99	4.703	PVC	326.76	226.2	4.8	63%
P-130	MH-127	MH-129	8	8		400	206.87	196.08	2.698	PVC	328.23	207.27	4.8	63%
P-132	MH-129	MH-131	8	8		362	196.08	184.48	3.204	PVC	329.69	196.48	4.8	63%
P-134	MH-131	MH-133	8	8		42	184.38	183.38	2.381	PVC	349.00	184.8	5.0	66%
P-136(1)	MH-133	MH-1901	15	15		105	182.62	174.75	7.495	PVC	350.46	182.97	4.2	≤50%
P-136(2)	MH-1901	MH-135	15	15		208	182.62	174.75	3.784	PVC	350.46	182.97	4.2	≤50%
P-138	MH-135	MH-137	15	15		327	174.68	173.14	0.471	PVC	351.92	175.04	4.3	≤50%
P-1749	SSMH #24 - Westchester	SSMH #23 - Westchester	8	8		150	196.51	195.91	0.4	PVC	0.00	196.51	0.0	≤50%
P-1748	SSMH #25 - Westchester	SSMH #23 - Westchester	8	8		113	196.36	195.91	0.398	PVC	0.00	196.36	0.0	≤50%
P-1747	SSMH #23 - Westchester	SSMH #20 - Westchester	8	8		219	195.81	194.93	0.402	PVC	0.00	195.81	0.0	≤50%
P-1735	SSMH #22 - Westchester	SSMH #20 - Westchester	8	8		223	207.55	194.93	5.659	PVC	0.00	207.55	0.0	≤50%
P-1734	SSMH #20 - Westchester	SSMH #19 - Westchester	8	8		153	194.93	186.24	5.68	PVC	0.00	194.93	0.0	≤50%
P-1733	SSMH #19 - Westchester	SSMH #18 - Westchester	8	8		356	186.14	173.29	3.61	PVC	0.00	186.14	0.0	≤50%
P-1732	SSMH #18 - Westchester	MH-137	8	8		46	173.19	173.14	0.109	PVC	0.00	173.41	2.6	≤50%
P-140	MH-137	MH-139	15	15		252	173.06	171.81	0.496	PVC	353.38	173.41	4.2	≤50%
P-142	MH-139	MH-141	15	15		401	171.74	169.66	0.519	PVC	399.49	172.11	4.4	≤50%
P-1737	SSMH #15 - Westchester	SSMH #14 - Westchester	8	8		144	182.09	181.41	0.472	PVC	0.00	182.09	0.0	≤50%
P-1736	SSMH #14 - Westchester	SSMH #3 - Westchester	8	8		400	181.31	179.71	0.4	PVC	0.00	181.31	0.0	≤50%
P-1739	SSMH #17 - Westchester	SSMH #16 - Westchester	8	8		150	198.79	195.9	1.927	PVC	0.00	198.79	0.0	≤50%
P-1738	SSMH #16 - Westchester	SSMH #4 - Westchester	8	8		400	195.8	194.2	0.4	PVC	0.00	195.8	0.0	≤50%
P-1745	SSMH #13 - Westchester	SSMH #8 - Westchester	8	8		213	221.35	216.28	2.38	PVC	0.00	221.35	0.0	≤50%
P-1746	SSMH #12 - Westchester	SSMH #9 - Westchester	8	8		270	229.81	221.99	2.896	PVC	0.00	229.81	0.0	≤50%
P-1744	SSMH #11 - Westchester	SSMH #10 - Westchester	8	8		284	235.15	227.63	2.648	PVC	0.00	235.15	0.0	≤50%
P-1743	SSMH #10 - Westchester	SSMH #9 - Westchester	8	8		149	227.53	221.99	3.718	PVC	0.00	227.53	0.0	≤50%
P-1742	SSMH #9 - Westchester	SSMH #8 - Westchester	8	8		131	221.89	216.28	4.282	PVC	0.00	221.89	0.0	≤50%
P-1741	SSMH #8 - Westchester	SSMH #7 - Westchester	8	8		138	216.18	215.46	0.522	PVC	0.00	216.18	0.0	≤50%
P-1740	SSMH #7 - Westchester	SSMH #6 - Westchester	8	8		352	215.36	213.95	0.401	PVC	0.00	215.36	0.0	≤50%
P-1731	SSMH #6 - Westchester	SSMH #5 - Westchester	8	8		76	213.85	207.89	7.842	PVC	0.00	213.85	0.0	≤50%
P-1730	SSMH #5 - Westchester	SSMH #4 - Westchester	8	8		169	207.79	194.2	8.041	PVC	0.00	207.79	0.0	≤50%
P-1729	SSMH #4 - Westchester	SSMH #3 - Westchester	8	8		242	194.1	179.71	5.946	PVC	0.00	194.1	0.0	≤50%
P-1728	SSMH #3 - Westchester	SSMH #2 - Westchester	8	8		73	179.61	178.88	1	PVC	0.00	179.61	0.0	≤50%
P-1727	SSMH #2 - Westchester	SSMH #1 - Westchester	8	8		92	178.78	178.02	0.826	PVC	0.00	178.78	0.0	≤50%
P-1726	SSMH #1 - Westchester	MH-141	8	8		134	177.92	169.66	6.164	PVC	0.00	177.92	0.0	≤50%
P-144	MH-141	MH-143	15	15		205	169.58	168.74	0.41	PVC	415.61	169.98	4.8	≤50%
P-146	MH-143	MH-145	15	15		291	168.72	167.22	0.515	PVC	417.08	169.1	4.6	≤50%
P-148	MH-145	MH-147	15	15		397	167.18	139.79	6.899	PVC	418.54	167.56	4.6	≤50%
P-150	MH-147	MH-149	15	15		336	139.66	136.31	0.997	PVC	420.00	140.04	4.6	≤50%
P-152	MH-149	MH-151	15	15		100	136.22	135.04	1.18	PVC	421.46	136.6	4.6	≤50%
P-154	MH-151	MH-153	15	15		134	134.87	131.93	2.194	PVC	422.92	135.25	4.6	≤50%
P-162	MH-160	MH-161	12	12		242	132.95	132.4	0.227	PVC	1.46	132.98	0.4	≤50%
P-163	MH-161	MH-153	12	12		72	132.4	132.25	0.208	PVC	2.92	132.45	0.6	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-156	MH-153	MH-155	15	15		100	131.83	131.09	0.74	PVC	427.30	132.21	4.6	≤50%
P-158	MH-155	MH-157	15	15		249	130.99	122.09	3.574	PVC	428.77	131.37	4.6	≤50%
P-159	MH-157	MH-49	15	15		310	122.09	117.19	1.581	PVC	430.23	122.47	4.6	≤50%
P-52	MH-49	MH-51	8	10	SM7	147	117.07	114.49	1.755	PVC	465.30	117.52	5.4	55%
P-54	MH-51	MH-53	8	10	SM7	277	114.49	110.02	1.614	PVC	466.76	114.94	5.4	55%
P-679	MH-677	MH-678	8	8		269	125.79	121.09	1.747	Concrete	1.46	125.82	0.4	≤50%
P-680	MH-678	MH-53	8	8		293	121.09	110.25	3.7	Concrete	2.92	121.13	0.5	≤50%
P-56	MH-53	MH-55	8	10	SM7	50	110.02	106.76	6.52	PVC	471.14	110.48	5.5	57%
P-58	MH-55	MH-57	8	10	SM7	157	106.76	95.81	6.975	PVC	472.60	107.22	5.5	57%
P-60	MH-57	MH-59	8	10	SM7	125	95.81	85.38	8.344	PVC	474.07	96.27	5.5	57%
P-62	MH-59	MH-61	8	10	SM7	136	85.38	72.78	9.265	PVC	475.53	85.84	5.5	57%
P-683	MH-681	MH-682	8	8		324	109	83.64	7.827	Concrete	1.46	109.03	0.4	≤50%
P-684	MH-682	MH-61	8	8		219	83.28	72.78	4.795	Concrete	2.92	83.32	0.5	≤50%
P-64	MH-61	MH-63	8	10	SM7	87	72.78	66.2	7.563	PVC	479.91	73.24	5.5	57%
P-753	MH-63	MH-1417	15	15		313	66.1	64.57	0.489	PVC	482.35	66.51	4.9	≤50%
P-755	MH-1417	MH-225	15	15		157	64.47	57.05	4.726	PVC	707.93	64.97	6.0	≤50%
P-757	MH-225	MH-67	15	15	SM3	100	56.95	41.96	14.99	PVC	710.36	57.45	6.0	≤50%
P-70	MH-67	MH-69	15	15	SM3	202	41.86	26.06	7.822	PVC	718.63	42.36	6.0	≤50%
P-716	MH-715	MH-69	8	8		383	28.38	26.84	0.402	Concrete	2.76	28.42	0.5	≤50%
P-72	MH-69	MH-71	15	15	SM3	78	25.96	19.77	7.936	PVC	724.15	26.46	6.0	≤50%
P-930	MH-928	MH-929	8	8		303	115.97	103.16	4.228	PVC	2.21	116	0.4	≤50%
P-932	MH-929	MH-931	8	8		301	102.98	85.22	5.9	PVC	4.41	103.02	0.5	≤50%
P-934	MH-931	MH-933	8	8		297	85.05	59.9	8.468	PVC	6.62	85.1	0.6	≤50%
P-935	MH-933	MH-837	8	8		302	59.25	32	9.023	PVC	8.82	59.31	0.7	≤50%
P-866	MH-864	MH-865	8	8		128	83.22	82.97	0.195	PVC	1.22	83.25	0.4	≤50%
P-867	MH-865	MH-799	8	8		253	82.87	81.42	0.573	PVC	2.44	82.91	0.5	≤50%
P-760	MH-759	MH-757	8	8		108	98	95.1	2.685	PVC	1.22	98.02	0.2	≤50%
P-758	MH-757	MH-755	8	8		123	95	92	2.439	PVC	2.44	95.03	0.4	≤50%
P-756	MH-755	MH-753	8	8		160	91.9	89.1	1.75	PVC	3.66	91.94	0.5	≤50%
P-762	MH-761	MH-753	8	8		127	91	89.1	1.496	PVC	1.22	91.02	0.2	≤50%
P-754	MH-753	MH-751	8	8		331	89	83.8	1.571	PVC	6.09	89.05	0.6	≤50%
P-752	MH-751	MH-749	8	8		74	83.7	82.27	1.932	PVC	7.31	83.76	0.7	≤50%
P-750	MH-749	MH-747	8	8		35	82.17	82.01	0.457	PVC	8.53	82.4	2.8	≤50%
P-765	MH-763	MH-764	8	8		245	107.25	95.23	4.906	PVC	1.22	107.27	0.2	≤50%
P-767	MH-764	MH-766	8	8		190	95.13	92.22	1.532	PVC	2.44	95.16	0.4	≤50%
P-773	MH-771	MH-772	8	8		76	93.33	92.99	0.447	PVC	1.22	93.36	0.4	≤50%
P-1348	MH-772	MH-766	8	8		103	92.89	92.22	0.65	PVC	2.44	92.93	0.5	≤50%
P-1351	MH-766	MH-768	8	8		188	92.22	91.58	0.34	PVC	6.09	92.28	0.7	≤50%
P-770	MH-768	MH-741	8	8		40	84.93	84.65	0.7	PVC	19.75	85.02	1.1	≤50%
P-738	MH-736	MH-737	8	8		107	87.23	86.66	0.533	Steel	1.22	87.26	0.4	≤50%
P-740	MH-737	MH-739	8	8		60	86.34	86.01	0.55	PVC	175.53	86.65	3.7	≤50%
P-742	MH-739	MH-741	8	8		305	86.01	84.65	0.446	PVC	176.75	86.34	4.0	≤50%
P-798	MH-797	MH-794	8	8		201	86.83	85.65	0.587	PVC	20.94	86.93	1.2	≤50%
P-777	MH-775	MH-776	8	8		233	99.74	98.69	0.451	PVC	1.22	99.77	0.4	≤50%
P-779	MH-776	MH-778	8	8		131	98.69	98.22	0.359	PVC	2.44	98.73	0.5	≤50%
P-781	MH-778	MH-780	8	8		298	98.22	97.09	0.379	PVC	3.66	98.27	0.6	≤50%
P-783	MH-780	MH-782	8	8		278	96.99	90.47	2.345	PVC	4.87	97.04	0.6	≤50%
P-785	MH-782	MH-784	8	8		85	90.47	89.85	0.729	PVC	6.09	90.52	0.6	≤50%
P-787	MH-784	MH-786	8	8		199	89.75	88.85	0.452	PVC	7.31	89.82	0.8	≤50%
P-789	MH-786	MH-788	8	8		298	88.8	88	0.268	PVC	8.53	88.88	1.0	≤50%
P-791	MH-788	MH-790	8	8		121	87.9	87.03	0.719	PVC	9.75	87.97	0.8	≤50%
P-793	MH-790	MH-792	8	8		85	86.93	86.55	0.447	PVC	10.97	87.01	1.0	≤50%
P-352	MH-350	MH-351	8	8		92	144	141.69	2.511	PVC	2.57	144.03	0.4	≤50%
P-354	MH-351	MH-353	8	8		201	141.61	133.61	3.98	PVC	5.14	141.66	0.6	≤50%
P-356	MH-353	MH-355	8	8		269	133.6	126.19	2.755	PVC	7.72	133.66	0.7	≤50%
P-358	MH-355	MH-357	8	8		187	126.15	120.57	2.984	PVC	10.29	126.22	0.8	≤50%
P-363	MH-362	MH-357	8	8		170	124.05	120.22	2.253	PVC	2.57	124.08	0.4	≤50%
P-360	MH-357	MH-359	8	8		142	120.26	116.05	2.965	PVC	15.43	120.34	1.0	≤50%
P-361	MH-359	MH-322	8	8		132	115.93	108.45	5.667	PVC	18.00	116.02	1.1	≤50%
P-366	MH-364	MH-365	8	8		221	142.26	134.78	3.385	PVC	2.57	142.29	0.4	≤50%
P-368	MH-365	MH-367	8	8		231	134.73	128.57	2.667	PVC	5.14	134.78	0.6	≤50%
P-369	MH-367	MH-322	8	8		207	128.57	108.47	9.71	PVC	7.72	128.63	0.7	≤50%
P-344	MH-342	MH-343	8	8		69	151.34	149.82	2.203	PVC	2.57	151.37	0.4	≤50%
P-346	MH-343	MH-345	8	8		264	149.65	134.49	5.742	PVC	5.14	149.7	0.6	≤50%

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20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-348	MH-345	MH-347	8	8		151	134.49	127.94	4.338	PVC	7.72	134.55	0.7	≤50%
P-349	MH-347	MH-318	8	8		227	127.84	109.89	7.907	PVC	10.29	127.91	0.8	≤50%
P-328	MH-326	MH-327	8	8		162	135.65	129.51	3.79	PVC	2.57	135.68	0.4	≤50%
P-330	MH-327	MH-329	8	8		78	129.35	127.37	2.538	PVC	5.14	129.4	0.6	≤50%
P-331	MH-329	MH-310	8	8		124	127.3	125.92	1.113	PVC	7.72	127.36	0.7	≤50%
P-309	MH-307	MH-308	8	8		90	143.9	141.24	2.956	PVC	2.57	143.93	0.4	≤50%
P-311	MH-308	MH-310	8	8		312	141.2	125.96	4.885	PVC	5.14	141.25	0.6	≤50%
P-313	MH-310	MH-312	8	8		282	125.74	116.72	3.199	PVC	15.43	125.82	1.0	≤50%
P-315	MH-312	MH-314	8	8		58	116.62	116.19	0.741	PVC	18.00	116.71	1.1	≤50%
P-317	MH-314	MH-316	8	8		189	116.14	113.49	1.402	PVC	20.58	116.24	1.2	≤50%
P-334	MH-332	MH-333	8	8		145	155.87	148.67	4.966	PVC	2.57	155.9	0.4	≤50%
P-336	MH-333	MH-335	8	8		223	148.6	134.6	6.278	PVC	5.14	148.65	0.6	≤50%
P-338	MH-335	MH-337	8	8		150	134.54	129.68	3.24	PVC	7.72	134.6	0.7	≤50%
P-340	MH-337	MH-339	8	8		206	129.66	118.75	5.296	PVC	10.29	129.73	0.8	≤50%
P-341	MH-339	MH-316	8	8		94	118.72	113.43	5.628	PVC	12.86	118.8	1.0	≤50%
P-319	MH-316	MH-318	8	8		227	113.26	109.89	1.485	PVC	36.01	113.39	1.6	≤50%
P-321	MH-318	MH-320	8	8		54	109.82	109.48	0.63	PVC	48.87	109.97	1.8	≤50%
P-323	MH-320	MH-322	8	8		220	109.45	108.34	0.505	PVC	51.44	109.61	1.9	≤50%
P-325	MH-322	MH-324	8	8		180	108.28	107.47	0.45	PVC	79.73	108.49	2.5	≤50%
P-687	MH-324	MH-1739	8	8		66	107.47	107.23	0.364	PVC	82.30	107.71	2.9	≤50%
P-1771	MH-1863	MH-1862	8	8		248	169.55	160.86	3.504	PVC	0.00	169.55	0.0	≤50%
P-1623	MH-1718	MH-1717	8	8		126	208.78	206.38	1.905	PVC	0.00	208.78	0.0	≤50%
P-1622	MH-1717	MH-1716	8	8		351	206.28	184.8	6.12	PVC	0.00	206.28	0.0	≤50%
P-1853	MH-1945	MH-1944	8	8		292	210.58	192.78	6.096	PVC	0.00	210.58	0.0	≤50%
P-1852	MH-1944	MH-1721	8	8		163	192.78	191.71	0.656	0	0.00	192.78	0.0	≤50%
P-1626	MH-1721	MH-1720	8	8		125	191.71	191.08	0.504	PVC	0.00	191.71	0.0	≤50%
P-1628	MH-1723	MH-1722	8	8		166	211.79	210.13	1	PVC	0.00	211.79	0.0	≤50%
P-1629	MH-1724	MH-1722	8	8		124	211.84	210.13	1.379	PVC	0.00	211.84	0.0	≤50%
P-1627	MH-1722	MH-1720	8	8		312	210.03	191.08	6.074	PVC	0.00	210.03	0.0	≤50%
P-1625	MH-1720	MH-1719	8	8		45	190.98	187.2	8.4	PVC	0.00	190.98	0.0	≤50%
P-1624	MH-1719	MH-1716	8	8		387	187.1	184.8	0.594	PVC	0.00	187.1	0.0	≤50%
P-1621	MH-1716	MH-1715	8	8		199	184.7	167.24	8.774	PVC	0.00	184.7	0.0	≤50%
P-1620	MH-1715	MH-1714	8	8		67	167.14	166.39	1.119	PVC	0.00	167.14	0.0	≤50%
P-645	MH-643	MH-644	8	8		196	169.21	167.81	0.714	PVC	8.28	169.27	0.7	≤50%
P-1618	MH-644	MH-1714	8	8		121	167.26	166.29	0.802	PVC	26.54	167.37	1.3	≤50%
P-1619	MH-1714	MH-646	8	12	SM12	131	166.19	165.55	0.489	PVC	26.54	166.84	7.8	69%
P-649	MH-646	MH-648	8	8		172	166.72	164.43	1.331	PVC	30.14	166.84	1.4	≤50%
P-669	MH-667	MH-668	8	8		113	199.97	196.79	2.814	PVC	3.60	200.01	0.5	≤50%
P-671	MH-668	MH-670	8	8		267	196.69	180.94	5.899	PVC	7.20	196.75	0.7	≤50%
P-673	MH-670	MH-672	8	8		124	180.84	172.51	6.718	PVC	10.80	180.91	0.8	≤50%
P-674	MH-672	MH-648	8	8		134	172.41	164.43	5.955	PVC	14.40	172.49	1.0	≤50%
P-651	MH-648	MH-650	8	8		244	164.33	162.57	0.721	PVC	48.15	164.48	1.8	≤50%
P-653(1)	MH-650	MH-1862	8	8		46	162.47	158.81	7.957	PVC	51.75	162.63	1.9	≤50%
P-653(2)	MH-1862	MH-652	8	8		194	162.47	158.81	1.887	PVC	51.75	162.63	1.9	≤50%
P-655	MH-652	MH-654	8	8		360	158.71	143.06	4.347	PVC	58.59	158.88	2.0	≤50%
P-657	MH-654	MH-656	8	8		89	142.96	140.35	2.933	PVC	62.19	143.13	2.0	≤50%
P-659(1)	MH-656	MH-1700	8	8		75	140.25	136.45	5.067	PVC	65.79	140.43	2.2	≤50%
P-659(2)	MH-1700	MH-658	8	8		73	140.25	136.45	5.205	PVC	65.79	140.43	2.2	≤50%
P-660	MH-658	MH-459	8	8		140	136.36	135.79	0.407	PVC	69.39	136.56	2.4	≤50%
P-627	MH-625	MH-626	8	8		400	143.5	139.83	0.917	PVC	3.60	143.54	0.5	≤50%
P-635	MH-633	MH-634	8	8		153	157.79	156.13	1.085	PVC	3.60	157.83	0.5	≤50%
P-637	MH-634	MH-636	8	8		348	156.04	146.32	2.793	PVC	7.20	156.1	0.7	≤50%
P-638	MH-636	MH-626	8	8		187	146.26	139.92	3.39	PVC	10.80	146.33	0.8	≤50%
P-629	MH-626	MH-628	8	8		86	139.75	136.93	3.279	PVC	18.00	139.84	1.1	≤50%
P-631	MH-628	MH-630	8	8		107	136.87	136.04	0.776	PVC	21.60	136.97	1.2	≤50%
P-632	MH-630	MH-457	8	12	SM4	104	135.99	135.25	0.712	PVC	25.21	136.58	7.1	61%
P-623	MH-621	MH-622	8	8		304	154.04	140.78	4.362	PVC	3.60	154.08	0.5	≤50%
P-624	MH-622	MH-453	8	8		78	140.62	137.71	3.731	PVC	7.20	140.68	0.7	≤50%
P-663	MH-661	MH-662	8	8		118	156.46	154.06	2.034	PVC	3.60	156.5	0.5	≤50%
P-665	MH-662	MH-664	8	8		374	153.96	144.93	2.414	PVC	7.20	154.02	0.7	≤50%
P-666	MH-664	MH-451	8	8		42	144.84	144.31	1.262	PVC	10.80	144.97	1.6	≤50%
P-613	MH-611	MH-612	6	6		14	163.36	161.87	10.643	PVC	3.60	163.4	0.5	≤50%
P-640	MH-639	MH-612	6	6		72	164.36	161.87	3.458	PVC	3.60	164.4	0.5	≤50%
P-615	MH-612	MH-614	8	8		239	161.77	154.19	3.172	PVC	10.80	161.84	0.8	≤50%

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Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-617	MH-614	MH-616	8	8		243	154.09	153.13	0.395	PVC	14.40	154.18	1.1	≤50%
P-642	MH-641	MH-616	8	8		110	159.22	153.13	5.536	PVC	3.60	159.26	0.5	≤50%
P-619	MH-616	MH-618	8	8		125	153.03	152.46	0.456	PVC	21.60	153.14	1.3	≤50%
P-620	MH-618	MH-447	8	8		128	152.36	149.04	2.594	PVC	25.21	152.47	1.3	≤50%
P-1823	MH-1919	MH-1918	12	12		400	158.52	157.52	0.25	PVC	0.00	158.52	0.0	≤50%
P-1848	MH-1940	MH-1914	8	8		166	175.57	171.65	2.361	PVC	0.00	175.57	0.0	≤50%
P-1818	MH-1914	MH-1911	8	8		180	171.65	167.4	2.361	PVC	0.00	171.65	0.0	≤50%
P-1815	MH-1911	MH-1910	8	8		36	167.4	158.13	25.75	PVC	0.00	167.4	0.0	≤50%
P-1830	MH-1925	MH-1924	8	8		142	186.01	183.03	2.099	PVC	0.00	186.01	0.0	≤50%
P-1829	MH-1924	MH-1923	8	8		25	183.03	182	4.12	PVC	0.00	183.03	0.0	≤50%
P-1828	MH-1923	MH-1921	8	8		124	182	179.6	1.935	PVC	0.00	182	0.0	≤50%
P-1827(2)	MH-1921	MH-1922	8	8		318	179.6	172.79	2.142	PVC	0.00	179.6	0.0	≤50%
P-1827(1)	MH-1922	MH-1909	8	8		57	172.79	171.4	2.439	PVC	0.00	172.79	0.0	≤50%
P-1812	MH-1907	MH-1908	8	8		41	172.43	171.99	1.073	PVC	0.00	172.43	0.0	≤50%
P-1813	MH-1908	MH-1909	8	8		98	171.99	171.4	0.602	PVC	0.00	171.99	0.0	≤50%
P-1814	MH-1909	MH-1910	8	8		261	171.4	158.13	5.084	PVC	0.00	171.4	0.0	≤50%
P-1819	MH-1915	MH-1912	8	8		122	159.83	159.06	0.631	PVC	0.00	159.83	0.0	≤50%
P-1842	MH-1937	MH-1936	8	8		70	167.1	165.45	2.357	PVC	0.00	167.1	0.0	≤50%
P-1839	MH-1933	MH-1934	8	8		297	180.75	178.87	0.633	PVC	0.00	180.75	0.0	≤50%
P-1840	MH-1934	MH-1935	8	8		322	178.87	166.92	3.711	PVC	0.00	178.87	0.0	≤50%
P-1841	MH-1935	MH-1936	8	8		80	166.92	165.45	1.838	PVC	0.00	166.92	0.0	≤50%
P-1844	MH-1936	MH-1938	8	8		77	165.45	164.54	1.182	PVC	0.00	165.45	0.0	≤50%
P-1846	MH-1938	MH-1931	8	8		109	164.54	163.94	0.55	PVC	0.00	164.54	0.0	≤50%
P-1837	MH-1931	MH-1913	8	8		309	163.94	161.81	0.689	PVC	0.00	163.94	0.0	≤50%
P-1836	MH-1930	MH-1928	12	12		119	184.83	179.31	4.639	PVC	0.00	184.83	0.0	≤50%
P-1831	MH-1926	MH-1927	8	8		113	185.8	183.16	2.336	PVC	0.00	185.8	0.0	≤50%
P-1832	MH-1927	MH-1928	8	8		401	183.16	179.31	0.96	PVC	0.00	183.16	0.0	≤50%
P-1835	MH-1928	MH-1929	8	8		204	179.31	173.56	2.819	PVC	0.00	179.31	0.0	≤50%
P-1834	MH-1929	MH-1913	8	8		387	173.56	161.81	3.036	PVC	0.00	173.56	0.0	≤50%
P-1817	MH-1913	MH-1912	12	12		95	161.81	159.06	2.895	PVC	0.00	161.81	0.0	≤50%
P-1816	MH-1912	MH-1910	12	12		420	159.06	158.13	0.221	PVC	0.00	159.06	0.0	≤50%
P-1847	MH-1910	MH-1918	12	12		271	158.13	157.52	0.225	PVC	0.00	158.13	0.0	≤50%
P-1822	MH-1918	MH-1917	12	12		168	157.52	157.09	0.256	PVC	0.00	157.52	0.0	≤50%
P-1821	MH-1916	MH-1917	8	8		273	167.39	157.09	3.773	PVC	0.00	167.39	0.0	≤50%
P-1826	MH-1917	MH-1920	12	12		133	157.09	156.68	0.308	0	0.00	157.09	0.0	≤50%
P-1825	MH-1920	MH-600	12	12		32	156.68	156.62	0.188	PVC	0.00	156.73	0.6	≤50%
P-601	MH-599	MH-600	8	8		393	158.18	156.69	0.379	PVC	39.30	158.33	1.8	≤50%
P-603	MH-600	MH-602	8	8		158	156.59	154.76	1.158	PVC	42.90	156.73	1.7	≤50%
P-605	MH-602	MH-604	8	8		31	154.66	154.21	1.452	PVC	46.50	154.81	1.8	≤50%
P-607	MH-604	MH-606	8	8		28	154.11	152.05	7.357	PVC	50.10	154.26	1.8	≤50%
P-609	MH-606	MH-608	8	8		188	152.05	149.86	1.165	PVC	53.70	152.21	1.9	≤50%
P-610	MH-608	MH-445	8	8		41	149.86	149.66	0.488	PVC	57.30	150.08	2.6	≤50%
P-1768	MH-1858	MH-1857	8	8		144	204.01	203.29	0.5	PVC	0.00	204.01	0.0	≤50%
P-559	MH-557	MH-558	8	8		76	206.81	206.41	0.526	PVC	3.60	206.86	0.6	≤50%
P-561	MH-558	MH-560	8	8		400	206.41	204.57	0.46	PVC	7.20	206.47	0.7	≤50%
P-1851	MH-1943	MH-597	8	8		165	240.45	233.77	4.048	PVC	0.00	240.45	0.0	≤50%
P-1850	MH-1942	MH-1941	8	8		93	234.23	233.77	0.495	PVC	0.00	234.23	0.0	≤50%
P-1849	MH-1941	MH-597	8	8		129	233.67	223.05	8.233	PVC	0.00	233.67	0.0	≤50%
P-598	MH-597	MH-560	8	8		287	222.95	204.57	6.404	PVC	3.60	222.99	0.5	≤50%
P-589	MH-587	MH-588	8	8		168	234.47	214.64	11.804	PVC	3.60	234.51	0.5	≤50%
P-591	MH-588	MH-590	8	8		47	214.54	213.28	2.681	PVC	7.20	214.6	0.7	≤50%
P-593	MH-590	MH-592	8	8		210	213.18	209.06	1.962	PVC	10.80	213.25	0.8	≤50%
P-595	MH-592	MH-594	8	8		109	208.96	208.37	0.541	PVC	14.40	209.05	1.1	≤50%
P-596	MH-594	MH-560	8	8		80	208.27	204.57	4.625	PVC	18.00	208.36	1.1	≤50%
P-563(1)	MH-560	MH-1857	8	8		294	204.47	203.29	0.4	PVC	32.41	204.59	1.4	≤50%
P-563(2)	MH-1857	MH-562	8	8		52	203.19	202.98	0.4	PVC	32.41	203.31	1.4	≤50%
P-565	MH-562	MH-564	8	8		77	202.88	202.57	0.4	PVC	36.01	203.02	1.7	≤50%
P-567	MH-564	MH-566	8	8		375	202.47	200.97	0.4	PVC	39.61	202.62	1.8	≤50%
P-569	MH-566	MH-568	8	8		86	200.87	200.6	0.314	PVC	43.21	201.04	2.0	≤50%
P-571	MH-568	MH-570	8	8		288	200.5	199.35	0.399	PVC	46.81	200.67	2.0	≤50%
P-1693	MH-1786	MH-1785	8	8		213	255.4	254.54	0.4	PVC	0.00	255.4	0.0	≤50%
P-1692	MH-1785	MH-1784	8	8		46	254.54	254.36	0.4	PVC	0.00	254.54	0.0	≤50%
P-1691	MH-1784	MH-1783	8	8		160	254.36	253.72	0.4	PVC	0.00	254.36	0.0	≤50%
P-1690	MH-1783	MH-1782	8	8		68	253.72	253.45	0.4	PVC	0.00	253.72	0.0	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1689	MH-1782	MH-1781	8	8		122	253.45	252.96	0.4	PVC	0.00	253.45	0.0	≤50%
P-1688	MH-1781	MH-577	8	8		10	252.96	252.92	0.4	PVC	0.00	253.01	0.6	≤50%
P-579	MH-577	MH-578	8	8		240	252.92	241.07	4.938	PVC	16.46	253.01	1.1	≤50%
P-581	MH-578	MH-580	8	8		152	240.97	227.6	8.796	PVC	20.06	241.07	1.2	≤50%
P-586	MH-585	MH-580	8	8		174	233.68	227.6	3.494	PVC	3.60	233.72	0.5	≤50%
P-583	MH-580	MH-582	8	8		400	227.5	202.51	6.248	PVC	27.26	227.61	1.3	≤50%
P-584	MH-582	MH-570	8	8		57	202.41	199.45	5.193	PVC	30.86	202.53	1.4	≤50%
P-573	MH-570	MH-572	8	8		373	199.35	176.21	6.204	PVC	81.28	199.55	2.4	≤50%
P-575	MH-572	MH-574	8	8		281	176.11	173.45	0.947	PVC	84.88	176.31	2.4	≤50%
P-576	MH-574	MH-441	8	8		400	173.35	171.25	0.525	PVC	88.48	173.56	2.5	≤50%
P-1770	MH-1861	MH-1860	8	8		156	185.33	184.6	0.468	PVC	0.00	185.33	0.0	≤50%
P-1769	MH-1860	MH-1859	8	8		366	184.5	181.12	0.923	PVC	0.00	184.5	0.0	≤50%
P-539(2)	MH-1859	MH-538	8	8		193	181.02	179.99	0.534	PVC	0.00	181.02	0.0	≤50%
P-541	MH-538	MH-540	8	8		218	179.89	177.66	1.023	PVC	3.60	179.93	0.5	≤50%
P-543	MH-540	MH-542	8	8		58	177.56	177.25	0.534	PVC	7.20	177.62	0.7	≤50%
P-545	MH-542	MH-544	8	8		141	177.15	175.1	1.454	PVC	10.80	177.22	0.8	≤50%
P-547	MH-544	MH-546	8	8		324	175	172.2	0.864	PVC	14.40	175.08	1.0	≤50%
P-551	MH-549	MH-550	8	8		97	180.72	178.72	2.062	PVC	3.60	180.76	0.5	≤50%
P-553	MH-550	MH-552	8	8		148	178.62	177.73	0.601	PVC	7.20	178.68	0.7	≤50%
P-555	MH-552	MH-554	8	8		169	177.63	176.62	0.598	PVC	10.80	177.7	0.8	≤50%
P-556	MH-554	MH-546	8	8		278	176.52	172.2	1.554	PVC	14.40	176.6	1.0	≤50%
P-548	MH-546	MH-437	8	8		345	171.98	169.85	0.617	PVC	32.41	172.1	1.4	≤50%
P-513	MH-511	MH-512	8	8		276	186.12	183.48	0.957	PVC	3.60	186.16	0.5	≤50%
P-515	MH-512	MH-514	8	8		382	183.18	181.06	0.555	PVC	7.20	183.24	0.7	≤50%
P-532	MH-531	MH-514	8	8		343	192.81	189.44	0.983	PVC	3.60	192.85	0.5	≤50%
P-517	MH-514	MH-516	8	8		166	180.95	179.74	0.729	PVC	14.40	181.03	1.0	≤50%
P-1429	MH-1428	MH-675	10	10		390	188.2	186.64	0.4	PVC	3.60	188.25	0.6	≤50%
P-676	MH-675	MH-516	10	10		164	186.18	179.89	3.835	PVC	7.20	186.23	0.6	≤50%
P-519	MH-516	MH-518	10	10		401	179.7	177.06	0.658	PVC	25.21	179.8	1.2	≤50%
P-520	MH-518	MH-431	10	10		399	176.97	174.58	0.599	PVC	28.81	177.08	1.3	≤50%
P-536	MH-535	MH-429	8	8		348	186.97	186.26	0.204	PVC	3.60	187.03	0.7	≤50%
P-530	MH-529	MH-524	8	8		101	190.75	181.73	8.931	PVC	3.60	190.79	0.5	≤50%
P-523	MH-521	MH-522	8	8		268	185.31	182.26	1.138	PVC	3.60	185.35	0.5	≤50%
P-525	MH-522	MH-524	8	8		65	182.16	181.63	0.815	PVC	7.20	182.22	0.7	≤50%
P-527	MH-524	MH-526	8	8		250	181.63	179.85	0.712	PVC	14.40	181.71	1.0	≤50%
P-528	MH-526	MH-427	8	8		249	179.75	177.61	0.859	PVC	18.00	179.84	1.1	≤50%
P-534	MH-533	MH-425	8	8		173	182.49	178.79	2.139	PVC	3.60	182.53	0.5	≤50%
P-1532	MH-1477	MH-703	8	8		325	197.73	196.43	0.4	PVC	3.60	197.77	0.5	≤50%
P-790	MH-703	MH-702	8	8		67	196.33	196.06	0.403	PVC	7.20	196.39	0.7	≤50%
P-1531	MH-702	MH-1475	8	8		256	195.96	194.94	0.398	PVC	10.80	196.03	0.8	≤50%
P-788	MH-701	MH-1476	8	8		183	205.13	203.15	1.082	PVC	3.60	205.17	0.5	≤50%
P-1530	MH-1476	MH-699	8	8		66	203.05	202.35	1.061	PVC	7.20	203.11	0.7	≤50%
P-786	MH-699	MH-1475	8	8		148	202.25	194.94	4.939	PVC	10.80	202.32	0.8	≤50%
P-803	MH-1481	MH-413	8	8		238	210.13	207.36	1.164	PVC	3.60	210.17	0.5	≤50%
P-1529	MH-413	MH-1475	8	8		235	207.26	194.94	5.243	PVC	7.20	207.32	0.7	≤50%
P-792	MH-1475	MH-417	8	8		186	194.84	194.1	0.398	PVC	32.41	194.96	1.4	≤50%
P-698	MH-417	MH-419	8	8		90	183.23	182.87	0.4	PVC	36.01	183.38	1.8	≤50%
P-694	MH-419	MH-421	8	8		192	182.77	181.92	0.443	PVC	39.61	182.92	1.8	≤50%
P-700	MH-421	MH-423	8	8		285	181.82	180.68	0.4	PVC	43.21	181.98	1.9	≤50%
P-706	MH-423	MH-425	8	8		400	180.58	178.79	0.448	PVC	46.81	180.74	1.9	≤50%
P-708	MH-425	MH-427	8	8		269	178.69	177.61	0.401	PVC	54.01	178.87	2.2	≤50%
P-710	MH-427	MH-429	8	8		308	177.51	176.16	0.438	PVC	75.62	177.72	2.5	≤50%
P-712	MH-429	MH-431	8	8		170	176.06	175.14	0.541	PVC	82.82	176.27	2.5	≤50%
P-715	MH-431	MH-433	10	10		372	174.51	172.5	0.54	PVC	115.23	174.73	2.6	≤50%
P-717	MH-433	MH-435	10	10		392	172.5	170.07	0.62	PVC	132.95	172.74	2.9	≤50%
P-718	MH-435	MH-437	10	10		91	170.02	169.7	0.352	PVC	136.55	170.29	3.2	≤50%
P-720	MH-437	MH-439	8	8		112	169.7	169.13	0.509	PVC	172.56	170.01	3.7	≤50%
P-722	MH-439	MH-441	8	8		175	169.13	167.9	0.703	PVC	176.16	169.42	3.5	≤50%
P-724	MH-441	MH-443	8	8		244	167.9	164.82	1.262	PVC	268.23	168.26	4.3	55%
P-726	MH-443	MH-445	8	8		280	164.72	157.16	2.7	PVC	271.83	165.09	4.4	57%
P-728	MH-445	MH-447	8	8		47	149.66	149.1	1.191	PVC	332.74	150.07	4.9	65%
P-729	MH-447	MH-449	8	8		217	149	145.9	1.429	PVC	361.55	149.42	5.0	66%
P-730	MH-449	MH-451	8	10	SM4	258	145.8	144.66	0.442	PVC	365.15	146.2	4.8	≤50%
P-732	MH-451	MH-453	8	10	SM4	308	144.56	137.93	2.153	PVC	379.55	144.97	4.9	≤50%

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2025 General Sewer Plan
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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1776	MH-1868	MH-1867	8	8		30	142.07	141.93	0.467	PVC	0.00	142.21	1.7	≤50%
P-1775	MH-1867	MH-1866	8	8		188	141.93	141.07	0.457	PVC	163.11	142.21	3.4	≤50%
P-1774	MH-1866	MH-1865	8	8		290	141.07	139.69	0.476	PVC	163.11	141.35	3.4	≤50%
P-1773	MH-1865	MH-1864	8	8		138	139.56	138.87	0.5	PVC	163.11	139.84	3.4	≤50%
P-1772	MH-1864	MH-453	8	8		68	138.82	138.47	0.515	PVC	163.11	139.1	3.4	≤50%
P-733	MH-453	MH-455	8	10	SM4	265	137.93	136.8	0.426	PVC	553.46	138.43	6.0	63%
P-736	MH-455	MH-457	8	10	SM4	175	136.7	136.1	0.343	PVC	557.06	137.24	6.5	69%
P-737	MH-457	MH-459	8	12	SM4	51	136.1	135.92	0.353	PVC	585.87	136.58	5.8	≤50%
P-1657	MH-459	MH-1751	12	12		323	135.69	134.64	0.325	PVC	683.50	136.23	6.5	55%
P-1656	MH-1751	MH-1750	12	12		204	134.64	131.6	1.49	PVC	683.50	135.16	6.2	53%
P-1655	MH-1750	MH-1749	12	12		222	131.13	126.79	1.955	PVC	683.50	131.65	6.2	53%
P-1654	MH-1749	MH-1748	12	12		237	126.61	120.78	2.46	PVC	683.50	127.13	6.2	53%
P-1653	MH-1748	MH-1747	12	12		29	120.66	119.4	4.345	PVC	683.50	121.18	6.2	53%
P-1652	MH-1747	MH-1746	12	12		157	119.29	116.44	1.815	PVC	683.50	119.81	6.2	53%
P-1651	MH-1746	MH-1745	12	12		308	116.33	111.05	1.714	PVC	683.50	116.85	6.2	53%
P-1650	MH-1745	MH-1744	12	12		113	110.86	109.73	1	PVC	683.50	111.38	6.2	53%
P-1649	MH-1744	MH-1743	12	12		146	109.6	108.85	0.514	PVC	683.50	110.12	6.2	53%
P-1648	MH-1743	MH-1742	12	12		121	108.85	107.8	0.868	PVC	683.50	109.37	6.2	53%
P-1646	MH-1742	MH-1741	15	15		8	107.7	107.65	0.625	PVC	683.50	108.19	5.9	≤50%
P-1606(1)(1)(1)(2)	MH-1741	MH-1739	15	15		53	107.55	107.23	0.604	PVC	683.50	108.04	5.9	≤50%
P-1606(1)(1)(2)	MH-1739	MH-1738	15	15		6	107.13	107.1	0.5	PVC	765.81	107.65	6.2	≤50%
P-1606(1)(2)	MH-1738	MH-1737	15	15		172	107	105.98	0.593	PVC	765.81	107.52	6.2	≤50%
P-1606(2)	MH-1737	MH-1703	15	15		315	105.88	103.99	0.6	PVC	765.81	106.4	6.2	≤50%
P-1607	MH-1703	MH-1704	15	15		128	103.89	103.12	0.602	PVC	765.81	104.41	6.2	≤50%
P-1608	MH-1704	MH-1705	15	15		220	103.02	101.7	0.6	PVC	765.81	103.54	6.2	≤50%
P-1609	MH-1705	MH-1706	15	15		341	101.6	99.55	0.601	PVC	765.81	102.12	6.2	≤50%
P-1610	MH-1706	MH-1707	15	15		63	99.45	99.07	0.603	PVC	765.81	99.97	6.2	≤50%
P-1611(1)(1)	MH-1707	MH-1972	15	15		142	98.97	98.1	0.613	PVC	765.81	99.49	6.2	≤50%
P-1611(1)(2)	MH-1972	MH-1736	15	15		172	98.97	98.1	0.506	PVC	765.81	99.49	6.2	≤50%
P-1611(2)	MH-1736	MH-1708	15	15		67	98.1	94.69	5.09	PVC	765.81	98.62	6.2	≤50%
P-1612	MH-1708	MH-1709	12	12		16	92.69	90.73	12.25	PVC	799.00	93.26	6.8	59%
P-1613	MH-1709	MH-1710	12	12		104	90.63	90.18	0.433	PVC	799.00	91.2	6.8	59%
P-1614	MH-1710	MH-1711	12	12		58	90.08	89.87	0.362	PVC	799.00	90.66	7.0	60%
P-1615	MH-1711	MH-1712	12	12		65	89.77	89.49	0.431	PVC	799.00	90.34	6.8	59%
P-1616	MH-1712	MH-792	12	12		246	89.39	88.41	0.398	PVC	799.00	89.96	6.8	59%
P-795	MH-792	MH-794	10	12	SM1	309	86.28	85.19	0.353	PVC	811.18	86.87	7.1	61%
P-796	MH-794	MH-741	10	15	SM1	297	85.11	84.31	0.269	PVC	833.34	85.68	6.8	≤50%
P-744	MH-741	MH-743	10	15	SM1	237	84.1	83.26	0.354	PVC	1,031.06	84.71	7.3	≤50%
P-746	MH-743	MH-745	10	15	SM1	252	83.18	82.48	0.278	PVC	1,032.28	83.82	7.7	52%
P-748	MH-745	MH-747	10	15	SM1	243	82.4	81.84	0.23	PVC	1,077.65	83.09	8.3	57%
P-800	MH-747	MH-799	10	15	SM1	173	81.74	81.25	0.283	PVC	1,087.40	82.4	7.9	54%
P-1750	MH-799	MH-1839	12	15	SM1	18	81.07	80.98	0.5	PVC	1,091.06	81.69	7.4	≤50%
P-1751	MH-1839	MH-1840	12	15	SM1	42	80.88	80.68	0.476	PVC	1,091.06	81.5	7.4	≤50%
P-1752	MH-1840	MH-1760	12	15	SM1	298	80.58	79.09	0.5	PVC	1,091.06	81.2	7.4	≤50%
P-848	MH-846	MH-847	8	8		53	82.12	81.71	0.774	PVC	1.22	82.14	0.2	≤50%
P-850	MH-847	MH-849	8	8		136	81.71	71.09	7.809	PVC	2.44	81.74	0.4	≤50%
P-852	MH-849	MH-851	8	8		65	80.95	80.69	0.4	PVC	3.66	81	0.6	≤50%
P-853	MH-851	MH-803	8	8		324	80.59	79.29	0.401	PVC	4.87	80.65	0.7	≤50%
P-861(2)	MH-803	MH-1760	15	15		16	79.09	78.95	0.875	PVC	6.09	79.54	5.4	≤50%
P-863	MH-862	MH-855	8	8		100	81.5	81.15	0.35	PVC	22.28	81.62	1.4	≤50%
P-856	MH-854	MH-855	8	8		149	81.7	81.15	0.369	PVC	1.22	81.73	0.4	≤50%
P-858	MH-855	MH-857	8	8		150	81.15	80.36	0.527	PVC	24.72	81.26	1.3	≤50%
P-860	MH-857	MH-859	8	8		66	80.36	79.83	0.803	PVC	25.94	80.47	1.3	≤50%
P-861(1)	MH-859	MH-1760	8	8		52	79.58	79.32	0.5	PVC	27.16	79.7	1.4	≤50%
P-1666	MH-1760	MH-1758	15	15		355	78.91	77.43	0.417	PVC	1,124.31	79.54	7.6	51%
P-1665	MH-1758	MH-1757	15	15		165	72.77	70.54	1.352	PVC	1,124.31	73.4	7.6	51%
P-1664	MH-1757	MH-1756	15	15		278	70.44	69.26	0.424	PVC	1,124.31	71.07	7.6	51%
P-1663	MH-1756	MH-1755	15	15		400	69.16	67.46	0.425	PVC	1,124.31	69.79	7.6	51%
P-1662	MH-1755	MH-1754	15	15		400	67.36	65.66	0.425	PVC	1,124.31	67.99	7.6	51%
P-1660	MH-1754	MH-711	15	15		23	65.65	65.56	0.391	PVC	1,124.31	66.28	7.6	51%
P-845	MH-844	MH-811	8	8		276	68.3	66.85	0.525	PVC	1.22	68.33	0.4	≤50%
P-808	MH-805	MH-807	8	8		285	79.06	77.63	0.502	PVC	1.22	79.09	0.4	≤50%
P-870	MH-868	MH-869	8	8		138	82.98	81.93	0.761	PVC	1.22	83	0.2	≤50%
P-871	MH-869	MH-807	8	8		281	81.83	76.84	1.776	PVC	2.44	81.86	0.4	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-810	MH-807	MH-809	8	8		300	77.53	68.78	2.917	PVC	4.87	77.58	0.6	≤50%
P-812	MH-809	MH-811	8	8		155	68.1	66.85	0.806	PVC	19.39	68.19	1.1	≤50%
P-1538	MH-811	MH-711	15	15		37	65.75	65.56	0.514	PVC	21.83	66.1	4.2	≤50%
P-801	MH-711	MH-1480	15	15		252	65.46	64.21	0.496	PVC	1,147.36	66.1	7.7	52%
P-1537	MH-1480	MH-709	15	15		249	64.1	61.73	0.952	PVC	1,199.54	64.76	7.9	54%
P-799	MH-709	MH-1479	15	15		398	61.63	55.94	1.43	PVC	1,200.69	62.29	7.9	54%
P-1536	MH-1479	MH-1444	15	18	SM11	19	55.84	55.74	0.526	PVC	1,201.85	56.76	11.0	64%
P-1446	MH-1444	MH-1436	12	15	SM11	114	56.11	55.4	0.623	PVC	1,203.00	56.77	7.9	54%
P-1440	MH-1436	MH-817	12	15	SM11	16	55.3	55.25	0.312	PVC	1,204.16	55.98	8.2	56%
P-820	MH-817	MH-819	12	15	SM8	175	55.15	54.68	0.269	PVC	1,205.31	55.86	8.5	59%
P-874	MH-872	MH-873	8	8		160	114	106.35	4.781	PVC	1.16	114.02	0.2	≤50%
P-891	MH-890	MH-873	8	8		313	109.05	106.35	0.863	PVC	1.16	109.07	0.2	≤50%
P-876	MH-873	MH-875	8	8		310	106.25	94.71	3.723	PVC	3.47	106.29	0.5	≤50%
P-894	MH-892	MH-893	8	8		144	102	96.51	3.813	PVC	1.16	102.02	0.2	≤50%
P-895	MH-893	MH-875	8	8		330	96.41	94.71	0.515	PVC	2.31	96.45	0.5	≤50%
P-878	MH-875	MH-877	8	8		186	94.61	86.76	4.22	PVC	6.93	94.67	0.7	≤50%
P-880	MH-877	MH-879	8	8		255	86.66	58.71	10.961	PVC	8.09	86.72	0.7	≤50%
P-889	MH-888	MH-879	8	8		160	60.28	58.71	0.981	PVC	1.16	60.3	0.2	≤50%
P-882	MH-879	MH-881	8	8		112	58.61	56.75	1.661	PVC	10.40	58.68	0.8	≤50%
P-886	MH-884	MH-885	8	8		300	60.5	58.23	0.757	PVC	1.16	60.52	0.2	≤50%
P-887	MH-885	MH-881	8	8		273	58.13	56.75	0.505	PVC	2.31	58.17	0.5	≤50%
P-883	MH-881	MH-819	8	8		140	56.65	55.01	1.171	PVC	13.86	56.73	1.0	≤50%
P-822	MH-819	MH-821	12	15	SM8	302	54.58	53.51	0.354	PVC	1,220.33	55.24	7.9	54%
P-1431	MH-821	MH-1430	12	15	SM8	301	53.41	52.33	0.359	PVC	1,372.26	54.11	8.4	58%
P-1659	MH-1430	MH-1752	15	18	SM11	297	52.23	51.79	0.148	PVC	1,373.42	53.05	9.8	56%
P-1673	MH-1752	MH-1766	15	15		27	51.69	51.47	0.815	PVC	1,373.42	52.39	8.4	58%
P-1672	MH-1766	MH-1765	15	15		178	51.37	49.73	0.921	PVC	1,373.42	52.07	8.4	58%
P-1671	MH-1765	MH-1764	15	15		154	49.63	48.25	0.896	PVC	1,373.42	50.33	8.4	58%
P-1670	MH-1764	MH-1763	15	15		154	48.15	46.73	0.922	PVC	1,373.42	48.85	8.4	58%
P-1669	MH-1763	MH-707	15	15		154	46.63	45.22	0.916	PVC	1,373.42	47.33	8.4	58%
P-908	MH-907	MH-905	8	8		208	110	102.67	3.524	PVC	1.16	110.02	0.2	≤50%
P-904	MH-902	MH-903	8	8		103	105	104	0.971	PVC	1.16	105.02	0.2	≤50%
P-906	MH-903	MH-905	8	8		122	103.9	102.67	1.008	PVC	2.31	103.93	0.4	≤50%
P-911	MH-909	MH-910	8	8		91	113	109	4.396	PVC	1.16	113.02	0.2	≤50%
P-912	MH-910	MH-905	8	8		474	108.9	102.65	1.319	PVC	2.31	108.93	0.4	≤50%
P-914	MH-905	MH-913	8	8		135	102.55	101.85	0.519	PVC	6.93	102.61	0.7	≤50%
P-916	MH-913	MH-915	8	8		338	101.75	85.11	4.923	PVC	8.09	101.81	0.7	≤50%
P-924	MH-922	MH-923	8	8		148	104.5	98.1	4.324	PVC	1.16	104.52	0.2	≤50%
P-926	MH-923	MH-925	8	8		107	98	92.1	5.514	PVC	2.31	98.03	0.4	≤50%
P-927	MH-925	MH-915	8	8		212	92	85.11	3.25	PVC	3.47	92.04	0.5	≤50%
P-918	MH-915	MH-917	8	8		163	85.01	71.6	8.227	PVC	12.71	85.09	1.0	≤50%
P-920	MH-917	MH-919	8	8		81	71.5	66.18	6.568	PVC	13.86	71.58	1.0	≤50%
P-921	MH-919	MH-831	8	8		190	66.08	45.52	10.821	PVC	15.02	66.16	1.0	≤50%
P-898	MH-896	MH-897	8	8		165	65.5	63.1	1.455	PVC	1.16	65.52	0.2	≤50%
P-900	MH-897	MH-899	8	8		217	63	59	1.843	PVC	2.31	63.03	0.4	≤50%
P-901	MH-899	MH-827	8	8		131	58.9	48.33	8.069	PVC	3.47	58.94	0.5	≤50%
P-828	MH-825	MH-827	8	8		246	50.37	48.23	0.87	PVC	1.16	50.39	0.2	≤50%
P-830	MH-827	MH-829	8	8		42	48.23	47.76	1.119	PVC	5.78	48.28	0.6	≤50%
P-832	MH-829	MH-831	8	8		300	47.71	45.52	0.73	PVC	6.93	47.77	0.7	≤50%
P-1535	MH-831	MH-707	15	15		38	45.42	45.22	0.526	PVC	23.11	45.83	4.9	≤50%
P-1534	MH-707	MH-1478	15	15		393	45.12	38.98	1.562	PVC	1,397.68	45.83	8.5	59%
P-794	MH-1478	MH-705	15	15		412	38.88	32.71	1.498	PVC	1,398.83	39.59	8.5	59%
P-1533	MH-705	MH-837	18	18		64	32.17	32	0.266	PVC	1,401.04	32.87	8.4	≤50%
P-840	MH-837	MH-839	10	18	SM5	239	31.9	28.41	1.46	PVC	1,412.07	32.58	8.2	≤50%
P-842	MH-839	MH-841	10	18	SM5	116	28.32	27.63	0.595	PVC	1,414.82	29	8.2	≤50%
P-1668	MH-841	MH-1762	18	18		45	27.6	27.45	0.337	PVC	1,417.58	28.28	8.2	≤50%
P-699	MH-697	MH-698	8	8		351	113	105.3	2.194	PVC	2.76	113.04	0.5	≤50%
P-701	MH-698	MH-700	8	8		426	105.2	103.2	0.469	Concrete	5.51	105.26	0.7	≤50%
P-702	MH-700	MH-692	8	8		442	103.1	80.1	5.204	Concrete	8.27	103.16	0.7	≤50%
P-693	MH-691	MH-692	8	8		190	99.5	80.2	10.158	Concrete	3.16	99.54	0.5	≤50%
P-703	MH-692	MH-1473	8	8		164	80	71.3	5.305	Concrete	14.19	80.08	1.0	≤50%
P-696	MH-694	MH-1473	8	8		224	82.5	71.2	5.045	Concrete	2.76	82.54	0.5	≤50%
P-705(1)	MH-1473	MH-1762	8	8		330	71.1	32.83	11.597	Concrete	19.70	71.19	1.1	≤50%
P-1667	MH-1762	MH-1761	18	18		51	27.35	27.18	0.333	PVC	1,437.28	28.03	8.2	≤50%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
20-Year (2044) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-707(2)	MH-1761	MH-706	18	18		303	27.08	26.02	0.35	PVC	1,437.28	27.76	8.2	≤50%
P-709	MH-706	MH-708	18	18		233	25.92	25.11	0.348	PVC	1,440.04	26.6	8.2	≤50%
P-711	MH-708	MH-710	15	15		59	25.01	24.59	0.712	PVC	1,442.79	25.73	8.6	60%
P-713	MH-710	MH-712	15	15		363	24.49	22.22	0.625	PVC	1,445.55	25.21	8.6	60%
P-714	MH-712	MH-71	15	15		376	22.12	19.77	0.625	PVC	1,496.05	22.86	8.9	62%
P-749	MH-71	MH-1391	12	18	SM3	144	19.67	10.5	6.368	PVC	2,222.95	20.53	10.3	59%
P-1392	MH-1391	MH-1375	12	18	SM3	76	10.4	5.14	6.921	PVC	2,225.86	11.26	10.3	59%
P-1389	MH-1375	MH-1374	18	21	SM3	440	4.94	-2.16	1.614	PVC	3,094.99	5.91	11.6	57%
P-1388	MH-1374	MH-1373	24	24		162	-2.26	-4.29	1.253	PVC	3,097.90	-1.33	11.2	≤50%
P-1387	MH-1373	MH-1372	27	27		150	-4.49	-4.51	0.013	PVC	3,100.81	-3.04	17.4	68%
P-1386	MH-1372	MH-1371	27	27		409	-4.51	-4.66	0.037	PVC	3,103.72	-3.15	16.3	63%
P-1385	MH-1371	MH-1370	27	27		151	-4.76	-5.08	0.212	PVC	3,108.96	-3.8	11.5	≤50%
P-1384	MH-1370	MH-1369	27	27		325	-5.08	-5.46	0.117	PVC	3,114.20	-3.95	13.6	50%
P-1383	MH-1369	MH-1368	27	27		302	-5.46	-5.89	0.142	PVC	3,119.44	-4.38	13.0	≤50%
P-1382	MH-1368	MH-1367	27	27		371	-5.89	-6.21	0.086	PVC	3,124.68	-4.69	14.4	54%
P-1381	MH-1367	MH-1366	27	27		302	-6.31	-6.75	0.146	PVC	3,129.92	-5.25	12.7	≤50%
P-1380	MH-1366	MH-1365	27	27		599	-6.85	-7.55	0.117	PVC	3,135.16	-5.71	13.7	51%
P-704	MH-1365	MH-1364	27	27		89	-7.65	-7.98	0.371	PVC	3,140.40	-6.6	12.6	≤50%
P-1378	MH-1364	MH-1363	27	27		263	-7.98	-8.01	0.011	PVC	3,145.64	-6.56	17.0	67%
P-1377	MH-1363	MH-1362	27	27		230	-8.01	-8.2	0.083	PVC	3,150.88	-6.82	14.3	54%
P-1641	MH-1362	WW-MAIN	24	24		23	-8.4	-8.8	1.739	Ductile Iron	3,156.12	-7.46	11.3	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1784	MH-1878	MH-1879	8	8		161	137.88	134.41	2.155	PVC	0.00	137.88	0.0	≤50%
P-1785	MH-1879	MH-1880	8	8		200	134.31	130.85	1.73	PVC	0.00	134.31	0.0	≤50%
P-1786	MH-1880	MH-1881	8	8		200	130.75	128.93	0.91	PVC	0.00	130.75	0.0	≤50%
P-1787	MH-1881	MH-1882	8	8		142	128.83	127.4	1.007	PVC	0.00	128.83	0.0	≤50%
P-1788	MH-1882	MH-1877	8	8		217	127.28	125.58	0.783	PVC	0.00	127.28	0.0	≤50%
P-1782	MH-1876	MH-1877	8	8		371	134.3	125.58	2.35	PVC	0.00	134.3	0.0	≤50%
P-1783	MH-1877	MH-1874	8	8		122	125.58	124.94	0.525	PVC	0.00	125.58	0.0	≤50%
P-1777	MH-1870	MH-1871	8	8		66	135.03	133.42	2.439	PVC	0.00	135.03	0.0	≤50%
P-1778	MH-1871	MH-1872	8	8		169	133.34	129.04	2.544	PVC	0.00	133.34	0.0	≤50%
P-1779	MH-1872	MH-1873	8	8		144	128.94	125.65	2.285	PVC	0.00	128.94	0.0	≤50%
P-1780	MH-1873	MH-1874	8	8		69	125.55	124.94	0.884	PVC	0.00	125.55	0.0	≤50%
P-1781	MH-1874	MH-1875	8	8		283	124.84	123.18	0.587	PVC	0.00	124.84	0.0	≤50%
P-1875	MH-1875	WW-10	8	8		10	123	123	0	PVC	0.00	123	0.0	≤50%
P-390	MH-389	MH-387	12	12		58	125.59	125.21	0.655	PVC	143.79	125.82	2.8	≤50%
P-493	MH-491	MH-492	8	8		282	191.11	182.09	3.199	PVC	2.82	191.15	0.5	≤50%
P-495	MH-492	MH-494	8	8		282	181.98	180.01	0.699	PVC	5.64	182.03	0.6	≤50%
P-497	MH-494	MH-496	8	8		150	179.94	179	0.627	PVC	8.46	180	0.7	≤50%
P-499	MH-496	MH-498	8	8		230	178.93	174.07	2.113	PVC	11.28	179	0.8	≤50%
P-500	MH-498	MH-474	8	8		260	173.93	158.13	6.077	PVC	14.10	174.01	1.0	≤50%
P-467	MH-465	MH-466	8	8		112	179.62	178.85	0.688	PVC	2.82	179.66	0.5	≤50%
P-469	MH-466	MH-468	8	8		239	178.85	171.09	3.247	PVC	5.64	178.9	0.6	≤50%
P-471	MH-468	MH-470	8	8		293	170.92	160.08	3.7	PVC	8.46	170.98	0.7	≤50%
P-473	MH-470	MH-472	8	8		159	159.94	159.08	0.541	PVC	11.28	160.02	1.0	≤50%
P-475	MH-472	MH-474	8	8		146	159.03	158.19	0.575	PVC	14.10	159.11	1.0	≤50%
P-477	MH-474	MH-476	8	8		359	157.88	156.37	0.421	PVC	31.01	158.01	1.6	≤50%
P-479	MH-476	MH-478	8	8		71	156.21	155.85	0.507	PVC	33.83	156.34	1.6	≤50%
P-481	MH-478	MH-480	8	8		180	155.85	155.15	0.389	PVC	36.65	156	1.8	≤50%
P-483	MH-480	MH-482	8	8		64	155.02	154.72	0.469	PVC	39.47	155.17	1.8	≤50%
P-485	MH-482	MH-484	8	8		69	154.72	152.33	3.464	PVC	42.29	154.86	1.7	≤50%
P-487	MH-484	MH-486	8	8		244	152.33	146.91	2.221	PVC	45.11	152.47	1.7	≤50%
P-489	MH-486	MH-488	12	12		256	146.6	138.64	3.109	PVC	47.93	146.73	1.6	≤50%
P-490	MH-488	MH-383	12	12		193	138.5	131.82	3.461	PVC	50.75	138.64	1.7	≤50%
P-372	MH-370	MH-371	8	8		78	230.75	224.6	7.885	PVC	2.82	230.79	0.5	≤50%
P-374	MH-371	MH-373	8	8		278	224.43	201.79	8.144	PVC	5.64	224.48	0.6	≤50%
P-376	MH-373	MH-375	8	8		301	201.7	196.85	1.611	PVC	8.46	201.76	0.7	≤50%
P-394	MH-393	MH-375	8	8		128	197.93	196.75	0.922	PVC	2.82	197.97	0.5	≤50%
P-378	MH-375	MH-377	8	8		249	196.72	179.76	6.811	PVC	14.10	196.8	1.0	≤50%
P-380	MH-377	MH-379	8	8		267	179.56	155.67	8.948	PVC	16.92	179.65	1.1	≤50%
P-382	MH-379	MH-381	8	8		147	155.55	139.74	10.755	PVC	19.73	155.64	1.1	≤50%
P-410	MH-409	MH-406	8	8		350	165.94	161.08	1.389	PVC	2.82	165.98	0.5	≤50%
P-412	MH-411	MH-402	8	8		145	198.2	193.94	2.938	PVC	2.82	198.24	0.5	≤50%
P-397	MH-395	MH-396	8	8		106	226.27	221.56	4.443	PVC	2.82	226.31	0.5	≤50%
P-399	MH-396	MH-398	8	8		106	221.36	216.32	4.755	PVC	5.64	221.41	0.6	≤50%
P-401	MH-398	MH-400	8	8		81	216.08	212.33	4.63	PVC	8.46	216.14	0.7	≤50%
P-403	MH-400	MH-402	8	8		399	212.21	194.02	4.559	PVC	11.28	212.28	0.8	≤50%
P-405	MH-402	MH-404	8	8		327	193.84	179.16	4.489	PVC	16.92	193.93	1.1	≤50%
P-407	MH-404	MH-406	8	8		338	179.02	161.08	5.308	PVC	19.73	179.11	1.1	≤50%
P-408	MH-406	MH-381	8	8		387	161	139.74	5.494	PVC	25.37	161.11	1.3	≤50%
P-384	MH-381	MH-383	12	12		219	139.43	131.82	3.475	PVC	47.93	139.56	1.6	≤50%
P-386	MH-383	MH-385	12	12		20	131.66	131.33	1.65	PVC	101.49	131.86	2.4	≤50%
P-388	MH-385	MH-387	12	12		62	131.26	125.21	9.758	PVC	101.49	131.46	2.4	≤50%
P-685	MH-387	WW-COPPER	30	30		23	125.12	122.5	11.391	PVC	245.28	125.36	2.9	≤50%
P-719	MH-717	MH-718	8	8		32	79.2	79	0.625	PVC	4.16	79.25	0.6	≤50%
P-721	MH-718	MH-720	8	8		33	79	78.72	0.848	PVC	8.33	79.06	0.7	≤50%
P-723	MH-720	MH-722	8	8		104	78.71	77.97	0.712	PVC	12.49	78.79	1.0	≤50%
P-725	MH-722	MH-724	8	8		64	77.87	77.29	0.906	PVC	34.47	78	1.6	≤50%
P-731	MH-724	MH-730	8	8		20	76.31	74.48	9.15	PVC	38.63	76.44	1.6	≤50%
P-734	MH-732	MH-733	8	8		325	76.9	75.6	0.4	PVC	134.36	77.19	3.5	≤50%
P-735	MH-733	MH-730	8	8		256	75.5	74.48	0.398	PVC	138.52	75.92	5.0	66%
P-691	MH-730	WW-LINDSTROM	30	30		1	74.48	74.46	2	PVC	181.31	75.76	15.4	52%
P-1455	MH-1450	MH-1451	6	6		105	45.71	40.8	4.676	PVC	4.16	45.76	0.6	≤50%
P-1469	MH-1451	MH-1467	8	8		50	40.7	40.2	1	PVC	8.33	40.76	0.7	≤50%
P-1456	MH-1449	MH-1448	8	8		246	53.16	35.4	7.22	PVC	4.16	53.2	0.5	≤50%
P-1457	MH-1448	MH-1447	8	8		157	35.3	34.51	0.503	PVC	8.33	35.37	0.8	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1458	MH-1447	MH-1454	8	8		104	34.41	33.93	0.462	PVC	12.49	34.49	1.0	≤50%
P-1459	MH-1454	MH-1453	8	8		91	33.83	33.37	0.505	PVC	16.65	33.92	1.1	≤50%
P-1460	MH-1453	MH-1452	8	8		36	33.27	33.09	0.5	PVC	20.82	33.38	1.3	≤50%
P-1468	MH-1452	MH-1467	8	8		52	32.99	32.47	1	PVC	24.98	33.1	1.3	≤50%
P-689	MH-1467	WW-TAYLOR	30	30		1	32.47	32	47	PVC	37.47	32.56	1.1	≤50%
P-1130	MH-1129	MH-1127	8	8		228	99.66	95.7	1.737	PVC	6.33	99.71	0.6	≤50%
P-1128	MH-1127	MH-1125	8	8		268	95.6	76.5	7.127	PVC	12.67	95.68	1.0	≤50%
P-1132	MH-1131	MH-1125	8	8		143	80.16	76.5	2.559	PVC	6.33	80.21	0.6	≤50%
P-1126	MH-1125	MH-1123	8	8		202	76.4	52.18	11.99	PVC	25.33	76.51	1.3	≤50%
P-1124	MH-1123	MH-1121	8	8		194	52.08	35.89	8.345	PVC	31.67	52.2	1.4	≤50%
P-1122	MH-1121	MH-1119	8	8		397	35.79	31.06	1.191	PVC	38.00	35.92	1.6	≤50%
P-1120	MH-1119	MH-1117	8	8		410	30.96	27.27	0.9	PVC	44.33	31.1	1.7	≤50%
P-1106	MH-1104	MH-1105	8	8		251	100.83	100.03	0.319	PVC	6.33	100.9	0.8	≤50%
P-771	MH-1648	MH-686	8	8		174	114	106.68	4.207	PVC	6.33	114.05	0.6	≤50%
P-1524	MH-686	MH-1105	8	8		285	106.58	103.56	1.06	PVC	12.67	106.66	1.0	≤50%
P-1108	MH-1105	MH-1107	8	8		264	99.93	98.45	0.561	PVC	25.33	100.04	1.3	≤50%
P-1110	MH-1107	MH-1109	8	8		182	98.35	97.31	0.571	PVC	31.67	98.48	1.6	≤50%
P-1112	MH-1109	MH-1111	8	8		237	97.21	92.31	2.068	PVC	38.00	97.34	1.6	≤50%
P-1114	MH-1111	MH-1113	8	8		313	92.21	75.59	5.31	PVC	44.33	92.35	1.7	≤50%
P-1116	MH-1113	MH-1115	8	8		289	75.58	38.31	12.896	PVC	50.67	75.73	1.8	≤50%
P-1118	MH-1115	MH-1117	8	8		50	38.21	27.27	21.88	PVC	57.00	38.37	1.9	≤50%
P-1138	MH-1117	MH-1134	8	8		126	27.17	26.21	0.762	PVC	107.66	27.4	2.8	≤50%
P-1135	MH-1133	MH-1134	8	8		212	26.93	26.21	0.34	PVC	267.51	27.4	5.6	75%
P-1137	MH-1134	MH-1136	8	8		34	26.11	26	0.324	PVC	381.50	26.7	7.1	94%
P-682	MH-1136	WW-PIONEER	30	30		88	26	22	4.545	PVC	387.84	26.3	3.6	≤50%
P-1291	MH-1289	MH-1290	6	6		140	0	-0.89	0.636	PVC	34.59	0.14	1.7	≤50%
P-1677	MH-1770	MH-1769	8	8		200	1.19	0.39	0.4	PVC	21.24	1.29	1.2	≤50%
P-1676	MH-1769	MH-1290	8	8		298	0.29	-0.89	0.396	PVC	21.24	0.39	1.2	≤50%
P-1292	MH-1290	MH-1276	8	8	SM6	330	-0.99	-6.99	1.818	PVC	65.05	-0.82	2.0	≤50%
P-1319	MH-1317	MH-1318	8	8		209	-0.02	-0.88	0.411	Asbestos Cement	9.23	0.05	0.8	≤50%
P-1321	MH-1318	MH-1320	8	8		202	-0.88	-1.48	0.297	Asbestos Cement	18.45	-0.77	1.3	≤50%
P-1323	MH-1320	MH-1322	8	8		126	-1.48	-1.92	0.349	Asbestos Cement	27.68	-1.35	1.6	≤50%
P-1325	MH-1322	MH-1324	8	8		317	-1.92	-3.01	0.344	Asbestos Cement	36.91	-1.77	1.8	≤50%
P-1327	MH-1324	MH-1326	8	8		272	-3.01	-4.06	0.386	Asbestos Cement	46.13	-2.84	2.0	≤50%
P-1330	MH-1329	MH-1326	8	8		230	-3.13	-4.06	0.404	Asbestos Cement	9.23	-3.05	1.0	≤50%
P-1328	MH-1326	MH-1270	8	8		374	-4.06	-5.5	0.385	Asbestos Cement	64.59	-3.86	2.4	≤50%
P-1316	MH-1315	MH-1268	8	8		263	0.12	-0.92	0.395	Asbestos Cement	9.23	0.2	1.0	≤50%
P-1312	MH-1311	MH-1262	8	8		197	-1.75	-5.89	2.102	Asbestos Cement	9.23	-1.69	0.7	≤50%
P-1309	MH-1307	MH-1308	8	8		341	-0.48	-2.64	0.633	Asbestos Cement	9.23	-0.41	0.8	≤50%
P-1310	MH-1308	MH-1262	8	8		29	-2.64	-5.89	11.207	Asbestos Cement	18.45	-2.55	1.1	≤50%
P-1306	MH-1305	MH-1260	8	8		316	-1.76	-3.4	0.519	Asbestos Cement	9.23	-1.69	0.8	≤50%
P-1298	MH-1297	MH-1258	8	8		383	-0.58	-2.53	0.509	Asbestos Cement	9.23	-0.51	0.8	≤50%
P-1296	MH-1295	MH-1258	8	8		341	-1.54	-2.53	0.29	Asbestos Cement	9.23	-1.46	1.0	≤50%
P-1294	MH-1293	MH-1256	8	8		339	0.28	-1.38	0.49	Asbestos Cement	9.23	0.35	0.8	≤50%
P-1257	MH-1255	MH-1256	8	8		376	0.79	-0.38	0.311	Asbestos Cement	9.23	0.87	1.0	≤50%
P-1259	MH-1256	MH-1258	8	8		290	-1.38	-2.53	0.397	Asbestos Cement	27.68	-1.25	1.6	≤50%
P-1261	MH-1258	MH-1260	8	8		284	-2.53	-3.4	0.306	Asbestos Cement	55.36	-2.34	2.3	≤50%
P-1301	MH-1299	MH-1300	8	8		237	-0.93	-1.93	0.422	Asbestos Cement	9.23	-0.86	0.8	≤50%
P-1303	MH-1300	MH-1302	8	8		139	-1.93	-2.33	0.288	Asbestos Cement	18.45	-1.82	1.3	≤50%
P-1304	MH-1302	MH-1260	8	8		341	-2.4	-3.4	0.293	Asbestos Cement	27.68	-2.26	1.7	≤50%
P-1263	MH-1260	MH-1262	8	8		170	-3.4	-3.89	0.288	Asbestos Cement	101.49	-3.13	3.2	≤50%
P-1265	MH-1262	MH-1264	8	8		122	-3.89	-4.25	0.295	Asbestos Cement	138.40	-3.57	3.8	≤50%
P-1267	MH-1264	MH-1266	8	8		38	-4.25	-4.41	0.421	Asbestos Cement	147.62	-3.95	3.6	≤50%
P-1269	MH-1266	MH-1268	8	8		110	-4.41	-4.74	0.3	Asbestos Cement	156.85	-4.07	4.1	51%
P-1314	MH-1313	MH-1268	8	8		357	0.21	-4.74	1.387	Asbestos Cement	9.23	0.27	0.7	≤50%
P-1271	MH-1268	MH-1270	8	8		262	-4.74	-5.54	0.305	Asbestos Cement	184.53	-4.36	4.6	59%
P-1273	MH-1270	MH-1272	8	8		119	-5.54	-5.95	0.345	Asbestos Cement	258.34	-5.08	5.5	74%
P-1332	MH-1331	MH-1272	8	8		390	-4.3	-5.95	0.423	PVC	9.23	-4.23	0.8	≤50%
P-1275	MH-1272	MH-1274	8	12	SM6	143	-5.95	-6.47	0.364	PVC	276.79	-5.62	4.0	≤50%
P-1277	MH-1274	MH-1276	8	12	SM6	199	-6.47	-6.99	0.261	PVC	419.03	-6.03	5.3	≤50%
P-1279	MH-1276	MH-1278	8	12	SM6	302	-6.99	-7.89	0.298	PVC	493.31	-6.53	5.5	≤50%
P-1287	MH-1285	MH-1286	8	8		242	-1.93	-3.35	0.587	Asbestos Cement	9.23	-1.86	0.8	≤50%
P-1288	MH-1286	MH-1278	8	8		291	-3.35	-4.64	0.443	Asbestos Cement	18.45	-3.25	1.2	≤50%
P-1281	MH-1278	MH-1280	8	12	SM6	128	-7.89	-8.25	0.281	PVC	520.99	-7.41	5.8	≤50%

City of Stanwood
2025 General Sewer Plan
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50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1283	MH-1280	MH-1282	8	12	SM2	393	-8.25	-9.45	0.305	PVC	530.21	-7.77	5.8	≤50%
P-1284	MH-1282	MH-1206	8	12	SM2	38	-9.45	-9.62	0.447	PVC	539.44	-8.99	5.5	≤50%
P-1247	MH-1245	MH-1246	8	8		121	-1.63	-2.16	0.438	Asbestos Cement	3.84	-1.58	0.6	≤50%
P-1249	MH-1246	MH-1248	8	8		112	-2.36	-2.8	0.393	Asbestos Cement	7.67	-2.29	0.8	≤50%
P-1251	MH-1248	MH-1250	8	8		313	-2.8	-4.05	0.399	Asbestos Cement	11.51	-2.72	1.0	≤50%
P-1253	MH-1250	MH-1252	8	8		318	-4.05	-5.29	0.39	Asbestos Cement	15.34	-3.95	1.2	≤50%
P-1254	MH-1252	MH-1200	8	8		152	-5.39	-7.16	1.164	Asbestos Cement	19.18	-5.3	1.1	≤50%
P-1528	MH-696	MH-695	8	8		258	2.23	-3.93	2.388	PVC	3.84	2.27	0.5	≤50%
P-782	MH-695	MH-1472	10	10		222	-4.03	-4.93	0.405	PVC	7.67	-3.97	0.7	≤50%
P-1527	MH-1472	MH-693	10	10		225	-5.03	-5.93	0.4	PVC	11.51	-4.96	0.8	≤50%
P-1526	MH-693	MH-1471	10	10		115	-6.03	-6.6	0.496	PVC	15.34	-5.95	1.0	≤50%
P-1244	MH-1243	MH-1194	8	8		109	0.09	-1.89	1.817	Asbestos Cement	3.84	0.13	0.5	≤50%
P-1242	MH-1241	MH-1192	8	8		112	0.28	-3.84	3.679	Asbestos Cement	3.84	0.32	0.5	≤50%
P-1235	MH-1233	MH-1234	8	8		240	1	-0.9	0.792	Asbestos Cement	3.84	1.04	0.5	≤50%
P-1239	MH-1237	MH-1238	8	8		238	4	1.1	1.218	Asbestos Cement	3.84	4.04	0.5	≤50%
P-1240	MH-1238	MH-1234	8	8		158	1	-0.9	1.203	Asbestos Cement	7.67	1.06	0.7	≤50%
P-1236	MH-1234	MH-1190	8	8		164	-1	-2.96	1.195	Asbestos Cement	15.34	-0.92	1.0	≤50%
P-1231	MH-1229	MH-1230	8	8		193	-0.42	-1.24	0.425	Asbestos Cement	3.84	-0.37	0.6	≤50%
P-1232	MH-1230	MH-1188	8	8		210	-1.24	-2.08	0.4	Asbestos Cement	7.67	-1.17	0.8	≤50%
P-1185	MH-1183	MH-1184	8	8		300	0.65	-1.1	0.583	Asbestos Cement	44.67	0.8	1.8	≤50%
P-1187	MH-1184	MH-1186	6	6		234	-1.1	-1.21	0.047	PVC	48.50	-0.76	4.1	72%
P-1227	MH-1225	MH-1226	8	8		206	0.26	-0.5	0.369	PVC	3.84	0.3	0.5	≤50%
P-1228	MH-1226	MH-1186	8	8		200	-0.58	-1.21	0.315	Corrugated HDPE (Smooth Interior)	7.67	-0.51	0.8	≤50%
P-1189	MH-1186	MH-1188	8	8		287	-1.21	-2.08	0.303	Asbestos Cement	60.01	-1.01	2.4	≤50%
P-1191	MH-1188	MH-1190	8	8		288	-2.08	-2.96	0.306	Asbestos Cement	260.65	-1.6	5.8	77%
P-1193	MH-1190	MH-1192	8	8		307	-2.96	-3.84	0.287	Asbestos Cement	279.83	-2.43	6.4	85%
P-1195	MH-1192	MH-1194	12	12		305	-4.44	-5.77	0.436	Asbestos Cement	287.50	-4.08	4.3	≤50%
P-1197	MH-1194	MH-1196	12	12		83	-5.77	-6.16	0.47	Asbestos Cement	295.17	-5.42	4.2	≤50%
P-1525	MH-1196	MH-1471	12	12		60	-6.16	-6.6	0.733	Concrete	299.01	-5.82	4.1	≤50%
P-778	MH-1471	MH-1198	12	12		344	-6.7	-7.61	0.265	Concrete	318.19	-6.27	5.2	≤50%
P-1201	MH-1198	MH-1200	12	12		115	-7.61	-8.16	0.478	Asbestos Cement	322.02	-7.24	4.4	≤50%
P-1203	MH-1200	MH-1202	12	12	SM2	174	-8.16	-8.84	0.391	Asbestos Cement	345.04	-7.75	4.9	≤50%
P-1205	MH-1202	MH-1204	12	12	SM2	107	-8.84	-9.26	0.393	Asbestos Cement	348.87	-8.43	4.9	≤50%
P-1215	MH-1213	MH-1214	6	6		125	1.5	-0.07	1.256	PVC	3.84	1.54	0.5	≤50%
P-1222	MH-1221	MH-1214	6	6		36	3.82	-0.07	10.806	PVC	3.84	3.86	0.5	≤50%
P-1217	MH-1214	MH-1216	8	8		196	-0.17	-0.95	0.398	PVC	11.51	-0.09	1.0	≤50%
P-1219	MH-1216	MH-1218	8	8		283	-1.05	-2.39	0.473	PVC	15.34	-0.96	1.1	≤50%
P-1220	MH-1218	MH-1204	8	8		56	-2.49	-2.76	0.482	PVC	19.18	-2.39	1.2	≤50%
P-1207	MH-1204	MH-1206	12	12	SM2	229	-9.26	-10.15	0.389	Asbestos Cement	371.89	-8.84	5.0	≤50%
P-1209	MH-1206	MH-1208	15	15	SM2	388	-10.28	-11.02	0.191	Asbestos Cement	918.24	-9.49	9.5	67%
P-1757	MH-1846	MH-1845	8	8		96	-0.39	-0.77	0.396	PVC	0.00	-0.39	0.0	≤50%
P-1756	MH-1845	MH-1843	8	8		46	-0.87	-1.05	0.391	PVC	0.00	-0.87	0.0	≤50%
P-1755	MH-1844	MH-1843	8	8		172	-0.36	-1.05	0.401	PVC	0.00	-0.36	0.0	≤50%
P-1754	MH-1843	MH-1842	8	8		128	-1.15	-1.66	0.398	PVC	0.00	-1.15	0.0	≤50%
P-1753	MH-1842	MH-1223	8	8		41	-1.66	-1.93	0.659	PVC	0.00	-1.66	0.0	≤50%
P-1224	MH-1223	MH-1208	8	8		324	-2.56	-4.66	0.648	Asbestos Cement	6.91	-2.5	0.7	≤50%
P-1211	MH-1208	MH-1210	15	15	SM2	365	-11.02	-11.68	0.181	Asbestos Cement	932.07	-10.21	9.7	69%
P-1212	MH-1210	MH-99	14	14	SM2	313	-11.68	-13.2	0.486	PVC	938.98	-11.09	7.1	51%
P-1169	MH-1168	MH-1166	8	8		83	-2	-4.1	2.53	PVC	14.36	-1.92	1.0	≤50%
P-1167	MH-1166	MH-1164	8	8		234	-4	-6.1	0.897	PVC	28.72	-3.89	1.3	≤50%
P-1163	MH-1161	MH-1162	8	8		197	1	-2.1	1.574	PVC	14.36	1.08	1.0	≤50%
P-1165	MH-1162	MH-1164	8	8		246	-2	-6.1	1.667	PVC	28.72	-1.89	1.3	≤50%
P-1170	MH-1164	MH-95	8	8		367	-6	-10.76	1.297	PVC	71.79	-5.82	2.2	≤50%
P-1639	MH-1732	MH-1731	8	8		115	3.23	2.71	0.452	PVC	0.00	3.23	0.0	≤50%
P-1638	MH-1731	MH-1730	8	8		139	2.61	1.99	0.446	PVC	0.00	2.61	0.0	≤50%
P-1637	MH-1730	MH-1729	8	8		188	1.89	0.93	0.511	PVC	0.00	1.89	0.0	≤50%
P-1636	MH-1729	MH-1141	8	8		128	0.83	0.18	0.508	PVC	0.00	0.83	0.0	≤50%
P-1142(1)	MH-1141	MH-1983	8	8		201	-4	-6.14	1.065	PVC	14.36	-3.91	1.1	≤50%
P-1142(2)	MH-1983	MH-87	8	8		164	-4	-6.14	1.305	PVC	14.36	-3.92	1.0	≤50%
P-1885	MH-1982	MH-1981	8	8		230	3.8	1.4	1.043	PVC	0.00	3.8	0.0	≤50%
P-1884	MH-1981	MH-1980	8	8		155	1.4	-3.46	3.135	PVC	0.00	1.4	0.0	≤50%
P-1883	MH-1980	MH-87	8	8		15	-3.46	-4.11	4.333	PVC	0.00	-3.46	0.0	≤50%
P-950	MH-948	MH-949	8	8		364	-0.39	-1.85	0.401	Asbestos Cement	7.98	-0.32	0.8	≤50%
P-951	MH-949	MH-943	8	8		140	-1.85	-2.41	0.4	Asbestos Cement	15.95	-1.75	1.2	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1882	MH-1979	MH-1978	8	8		196	-0.07	-2.03	1	PVC	0.00	-0.07	0.0	≤50%
P-1881	MH-1978	MH-941	8	8		60	-2.13	-4.73	4.333	PVC	0.00	-2.13	0.0	≤50%
P-954	MH-952	MH-953	8	8		102	-2.68	-3.09	0.402	Asbestos Cement	7.98	-2.61	0.8	≤50%
P-955	MH-953	MH-939	8	8		52	-3.09	-3.27	0.346	Asbestos Cement	15.95	-2.99	1.2	≤50%
P-938	MH-936	MH-937	6	6		73	0	-1.9	2.603	PVC	7.98	0.06	0.7	≤50%
P-940	MH-937	MH-939	8	8		153	-1.9	-3.27	0.895	PVC	15.95	-1.81	1.1	≤50%
P-942	MH-939	MH-941	8	8		372	-3.27	-4.78	0.406	Asbestos Cement	39.89	-3.12	1.8	≤50%
P-944	MH-941	MH-943	8	8		284	-4.78	-5.91	0.398	Asbestos Cement	47.86	-4.61	2.0	≤50%
P-945	MH-943	MH-83	8	8		157	-5.91	-6.43	0.331	PVC	78.18	-5.71	2.4	≤50%
P-1643	MH-1733	MH-1037	10	10		45	-2.08	-2.19	0.24	PVC	0.00	-2.08	0.0	≤50%
P-1038	MH-1037	MH-1035	10	10		100	-2.29	-2.51	0.22	PVC	7.98	-2.22	0.8	≤50%
P-739	MH-1035	MH-1393	10	10		50	-2.61	-2.72	0.22	PVC	15.95	-2.52	1.1	≤50%
P-747	MH-1393	MH-75	8	8		187	-2.82	-4.53	0.914	Concrete	23.93	-2.72	1.2	≤50%
P-751	MH-676	MH-75	12	12		206	-1	-4.43	1.665	PVC	7.98	-0.95	0.6	≤50%
P-78	MH-75	MH-77	14	14		253	-4.53	-5.51	0.387	Asbestos Cement	39.89	-4.41	1.4	≤50%
P-80	MH-77	MH-79	14	14		363	-5.51	-6.29	0.215	Cast iron	47.86	-5.35	1.9	≤50%
P-82	MH-79	MH-81	14	14		409	-6.29	-6.72	0.105	Asbestos Cement	55.84	-6.1	2.3	≤50%
P-947	MH-946	MH-81	8	8		186	-4.52	-6.37	0.995	Asbestos Cement	14.36	-4.44	1.0	≤50%
P-84	MH-81	MH-83	14	14		132	-6.72	-7.12	0.303	Asbestos Cement	84.56	-6.54	2.2	≤50%
P-86	MH-83	MH-85	14	14		297	-7.12	-7.95	0.279	Asbestos Cement	177.09	-6.85	3.2	≤50%
P-88	MH-85	MH-87	14	14		323	-7.95	-8.58	0.195	Asbestos Cement	191.45	-7.64	3.7	≤50%
P-1140	MH-1139	MH-87	8	8		152	-4.25	-6.14	1.243	PVC	14.36	-4.17	1.0	≤50%
P-90	MH-87	MH-89	14	14		343	-8.27	-9.07	0.233	Asbestos Cement	234.53	-7.94	4.0	≤50%
P-92	MH-89	MH-91	14	14		342	-9.07	-10.11	0.304	Asbestos Cement	248.89	-8.76	3.7	≤50%
P-1145	MH-1143	MH-1144	8	8		201	-2.18	-4.18	0.995	PVC	14.36	-2.1	1.0	≤50%
P-1335	MH-1144	MH-1333	8	8		300	-4.28	-7.28	1	PVC	28.72	-4.17	1.3	≤50%
P-1160	MH-1159	MH-1156	6	6		61	2.7	2.3	0.656	PVC	14.36	3.03	4.0	70%
P-1157	MH-1155	MH-1156	6	6		54	5	2.88	3.926	PVC	14.36	5.09	1.1	≤50%
P-1158	MH-1156	MH-1150	6	6		118	2.88	-1.92	4.068	PVC	43.08	3.03	1.8	≤50%
P-1151	MH-1149	MH-1150	8	8		145	-0.52	-1.92	0.966	PVC	14.36	-0.44	1.0	≤50%
P-1338	MH-1150	MH-1336	8	8		209	-2.02	-4.18	1.033	PVC	71.79	-1.84	2.2	≤50%
P-1337	MH-1336	MH-1333	8	8		301	-4.28	-7.28	0.997	PVC	86.15	-4.08	2.4	≤50%
P-1334	MH-1333	MH-1146	8	8		98	-7.38	-8.13	0.765	PVC	129.23	-7.13	3.0	≤50%
P-1148	MH-1146	MH-91	8	8		268	-8.5	-9.48	0.366	Asbestos Cement	143.59	-8.19	3.7	≤50%
P-94	MH-91	MH-93	14	14		284	-10.11	-10.32	0.074	Asbestos Cement	406.83	-9.53	7.0	≤50%
P-1347	MH-93	MH-95	14	14		167	-10.48	-10.76	0.168	Asbestos Cement	421.19	-10	5.8	≤50%
P-695	MH-95	MH-97	14	14		152	-10.76	-11.33	0.375	Asbestos Cement	507.35	-10.33	5.2	≤50%
P-100	MH-97	MH-99	14	14		291	-11.33	-12.08	0.258	Asbestos Cement	521.70	-10.85	5.8	≤50%
P-102	MH-99	MH-101	20	24	SM2	245	-13.2	-13.29	0.037	PVC	1,475.04	-12.01	14.3	62%
P-1173	MH-1171	MH-1172	8	8		176	0.3	-0.49	0.449	PVC	14.36	0.39	1.1	≤50%
P-1175	MH-1172	MH-1174	8	8		272	-0.59	-1.82	0.452	PVC	28.72	-0.46	1.6	≤50%
P-1177	MH-1174	MH-1176	8	8		205	-1.92	-2.85	0.454	PVC	43.08	-1.77	1.8	≤50%
P-1179	MH-1176	MH-1178	8	8		358	-2.95	-4.46	0.422	PVC	57.44	-2.77	2.2	≤50%
P-1181	MH-1178	MH-1180	8	8		229	-4.41	-5.76	0.59	Asbestos Cement	71.79	-4.22	2.3	≤50%
P-1873	MH-1966	MH-1967	6	6		216	-2.51	-4.67	1	PVC	0.00	-2.51	0.0	≤50%
P-1874	MH-1967	MH-1180	6	6		13	-4.67	-5.08	3.154	PVC	0.00	-4.67	0.0	≤50%
P-1182	MH-1180	MH-101	12	12		267	-5.61	-8.03	0.906	PVC	86.15	-5.43	2.2	≤50%
P-681	MH-101	WW-MAIN	20	20		27	-13.35	-13	-1.296	Cast iron	1,575.55	-12.07	15.4	82%
P-958	MH-956	MH-957	8	8		363	146	141	1.377	PVC	19.00	146.09	1.1	≤50%
P-960	MH-957	MH-959	8	8		265	140.9	134.4	2.453	PVC	38.00	141.03	1.6	≤50%
P-962	MH-959	MH-961	8	8		185	134.3	116.3	9.73	PVC	57.00	134.46	1.9	≤50%
P-964	MH-961	MH-963	8	8		122	116.2	99.2	13.934	PVC	76.00	116.39	2.3	≤50%
P-966	MH-963	MH-965	8	8		185	99.1	90.1	4.865	PVC	95.00	99.31	2.5	≤50%
P-968	MH-965	MH-967	8	8		144	90	87.11	2.007	PVC	114.00	90.23	2.8	≤50%
P-1017	MH-1015	MH-1016	8	8		366	140.2	125.2	4.098	PVC	19.00	140.29	1.1	≤50%
P-1019	MH-1016	MH-1018	8	8		182	125.1	114.1	6.044	PVC	38.00	125.23	1.6	≤50%
P-1022	MH-1021	MH-1018	8	8		139	116	114.1	1.367	PVC	19.00	116.09	1.1	≤50%
P-1020	MH-1018	MH-967	8	8		157	114	90.11	15.217	PVC	76.00	114.19	2.3	≤50%
P-970	MH-967	MH-969	8	8		96	87.01	80.01	7.292	PVC	209.00	87.33	3.8	≤50%
P-972	MH-969	MH-971	8	8		83	79.91	72.91	8.434	PVC	227.99	80.24	4.0	≤50%
P-974	MH-971	MH-973	8	8		69	72.81	68.81	5.797	PVC	246.99	73.16	4.2	53%
P-976	MH-973	MH-975	8	8		106	68.71	68.31	0.377	Concrete	265.99	69.16	5.4	72%
P-1024	MH-1023	MH-975	8	8		120	74.08	68.21	4.892	Concrete	19.00	74.17	1.1	≤50%
P-978	MH-975	MH-977	8	8		291	68.11	50.88	5.921	Concrete	303.99	68.5	4.7	61%

City of Stanwood
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= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-980	MH-977	MH-979	8	8		170	50.78	44.86	3.482	Concrete	322.99	51.18	4.8	63%
P-1027	MH-1025	MH-1026	8	8		215	60.8	47.9	6	Concrete	19.00	60.89	1.1	≤50%
P-1028	MH-1026	MH-979	8	8		115	47.8	44.86	2.557	Concrete	38.00	47.93	1.6	≤50%
P-982	MH-979	MH-981	8	8		154	44.76	34.76	6.494	Concrete	379.99	45.2	5.3	70%
P-776	MH-1470	MH-690	8	8		347	178.04	177.39	0.187	PVC	9.50	178.12	1.0	≤50%
P-775	MH-690	MH-1469	8	8		187	177.29	171.88	2.893	PVC	19.00	177.38	1.1	≤50%
P-774	MH-1469	MH-688	8	8		164	171.83	167.32	2.75	PVC	28.50	171.94	1.3	≤50%
P-772	MH-688	MH-1092	8	8		105	167.17	163.64	3.362	PVC	38.00	167.3	1.6	≤50%
P-1094	MH-1092	MH-1093	8	8		156	163.51	160	2.25	PVC	47.50	163.66	1.8	≤50%
P-1096	MH-1093	MH-1095	8	8		319	159.9	130.9	9.091	PVC	57.00	160.06	1.9	≤50%
P-1098	MH-1095	MH-1097	8	8		105	130.9	129.22	1.6	PVC	66.50	131.08	2.2	≤50%
P-1100	MH-1097	MH-1099	8	8		112	129.12	125.24	3.464	PVC	76.00	129.31	2.3	≤50%
P-1102	MH-1099	MH-1101	8	8		399	125.14	112.58	3.148	PVC	85.50	125.34	2.4	≤50%
P-1103	MH-1101	MH-1056	8	8		358	112.48	104.79	2.148	PVC	95.00	112.69	2.5	≤50%
P-1087	MH-1086	MH-1070	8	8		138	131.21	130.56	0.471	PVC	9.50	131.28	0.8	≤50%
P-1085	MH-1084	MH-1072	8	8		270	148.87	147.53	0.496	PVC	9.50	148.94	0.8	≤50%
P-1083	MH-1082	MH-1080	8	8		180	171.73	168.38	1.861	PVC	9.50	171.8	0.8	≤50%
P-1081	MH-1080	MH-1078	8	8		89	168.28	163.87	4.955	PVC	19.00	168.37	1.1	≤50%
P-1079	MH-1078	MH-1076	8	8		217	163.77	154.86	4.106	PVC	28.50	163.88	1.3	≤50%
P-1077	MH-1076	MH-1074	8	8		95	154.76	152.33	2.558	PVC	38.00	154.89	1.6	≤50%
P-1075	MH-1074	MH-1072	8	8		119	152.23	147.53	3.95	PVC	47.50	152.38	1.8	≤50%
P-1073	MH-1072	MH-1070	8	8		284	147.43	130.56	5.94	PVC	66.50	147.61	2.2	≤50%
P-1071	MH-1070	MH-1068	8	8		104	130.46	126.87	3.452	PVC	85.50	130.66	2.4	≤50%
P-1069	MH-1068	MH-1066	8	8		111	126.77	121.45	4.793	PVC	95.00	126.98	2.5	≤50%
P-1863	MH-1956	MH-1955	8	8		394	175.88	156.83	4.835	PVC	0.00	175.88	0.0	≤50%
P-1862	MH-1955	MH-1954	8	8		250	156.83	146.9	3.972	PVC	0.00	156.83	0.0	≤50%
P-1861	MH-1954	MH-1947	8	8		250	146.9	129.45	6.98	PVC	0.00	146.9	0.0	≤50%
P-1860	MH-1953	MH-1952	8	8		203	156.88	147.16	4.788	PVC	0.00	156.88	0.0	≤50%
P-1859	MH-1952	MH-1951	8	8		87	147.16	134.79	14.218	PVC	0.00	147.16	0.0	≤50%
P-1871	MH-1964	MH-1965	8	8		349	165.55	151.38	4.06	PVC	0.00	165.55	0.0	≤50%
P-1872	MH-1965	MH-1961	8	8		105	151.38	148.98	2.286	PVC	0.00	151.38	0.0	≤50%
P-1864	MH-1957	MH-1958	8	8		256	180.86	179.46	0.547	PVC	0.00	180.86	0.0	≤50%
P-1865	MH-1958	MH-1959	8	8		235	179.46	169.65	4.174	PVC	0.00	179.46	0.0	≤50%
P-1866	MH-1959	MH-1960	8	8		86	169.65	162.15	8.721	PVC	0.00	169.65	0.0	≤50%
P-1867	MH-1960	MH-1961	8	8		133	162.15	148.98	9.902	PVC	0.00	162.15	0.0	≤50%
P-1868	MH-1961	MH-1962	8	8		202	148.98	136.29	6.282	PVC	0.00	148.98	0.0	≤50%
P-1869	MH-1962	MH-1963	8	8		153	136.29	135.4	0.582	PVC	0.00	136.29	0.0	≤50%
P-1870	MH-1963	MH-1951	8	8		98	135.4	134.79	0.622	PVC	0.00	135.4	0.0	≤50%
P-1858	MH-1951	MH-1950	8	8		96	134.79	134.19	0.625	PVC	0.00	134.79	0.0	≤50%
P-1857	MH-1950	MH-1949	8	8		107	134.19	133.53	0.617	PVC	0.00	134.19	0.0	≤50%
P-1856	MH-1949	MH-1948	8	8		255	133.53	132.14	0.545	PVC	0.00	133.53	0.0	≤50%
P-1855	MH-1948	MH-1947	8	8		256	132.14	129.45	1.051	PVC	0.00	132.14	0.0	≤50%
P-1854	MH-1947	MH-1088	8	8		169	129.45	123.09	3.763	PVC	0.00	129.45	0.0	≤50%
P-1089	MH-1088	MH-1066	8	8		357	123.26	121.48	0.499	PVC	80.91	123.47	2.5	≤50%
P-1067	MH-1066	MH-1064	8	8		161	121.38	117.66	2.311	PVC	185.40	121.68	3.6	≤50%
P-1065	MH-1064	MH-1062	8	8		119	111.09	109.72	1.151	PVC	194.90	111.4	3.7	≤50%
P-1091	MH-1090	MH-1062	8	8		149	111.09	109.72	0.919	PVC	9.50	111.16	0.8	≤50%
P-1063	MH-1062	MH-1060	8	8		108	109.62	108.05	1.454	PVC	213.90	109.94	3.8	≤50%
P-1061	MH-1060	MH-1058	8	8		200	107.95	105.78	1.085	PVC	223.40	108.28	4.0	≤50%
P-1059	MH-1058	MH-1056	8	8		182	105.68	104.79	0.489	PVC	232.90	106.06	4.6	59%
P-1057	MH-1056	MH-1054	8	8		262	104.69	103.41	0.489	PVC	337.40	105.18	5.9	79%
P-1055	MH-1054	MH-1052	8	8		293	103.3	101.95	0.461	PVC	346.90	103.81	6.1	82%
P-1053	MH-1052	MH-1050	8	8		309	101.85	97.5	1.408	PVC	356.40	102.27	5.0	66%
P-1051	MH-1050	MH-1048	8	8		91	97.4	90.1	8.022	PVC	365.90	97.83	5.2	68%
P-1049	MH-1048	MH-1046	8	8		361	90	62.95	7.493	Concrete	375.40	90.43	5.2	68%
P-1047	MH-1046	MH-1044	8	8		193	62.95	47.9	7.798	Concrete	384.90	63.39	5.3	70%
P-1045	MH-1044	MH-1042	15	15		18	47.9	47.77	0.722	PVC	394.40	48.27	4.4	≤50%
P-1043	MH-1042	MH-1040	15	15		412	47.6	46.14	0.354	PVC	857.64	48.15	6.6	≤50%
P-1041	MH-1040	MH-989	15	15		378	46.14	44.67	0.389	PVC	867.14	46.69	6.6	≤50%
P-1003	MH-1001	MH-1002	6	6		149	147	145.1	1.275	PVC	9.50	147.07	0.8	≤50%
P-1005	MH-1002	MH-1004	6	6		199	145	141.1	1.96	PVC	19.00	145.1	1.2	≤50%
P-1007	MH-1004	MH-1006	6	6		335	141	137.1	1.164	PVC	28.50	141.12	1.4	≤50%
P-1009	MH-1006	MH-1008	6	6		170	137	119.1	10.529	PVC	38.00	137.14	1.7	≤50%
P-1011	MH-1008	MH-1010	8	8		232	119	101.1	7.716	Concrete	47.50	119.15	1.8	≤50%

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Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1013	MH-1010	MH-1012	8	8		360	101	95.1	1.639	Concrete	57.00	101.16	1.9	≤50%
P-1014	MH-1012	MH-991	8	8		240	95	64.12	12.867	Concrete	203.93	95.31	3.7	≤50%
P-1000	MH-999	MH-997	8	8		267	107.12	106.03	0.408	Concrete	9.50	107.2	1.0	≤50%
P-998	MH-997	MH-995	8	8		275	106.03	104.94	0.396	Concrete	19.00	106.14	1.3	≤50%
P-996	MH-995	MH-993	8	8		313	104.94	86.96	5.744	Concrete	28.50	105.05	1.3	≤50%
P-994	MH-993	MH-991	8	8		305	86.96	64.02	7.521	Concrete	38.00	87.09	1.6	≤50%
P-992	MH-991	MH-989	8	8		187	64.02	49.06	8	Concrete	251.43	64.37	4.2	53%
P-990	MH-989	MH-987	15	15		153	44.67	44.07	0.392	PVC	1,128.07	45.3	7.6	51%
P-988	MH-987	MH-985	15	15		332	44.07	42.75	0.398	PVC	1,147.07	44.71	7.7	52%
P-986	MH-985	MH-983	15	15		259	42.75	41.7	0.405	PVC	1,166.07	43.4	7.8	53%
P-984	MH-983	MH-981	15	15		274	41.7	34.86	2.496	PVC	1,185.07	42.35	7.8	53%
P-1390	MH-981	MH-1375	12	12		285	34.6	5.04	10.372	Corrugated HDPE (Smooth Interior)	1,584.06	35.4	9.6	86%
P-784	MH-1474	MH-65	8	8		227	65.06	43.1	9.674	Concrete	7.55	65.12	0.7	≤50%
P-68(1)	MH-65	MH-1984	8	8		224	43	41.96	0.464	Concrete	15.11	43.11	1.3	≤50%
P-68(2)	MH-1984	MH-67	8	8		25	43	41.96	4.16	Concrete	15.11	43.08	1.0	≤50%
P-688	MH-687	MH-223	8	8		141	93.91	85.51	5.957	Concrete	6.67	93.96	0.6	≤50%
P-240	MH-238	MH-239	8	8		126	132	130.1	1.508	PVC	53.19	132.16	1.9	≤50%
P-242	MH-239	MH-241	8	8		337	130	120.1	2.938	PVC	59.87	130.17	2.0	≤50%
P-1349	MH-241	MH-207	18	18		19	120	119.06	4.947	PVC	66.54	120.14	1.7	≤50%
P-1789	MH-1884	MH-1883	8	8		129	148.59	148.07	0.403	PVC	0.00	148.59	0.0	≤50%
P-247	MH-245	MH-246	8	8		365	244.65	240.69	1.085	PVC	6.67	244.7	0.6	≤50%
P-249	MH-246	MH-248	8	8		98	240.59	230.55	10.245	PVC	13.35	240.67	1.0	≤50%
P-251	MH-248	MH-250	8	8		400	230.45	219.1	2.838	PVC	20.02	230.55	1.2	≤50%
P-300	MH-298	MH-299	8	8		253	223.33	213.27	3.976	PVC	6.67	223.38	0.6	≤50%
P-302	MH-299	MH-301	8	8		93	213.17	212.79	0.409	PVC	13.35	213.26	1.1	≤50%
P-303	MH-301	MH-250	8	8		159	212.69	210.7	1.252	PVC	20.02	212.79	1.2	≤50%
P-253	MH-250	MH-252	8	8		288	210.6	208.76	0.639	PVC	46.72	210.75	1.8	≤50%
P-255	MH-252	MH-254	8	8		263	208.66	194.58	5.354	PVC	53.39	208.82	1.9	≤50%
P-257	MH-254	MH-256	8	8		230	194.48	182.94	5.017	PVC	60.07	194.65	2.0	≤50%
P-259	MH-256	MH-258	8	8		360	182.84	181.42	0.394	PVC	66.74	183.04	2.4	≤50%
P-1764	MH-1853	MH-258	8	8		212	194.79	184.8	4.712	PVC	0.00	194.79	0.0	≤50%
P-1763	MH-1852	MH-258	8	8		120	185.75	184.8	0.792	PVC	0.00	185.75	0.0	≤50%
P-261	MH-258	MH-260	10	10		272	181.32	161.9	7.14	PVC	78.34	181.5	2.2	≤50%
P-263	MH-260	MH-262	10	10		106	161.8	147.91	13.104	PVC	85.01	161.99	2.3	≤50%
P-297	MH-296	MH-293	8	8		28	154.4	153.53	3.107	PVC	6.67	154.45	0.6	≤50%
P-292	MH-290	MH-291	8	8		23	160.16	160.04	0.522	PVC	6.67	160.22	0.7	≤50%
P-294	MH-291	MH-293	8	8		125	159.94	153.99	4.76	PVC	13.35	160.02	1.0	≤50%
P-295	MH-293	MH-262	8	8		253	153.43	145.67	3.067	PVC	26.70	153.54	1.3	≤50%
P-265(1)	MH-262	MH-1883	10	10		136	147.66	134.16	9.926	PVC	118.38	147.88	2.6	≤50%
P-265(2)	MH-1883	MH-264	10	10		185	147.66	134.16	7.297	PVC	118.38	147.88	2.6	≤50%
P-267	MH-264	MH-266	10	10		324	134.06	125.91	2.515	PVC	125.06	134.29	2.8	≤50%
P-269	MH-266	MH-268	12	12		271	125.71	124.75	0.354	Steel	131.73	125.96	3.0	≤50%
P-271	MH-268	MH-270	12	12		307	124.5	123.36	0.371	Steel	138.40	124.75	3.0	≤50%
P-273	MH-270	MH-272	12	12		401	123.26	121.9	0.339	Steel	145.08	123.53	3.2	≤50%
P-275	MH-272	MH-274	12	12		401	121.8	120.44	0.339	Steel	151.75	122.07	3.2	≤50%
P-276	MH-274	MH-207	12	12		375	120.34	119.06	0.341	Steel	158.43	120.62	3.4	≤50%
P-1361	MH-1360	MH-181	8	8		150	224	214.41	6.393	PVC	9.38	224.06	0.7	≤50%
P-1704	MH-1798	MH-1797	8	8		222	225.91	225.02	0.4	PVC	0.00	225.91	0.0	≤50%
P-1703	MH-1797	MH-1789	8	8		81	225.02	224.7	0.4	PVC	0.00	225.02	0.0	≤50%
P-1702	MH-1796	MH-1794	8	8		198	228.18	227.39	0.4	PVC	0.00	228.18	0.0	≤50%
P-1701	MH-1795	MH-1794	8	8		405	229.01	227.39	0.4	PVC	0.00	229.01	0.0	≤50%
P-1700	MH-1794	MH-1791	8	8		261	227.39	226.34	0.4	PVC	0.00	227.39	0.0	≤50%
P-1699	MH-1793	MH-1791	8	8		112	226.79	226.34	0.4	PVC	0.00	226.79	0.0	≤50%
P-1698	MH-1792	MH-1791	8	8		119	226.82	226.34	0.4	PVC	0.00	226.82	0.0	≤50%
P-1697	MH-1791	MH-1790	8	8		333	226.34	225.01	0.4	PVC	0.00	226.34	0.0	≤50%
P-1696	MH-1790	MH-1789	8	8		78	225.01	224.7	0.4	PVC	0.00	225.01	0.0	≤50%
P-1695	MH-1789	MH-176	8	8		120	224.7	224.22	0.4	PVC	0.00	224.7	0.0	≤50%
P-178	MH-176	MH-177	8	8		305	224.22	222.68	0.505	PVC	60.26	224.4	2.2	≤50%
P-180	MH-177	MH-179	8	8		308	222.68	218.82	1.253	PVC	69.64	222.86	2.2	≤50%
P-182	MH-179	MH-181	8	8		239	218.82	214.41	1.845	PVC	79.02	219.01	2.3	≤50%
P-184	MH-181	MH-183	8	8		212	214.41	202.48	5.627	PVC	97.77	214.62	2.5	≤50%
P-186	MH-183	MH-185	8	8		206	202.48	194.44	3.903	PVC	107.15	202.71	2.8	≤50%
P-188	MH-185	MH-187	8	8		47	194.44	191.6	6.043	PVC	116.53	194.68	2.9	≤50%
P-190	MH-187	MH-189	8	8		162	191.6	190.78	0.506	PVC	125.90	191.86	3.1	≤50%

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50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-192	MH-189	MH-191	8	8		157	190.78	184.15	4.223	PVC	135.28	191.03	3.0	≤50%
P-194	MH-191	MH-193	8	8		279	184.15	161.51	8.115	PVC	144.66	184.41	3.1	≤50%
P-196	MH-193	MH-195	8	8		42	161.51	154.32	17.119	PVC	154.04	161.78	3.2	≤50%
P-198	MH-195	MH-197	8	8	SM10	128	154.32	143.68	8.312	PVC	163.41	154.6	3.4	≤50%
P-200	MH-197	MH-199	8	8	SM10	84	143.58	141	3.071	Concrete	172.79	143.87	3.5	≤50%
P-202	MH-199	MH-201	8	8	SM10	324	139.9	131.1	2.716	Concrete	182.17	140.2	3.6	≤50%
P-204	MH-201	MH-203	8	8	SM10	476	131	124.76	1.311	Concrete	191.54	131.3	3.6	≤50%
P-288	MH-286	MH-287	8	8		300	127.72	126.43	0.43	PVC	9.38	127.79	0.8	≤50%
P-289	MH-287	MH-203	8	8		300	126.43	124.76	0.557	PVC	18.75	126.53	1.2	≤50%
P-206	MH-203	MH-205	8	8	SM10	276	124.66	119.6	1.833	Concrete	219.67	124.99	4.0	≤50%
P-208	MH-205	MH-207	8	8	SM10	23	119.5	119.06	1.913	PVC	226.35	119.83	4.0	≤50%
P-210	MH-207	MH-209	12	12		263	118.96	117.37	0.605	PVC	457.99	119.38	5.0	≤50%
P-212	MH-209	MH-211	12	12		275	117.27	115.62	0.6	PVC	464.66	117.7	5.2	≤50%
P-230	MH-228	MH-229	8	8		308	126.83	125.31	0.494	Concrete	6.67	126.89	0.7	≤50%
P-232(1)	MH-229	MH-1946	8	8		265	123.21	123.14	0.026	Concrete	13.35	123.4	2.3	≤50%
P-232(2)	MH-1946	MH-231	8	8		144	123.21	123.14	0.049	Concrete	13.35	123.36	1.8	≤50%
P-234	MH-231	MH-233	8	8		205	123.04	119.5	1.727	PVC	20.02	123.14	1.2	≤50%
P-236	MH-233	MH-235	8	8		218	119.4	116.1	1.514	PVC	26.70	119.51	1.3	≤50%
P-237	MH-235	MH-211	8	8		30	116	115.62	1.267	PVC	33.37	116.12	1.4	≤50%
P-214	MH-211	MH-213	12	12		366	115.52	113.3	0.607	PVC	504.71	115.97	5.4	≤50%
P-279	MH-277	MH-278	6	6		464	124	116	1.724	PVC	6.67	124.06	0.7	≤50%
P-1356	MH-1355	MH-284	8	8	SM10	218	122.87	121.91	0.44	Concrete	6.67	122.93	0.7	≤50%
P-741	MH-284	MH-282	8	8	SM10	274	121.91	120.84	0.391	Concrete	13.35	122	1.1	≤50%
P-743	MH-282	MH-280	8	8	SM10	224	120.84	116.32	2.018	PVC	20.02	120.94	1.2	≤50%
P-745	MH-280	MH-278	8	8	SM10	154	116.32	115.58	0.481	PVC	26.70	116.44	1.4	≤50%
P-697	MH-278	MH-213	8	8		16	115.9	113.3	16.25	Concrete	40.04	116.04	1.7	≤50%
P-216	MH-213	MH-215	12	12		278	113.2	105.58	2.741	PVC	551.43	113.67	5.6	≤50%
P-1342	MH-1341	MH-215	8	8		11	105.7	105.58	1.091	Steel	6.67	105.95	3.0	≤50%
P-218	MH-215	MH-217	12	12		353	105.48	101.95	1	PVC	564.77	105.95	5.6	≤50%
P-220	MH-217	MH-219	12	12		15	101.7	101.6	0.667	PVC	571.45	102.18	5.8	≤50%
P-222	MH-219	MH-221	8	8		72	101.5	94.51	9.708	Concrete	578.12	102.04	6.5	87%
P-690	MH-689	MH-221	8	8		217	95.43	94.51	0.424	Concrete	6.67	95.49	0.7	≤50%
P-759	MH-221	MH-223	8	8		291	94.41	85.51	3.058	PVC	591.47	94.95	6.5	87%
P-1422	MH-223	MH-1421	8	8		133	85.41	72.4	9.782	Concrete	604.82	85.96	6.6	88%
P-1425	MH-1421	MH-1417	8	8		27	72.06	69.69	8.778	PVC	611.49	72.61	6.6	88%
P-104	MH-103	MH-25	8	8		119	190.8	188.81	1.672	PVC	4.00	190.84	0.5	≤50%
P-21	MH-19	MH-20	8	8		131	234.62	228.59	4.603	PVC	4.00	234.66	0.5	≤50%
P-23	MH-20	MH-22	8	8		209	228.49	215.96	5.995	PVC	8.01	228.55	0.7	≤50%
P-26	MH-22	MH-25	8	8		232	215.86	188.81	11.659	PVC	12.01	215.93	0.8	≤50%
P-28	MH-25	MH-27	8	8		109	179.83	164.06	14.468	PVC	20.02	179.93	1.2	≤50%
P-30	MH-27	MH-29	8	8		124	164.06	151.94	9.774	PVC	24.03	164.16	1.2	≤50%
P-32	MH-29	MH-31	8	8		100	151.84	139.99	11.85	PVC	28.03	151.95	1.3	≤50%
P-34	MH-31	MH-33	8	8		113	139.99	139.89	0.088	PVC	32.04	140.19	2.4	≤50%
P-36	MH-33	MH-35	8	8		166	139.89	133.12	4.078	PVC	36.04	140.02	1.6	≤50%
P-38	MH-35	MH-37	8	8		195	133.02	127.2	2.985	PVC	40.04	133.16	1.7	≤50%
P-40	MH-37	MH-39	8	8		186	126	121.64	2.344	PVC	44.05	126.14	1.7	≤50%
P-166	MH-164	MH-165	8	8		191	123.49	122.73	0.398	PVC	4.00	123.54	0.6	≤50%
P-168	MH-165	MH-167	8	8		124	122.63	122.15	0.387	PVC	8.01	122.7	0.8	≤50%
P-169	MH-167	MH-39	8	8		328	122.05	120.77	0.39	PVC	12.01	122.14	1.1	≤50%
P-42	MH-39	MH-41	8	8		271	121.54	120.21	0.491	PVC	60.07	121.72	2.2	≤50%
P-172	MH-170	MH-171	8	8		301	122.82	121.62	0.399	PVC	4.00	122.87	0.6	≤50%
P-174	MH-171	MH-173	8	8		167	121.52	120.85	0.401	PVC	8.01	121.59	0.8	≤50%
P-175	MH-173	MH-41	8	8		286	120.85	120.21	0.224	PVC	12.01	120.95	1.2	≤50%
P-44	MH-41	MH-43	8	8		267	120.11	118.75	0.509	PVC	76.08	120.31	2.4	≤50%
P-306	MH-304	MH-43	8	8		304	126.25	118.75	2.467	PVC	4.00	126.29	0.5	≤50%
P-46	MH-43	MH-45	8	8		84	118.65	118.22	0.512	PVC	84.09	118.86	2.5	≤50%
P-48	MH-45	MH-47	8	8		211	118.12	117.06	0.502	PVC	88.10	118.34	2.6	≤50%
P-50	MH-47	MH-49	8	12	SM7	18	116.96	116.8	0.889	PVC	92.10	117.62	7.9	70%
P-1809	MH-1906	MH-1905	8	8		101	203.82	196.29	7.455	PVC	0.00	203.82	0.0	≤50%
P-1807	MH-1903	MH-1904	8	8		257	214.92	204.15	4.191	PVC	0.00	214.92	0.0	≤50%
P-1808	MH-1904	MH-1905	8	8		249	204.15	196.29	3.157	PVC	0.00	204.15	0.0	≤50%
P-1811	MH-1905	MH-1895	8	8		361	196.29	193.05	0.898	PVC	0.00	196.29	0.0	≤50%
P-1806	MH-1902	MH-1894	8	8		313	199.97	194.48	1.754	PVC	0.00	199.97	0.0	≤50%
P-1797	MH-1893	MH-1892	8	8		204	213.75	205.28	4.152	PVC	0.00	213.75	0.0	≤50%

City of Stanwood
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Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1796	MH-1892	MH-1891	8	8		98	205.28	200.53	4.847	PVC	0.00	205.28	0.0	≤50%
P-1795	MH-1891	MH-1890	8	8		33	200.53	199.27	3.818	PVC	0.00	200.53	0.0	≤50%
P-1794	MH-1889	MH-1890	8	8		110	200.6	199.27	1.209	PVC	0.00	200.6	0.0	≤50%
P-1798	MH-1890	MH-1894	8	8		284	199.27	194.48	1.687	PVC	0.00	199.27	0.0	≤50%
P-1799	MH-1894	MH-1895	8	8		250	194.48	193.05	0.572	PVC	0.00	194.48	0.0	≤50%
P-1800	MH-1895	MH-1896	8	8		139	193.05	192.11	0.676	PVC	0.00	193.05	0.0	≤50%
P-1801	MH-1896	MH-1897	8	8		203	192.11	190.71	0.69	PVC	0.00	192.11	0.0	≤50%
P-1802	MH-1897	MH-1898	8	8		71	190.71	189.7	1.423	PVC	0.00	190.71	0.0	≤50%
P-1803	MH-1898	MH-1899	8	8		241	189.7	187.7	0.83	PVC	0.00	189.7	0.0	≤50%
P-1804	MH-1899	MH-1900	8	8		290	187.7	185.69	0.693	PVC	0.00	187.7	0.0	≤50%
P-1805	MH-1900	MH-133	8	8		252	185.69	184.29	0.556	PVC	0.00	185.69	0.0	≤50%
P-124	MH-122	MH-123	8	8		343	240.58	237.2	0.985	PVC	4.00	240.62	0.5	≤50%
P-1687	MH-1780	MH-1779	8	8		203	239.68	238.87	0.4	PVC	0.00	239.68	0.0	≤50%
P-1686	MH-1779	MH-1778	8	8		45	238.87	238.69	0.4	PVC	0.00	238.87	0.0	≤50%
P-1685	MH-1778	MH-1772	8	8		228	238.69	237.78	0.4	PVC	0.00	238.69	0.0	≤50%
P-1684	MH-1777	MH-1776	8	8		264	241	239.94	0.4	PVC	0.00	241	0.0	≤50%
P-1683	MH-1776	MH-1775	8	8		65	239.94	239.68	0.4	PVC	0.00	239.94	0.0	≤50%
P-1682	MH-1775	MH-1774	8	8		133	239.68	239.15	0.4	PVC	0.00	239.68	0.0	≤50%
P-1681	MH-1774	MH-1773	8	8		87	239.15	238.8	0.4	PVC	0.00	239.15	0.0	≤50%
P-1680	MH-1773	MH-1772	8	8		257	238.8	237.78	0.4	PVC	0.00	238.8	0.0	≤50%
P-1679	MH-1772	MH-1771	8	8		113	237.78	237.32	0.4	PVC	0.00	237.78	0.0	≤50%
P-1678	MH-1771	MH-123	8	8		31	237.32	237.2	0.4	PVC	0.00	237.63	3.7	≤50%
P-126	MH-123	MH-125	8	8		305	237.2	225.96	3.685	PVC	368.97	237.63	5.2	68%
P-128	MH-125	MH-127	8	8		400	225.8	206.99	4.703	PVC	372.98	226.23	5.2	68%
P-130	MH-127	MH-129	8	8		400	206.87	196.08	2.698	PVC	376.98	207.3	5.2	68%
P-132	MH-129	MH-131	8	8		362	196.08	184.48	3.204	PVC	380.99	196.52	5.3	70%
P-134	MH-131	MH-133	8	8		42	184.38	183.38	2.381	PVC	433.91	184.85	5.6	75%
P-136(1)	MH-133	MH-1901	15	15		105	182.62	174.75	7.495	PVC	437.91	183.01	4.7	≤50%
P-136(2)	MH-1901	MH-135	15	15		208	182.62	174.75	3.784	PVC	437.91	183.01	4.7	≤50%
P-138	MH-135	MH-137	15	15		327	174.68	173.14	0.471	PVC	441.91	175.08	4.8	≤50%
P-1749	SSMH #24 - Westchester	SSMH #23 - Westchester	8	8		150	196.51	195.91	0.4	PVC	0.00	196.51	0.0	≤50%
P-1748	SSMH #25 - Westchester	SSMH #23 - Westchester	8	8		113	196.36	195.91	0.398	PVC	0.00	196.36	0.0	≤50%
P-1747	SSMH #23 - Westchester	SSMH #20 - Westchester	8	8		219	195.81	194.93	0.402	PVC	0.00	195.81	0.0	≤50%
P-1735	SSMH #22 - Westchester	SSMH #20 - Westchester	8	8		223	207.55	194.93	5.659	PVC	0.00	207.55	0.0	≤50%
P-1734	SSMH #20 - Westchester	SSMH #19 - Westchester	8	8		153	194.93	186.24	5.68	PVC	0.00	194.93	0.0	≤50%
P-1733	SSMH #19 - Westchester	SSMH #18 - Westchester	8	8		356	186.14	173.29	3.61	PVC	0.00	186.14	0.0	≤50%
P-1732	SSMH #18 - Westchester	MH-137	8	8		46	173.19	173.14	0.109	PVC	0.00	173.46	3.2	≤50%
P-140	MH-137	MH-139	15	15		252	173.06	171.81	0.496	PVC	445.92	173.46	4.8	≤50%
P-142	MH-139	MH-141	15	15		401	171.74	169.66	0.519	PVC	572.28	172.19	5.4	≤50%
P-1737	SSMH #15 - Westchester	SSMH #14 - Westchester	8	8		144	182.09	181.41	0.472	PVC	0.00	182.09	0.0	≤50%
P-1736	SSMH #14 - Westchester	SSMH #3 - Westchester	8	8		400	181.31	179.71	0.4	PVC	0.00	181.31	0.0	≤50%
P-1739	SSMH #17 - Westchester	SSMH #16 - Westchester	8	8		150	198.79	195.9	1.927	PVC	0.00	198.79	0.0	≤50%
P-1738	SSMH #16 - Westchester	SSMH #4 - Westchester	8	8		400	195.8	194.2	0.4	PVC	0.00	195.8	0.0	≤50%
P-1745	SSMH #13 - Westchester	SSMH #8 - Westchester	8	8		213	221.35	216.28	2.38	PVC	0.00	221.35	0.0	≤50%
P-1746	SSMH #12 - Westchester	SSMH #9 - Westchester	8	8		270	229.81	221.99	2.896	PVC	0.00	229.81	0.0	≤50%
P-1744	SSMH #11 - Westchester	SSMH #10 - Westchester	8	8		284	235.15	227.63	2.648	PVC	0.00	235.15	0.0	≤50%
P-1743	SSMH #10 - Westchester	SSMH #9 - Westchester	8	8		149	227.53	221.99	3.718	PVC	0.00	227.53	0.0	≤50%
P-1742	SSMH #9 - Westchester	SSMH #8 - Westchester	8	8		131	221.89	216.28	4.282	PVC	0.00	221.89	0.0	≤50%
P-1741	SSMH #8 - Westchester	SSMH #7 - Westchester	8	8		138	216.18	215.46	0.522	PVC	0.00	216.18	0.0	≤50%
P-1740	SSMH #7 - Westchester	SSMH #6 - Westchester	8	8		352	215.36	213.95	0.401	PVC	0.00	215.36	0.0	≤50%
P-1731	SSMH #6 - Westchester	SSMH #5 - Westchester	8	8		76	213.85	207.89	7.842	PVC	0.00	213.85	0.0	≤50%
P-1730	SSMH #5 - Westchester	SSMH #4 - Westchester	8	8		169	207.79	194.2	8.041	PVC	0.00	207.79	0.0	≤50%
P-1729	SSMH #4 - Westchester	SSMH #3 - Westchester	8	8		242	194.1	179.71	5.946	PVC	0.00	194.1	0.0	≤50%
P-1728	SSMH #3 - Westchester	SSMH #2 - Westchester	8	8		73	179.61	178.88	1	PVC	0.00	179.61	0.0	≤50%
P-1727	SSMH #2 - Westchester	SSMH #1 - Westchester	8	8		92	178.78	178.02	0.826	PVC	0.00	178.78	0.0	≤50%
P-1726	SSMH #1 - Westchester	MH-141	8	8		134	177.92	169.66	6.164	PVC	0.00	177.92	0.0	≤50%
P-144	MH-141	MH-143	15	15		205	169.58	168.74	0.41	PVC	616.46	170.08	6.0	≤50%
P-146	MH-143	MH-145	15	15		291	168.72	167.22	0.515	PVC	620.46	169.19	5.6	≤50%
P-148	MH-145	MH-147	15	15		397	167.18	139.79	6.899	PVC	624.47	167.65	5.6	≤50%
P-150	MH-147	MH-149	15	15		336	139.66	136.31	0.997	PVC	628.47	140.13	5.6	≤50%
P-152	MH-149	MH-151	15	15		100	136.22	135.04	1.18	PVC	632.48	136.69	5.6	≤50%
P-154	MH-151	MH-153	15	15		134	134.87	131.93	2.194	PVC	636.48	135.34	5.6	≤50%
P-162	MH-160	MH-161	12	12		242	132.95	132.4	0.227	PVC	4.00	133	0.6	≤50%
P-163	MH-161	MH-153	12	12		72	132.4	132.25	0.208	PVC	8.01	132.47	0.8	≤50%

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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-156	MH-153	MH-155	15	15		100	131.83	131.09	0.74	PVC	648.49	132.31	5.8	≤50%
P-158	MH-155	MH-157	15	15		249	130.99	122.09	3.574	PVC	652.50	131.47	5.8	≤50%
P-159	MH-157	MH-49	15	15		310	122.09	117.19	1.581	PVC	656.50	122.57	5.8	≤50%
P-52	MH-49	MH-51	8	12	SM7	147	117.07	114.49	1.755	PVC	752.61	117.62	6.6	56%
P-54	MH-51	MH-53	8	12	SM7	277	114.49	110.02	1.614	PVC	756.61	115.04	6.6	56%
P-679	MH-677	MH-678	8	8		269	125.79	121.09	1.747	Concrete	4.00	125.83	0.5	≤50%
P-680	MH-678	MH-53	8	8		293	121.09	110.25	3.7	Concrete	8.01	121.15	0.7	≤50%
P-56	MH-53	MH-55	8	12	SM7	50	110.02	106.76	6.52	PVC	768.63	110.58	6.7	58%
P-58	MH-55	MH-57	8	12	SM7	157	106.76	95.81	6.975	PVC	772.63	107.32	6.7	58%
P-60	MH-57	MH-59	8	12	SM7	125	95.81	85.38	8.344	PVC	776.64	96.37	6.7	58%
P-62	MH-59	MH-61	8	12	SM7	136	85.38	72.78	9.265	PVC	780.64	85.94	6.7	58%
P-683	MH-681	MH-682	8	8		324	109	83.64	7.827	Concrete	4.00	109.04	0.5	≤50%
P-684	MH-682	MH-61	8	8		219	83.28	72.78	4.795	Concrete	8.01	83.34	0.7	≤50%
P-64	MH-61	MH-63	8	12	SM7	87	72.78	66.2	7.563	PVC	792.65	73.35	6.8	59%
P-753	MH-63	MH-1417	15	15		313	66.1	64.57	0.489	PVC	799.33	66.63	6.4	≤50%
P-755	MH-1417	MH-225	15	15		157	64.47	57.05	4.726	PVC	1,417.49	65.19	8.6	60%
P-757	MH-225	MH-67	15	15	SM3	100	56.95	41.96	14.99	PVC	1,424.17	57.67	8.6	60%
P-70	MH-67	MH-69	15	15	SM3	202	41.86	26.06	7.822	PVC	1,446.83	42.58	8.6	60%
P-716	MH-715	MH-69	8	8		383	28.38	26.84	0.402	Concrete	7.55	28.45	0.8	≤50%
P-72	MH-69	MH-71	15	15	SM3	78	25.96	19.77	7.936	PVC	1,461.94	26.69	8.8	61%
P-930	MH-928	MH-929	8	8		303	115.97	103.16	4.228	PVC	6.04	116.02	0.6	≤50%
P-932	MH-929	MH-931	8	8		301	102.98	85.22	5.9	PVC	12.09	103.05	0.8	≤50%
P-934	MH-931	MH-933	8	8		297	85.05	59.9	8.468	PVC	18.13	85.14	1.1	≤50%
P-935	MH-933	MH-837	8	8		302	59.25	32	9.023	PVC	24.17	59.35	1.2	≤50%
P-866	MH-864	MH-865	8	8		128	83.22	82.97	0.195	PVC	3.34	83.27	0.6	≤50%
P-867	MH-865	MH-799	8	8		253	82.87	81.42	0.573	PVC	6.68	82.93	0.7	≤50%
P-760	MH-759	MH-757	8	8		108	98	95.1	2.685	PVC	3.34	98.04	0.5	≤50%
P-758	MH-757	MH-755	8	8		123	95	92	2.439	PVC	6.68	95.05	0.6	≤50%
P-756	MH-755	MH-753	8	8		160	91.9	89.1	1.75	PVC	10.02	91.97	0.8	≤50%
P-762	MH-761	MH-753	8	8		127	91	89.1	1.496	PVC	3.34	91.04	0.5	≤50%
P-754	MH-753	MH-751	8	8		331	89	83.8	1.571	PVC	16.70	89.09	1.1	≤50%
P-752	MH-751	MH-749	8	8		74	83.7	82.27	1.932	PVC	20.04	83.8	1.2	≤50%
P-750	MH-749	MH-747	8	8		35	82.17	82.01	0.457	PVC	23.38	82.7	6.4	85%
P-765	MH-763	MH-764	8	8		245	107.25	95.23	4.906	PVC	3.34	107.29	0.5	≤50%
P-767	MH-764	MH-766	8	8		190	95.13	92.22	1.532	PVC	6.68	95.18	0.6	≤50%
P-773	MH-771	MH-772	8	8		76	93.33	92.99	0.447	PVC	3.34	93.38	0.6	≤50%
P-1348	MH-772	MH-766	8	8		103	92.89	92.22	0.65	PVC	6.68	92.95	0.7	≤50%
P-1351	MH-766	MH-768	8	8		188	92.22	91.58	0.34	PVC	16.70	92.32	1.2	≤50%
P-770	MH-768	MH-741	8	8		40	84.93	84.65	0.7	PVC	54.13	85.09	1.9	≤50%
P-738	MH-736	MH-737	8	8		107	87.23	86.66	0.533	Steel	3.34	87.27	0.5	≤50%
P-740	MH-737	MH-739	8	8		60	86.34	86.01	0.55	PVC	179.77	86.65	3.7	≤50%
P-742	MH-739	MH-741	8	8		305	86.01	84.65	0.446	PVC	183.11	86.35	4.1	51%
P-798	MH-797	MH-794	8	8		201	86.83	85.65	0.587	PVC	57.38	87	2.0	≤50%
P-777	MH-775	MH-776	8	8		233	99.74	98.69	0.451	PVC	3.34	99.79	0.6	≤50%
P-779	MH-776	MH-778	8	8		131	98.69	98.22	0.359	PVC	6.68	98.76	0.8	≤50%
P-781	MH-778	MH-780	8	8		298	98.22	97.09	0.379	PVC	10.02	98.3	1.0	≤50%
P-783	MH-780	MH-782	8	8		278	96.99	90.47	2.345	PVC	13.36	97.07	1.0	≤50%
P-785	MH-782	MH-784	8	8		85	90.47	89.85	0.729	PVC	16.70	90.56	1.1	≤50%
P-787	MH-784	MH-786	8	8		199	89.75	88.85	0.452	PVC	20.04	89.86	1.3	≤50%
P-789	MH-786	MH-788	8	8		298	88.8	88	0.268	PVC	23.38	88.93	1.6	≤50%
P-791	MH-788	MH-790	8	8		121	87.9	87.03	0.719	PVC	26.72	88.01	1.3	≤50%
P-793	MH-790	MH-792	8	8		85	86.93	86.55	0.447	PVC	30.06	87.09	1.9	≤50%
P-352	MH-350	MH-351	8	8		92	144	141.69	2.511	PVC	7.05	144.06	0.7	≤50%
P-354	MH-351	MH-353	8	8		201	141.61	133.61	3.98	PVC	14.10	141.69	1.0	≤50%
P-356	MH-353	MH-355	8	8		269	133.6	126.19	2.755	PVC	21.14	133.7	1.2	≤50%
P-358	MH-355	MH-357	8	8		187	126.15	120.57	2.984	PVC	28.19	126.26	1.3	≤50%
P-363	MH-362	MH-357	8	8		170	124.05	120.22	2.253	PVC	7.05	124.11	0.7	≤50%
P-360	MH-357	MH-359	8	8		142	120.26	116.05	2.965	PVC	42.29	120.4	1.7	≤50%
P-361	MH-359	MH-322	8	8		132	115.93	108.45	5.667	PVC	49.34	116.08	1.8	≤50%
P-366	MH-364	MH-365	8	8		221	142.26	134.78	3.385	PVC	7.05	142.32	0.7	≤50%
P-368	MH-365	MH-367	8	8		231	134.73	128.57	2.667	PVC	14.10	134.81	1.0	≤50%
P-369	MH-367	MH-322	8	8		207	128.57	108.47	9.71	PVC	21.14	128.67	1.2	≤50%
P-344	MH-342	MH-343	8	8		69	151.34	149.82	2.203	PVC	7.05	151.4	0.7	≤50%
P-346	MH-343	MH-345	8	8		264	149.65	134.49	5.742	PVC	14.10	149.73	1.0	≤50%

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Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-348	MH-345	MH-347	8	8		151	134.49	127.94	4.338	PVC	21.14	134.59	1.2	≤50%
P-349	MH-347	MH-318	8	8		227	127.84	109.89	7.907	PVC	28.19	127.95	1.3	≤50%
P-328	MH-326	MH-327	8	8		162	135.65	129.51	3.79	PVC	7.05	135.71	0.7	≤50%
P-330	MH-327	MH-329	8	8		78	129.35	127.37	2.538	PVC	14.10	129.43	1.0	≤50%
P-331	MH-329	MH-310	8	8		124	127.3	125.92	1.113	PVC	21.14	127.4	1.2	≤50%
P-309	MH-307	MH-308	8	8		90	143.9	141.24	2.956	PVC	7.05	143.96	0.7	≤50%
P-311	MH-308	MH-310	8	8		312	141.2	125.96	4.885	PVC	14.10	141.28	1.0	≤50%
P-313	MH-310	MH-312	8	8		282	125.74	116.72	3.199	PVC	42.29	125.88	1.7	≤50%
P-315	MH-312	MH-314	8	8		58	116.62	116.19	0.741	PVC	49.34	116.77	1.8	≤50%
P-317	MH-314	MH-316	8	8		189	116.14	113.49	1.402	PVC	56.39	116.3	1.9	≤50%
P-334	MH-332	MH-333	8	8		145	155.87	148.67	4.966	PVC	7.05	155.93	0.7	≤50%
P-336	MH-333	MH-335	8	8		223	148.6	134.6	6.278	PVC	14.10	148.68	1.0	≤50%
P-338	MH-335	MH-337	8	8		150	134.54	129.68	3.24	PVC	21.14	134.64	1.2	≤50%
P-340	MH-337	MH-339	8	8		206	129.66	118.75	5.296	PVC	28.19	129.77	1.3	≤50%
P-341	MH-339	MH-316	8	8		94	118.72	113.43	5.628	PVC	35.24	118.85	1.6	≤50%
P-319	MH-316	MH-318	8	8		227	113.26	109.89	1.485	PVC	98.67	113.48	2.6	≤50%
P-321	MH-318	MH-320	8	8		54	109.82	109.48	0.63	PVC	133.91	110.08	3.1	≤50%
P-323	MH-320	MH-322	8	8		220	109.45	108.34	0.505	PVC	140.96	109.73	3.4	≤50%
P-325	MH-322	MH-324	8	8		180	108.28	107.47	0.45	PVC	218.49	108.65	4.4	57%
P-687	MH-324	MH-1739	8	8		66	107.47	107.23	0.364	PVC	225.54	108.05	7.0	92%
P-1771	MH-1863	MH-1862	8	8		248	169.55	160.86	3.504	PVC	0.00	169.55	0.0	≤50%
P-1623	MH-1718	MH-1717	8	8		126	208.78	206.38	1.905	PVC	0.00	208.78	0.0	≤50%
P-1622	MH-1717	MH-1716	8	8		351	206.28	184.8	6.12	PVC	0.00	206.28	0.0	≤50%
P-1853	MH-1945	MH-1944	8	8		292	210.58	192.78	6.096	PVC	0.00	210.58	0.0	≤50%
P-1852	MH-1944	MH-1721	8	8		163	192.78	191.71	0.656	0	0.00	192.78	0.0	≤50%
P-1626	MH-1721	MH-1720	8	8		125	191.71	191.08	0.504	PVC	0.00	191.71	0.0	≤50%
P-1628	MH-1723	MH-1722	8	8		166	211.79	210.13	1	PVC	0.00	211.79	0.0	≤50%
P-1629	MH-1724	MH-1722	8	8		124	211.84	210.13	1.379	PVC	0.00	211.84	0.0	≤50%
P-1627	MH-1722	MH-1720	8	8		312	210.03	191.08	6.074	PVC	0.00	210.03	0.0	≤50%
P-1625	MH-1720	MH-1719	8	8		45	190.98	187.2	8.4	PVC	0.00	190.98	0.0	≤50%
P-1624	MH-1719	MH-1716	8	8		387	187.1	184.8	0.594	PVC	0.00	187.1	0.0	≤50%
P-1621	MH-1716	MH-1715	8	8		199	184.7	167.24	8.774	PVC	0.00	184.7	0.0	≤50%
P-1620	MH-1715	MH-1714	8	8		67	167.14	166.39	1.119	PVC	0.00	167.14	0.0	≤50%
P-645	MH-643	MH-644	8	8		196	169.21	167.81	0.714	PVC	22.70	169.31	1.2	≤50%
P-1618	MH-644	MH-1714	8	8		121	167.26	166.29	0.802	PVC	72.74	167.44	2.2	≤50%
P-1619	MH-1714	MH-646	8	12	SM12	131	166.19	165.55	0.489	PVC	72.74	166.92	8.8	78%
P-649	MH-646	MH-648	8	8		172	166.72	164.43	1.331	PVC	82.60	166.92	2.4	≤50%
P-669	MH-667	MH-668	8	8		113	199.97	196.79	2.814	PVC	9.87	200.04	0.8	≤50%
P-671	MH-668	MH-670	8	8		267	196.69	180.94	5.899	PVC	19.73	196.78	1.1	≤50%
P-673	MH-670	MH-672	8	8		124	180.84	172.51	6.718	PVC	29.60	180.96	1.4	≤50%
P-674	MH-672	MH-648	8	8		134	172.41	164.43	5.955	PVC	39.47	172.54	1.6	≤50%
P-651	MH-648	MH-650	8	8		244	164.33	162.57	0.721	PVC	131.94	164.58	3.0	≤50%
P-653(1)	MH-650	MH-1862	8	8		46	162.47	158.81	7.957	PVC	141.81	162.73	3.1	≤50%
P-653(2)	MH-1862	MH-652	8	8		194	162.47	158.81	1.887	PVC	141.81	162.73	3.1	≤50%
P-655	MH-652	MH-654	8	8		360	158.71	143.06	4.347	PVC	160.56	158.99	3.4	≤50%
P-657	MH-654	MH-656	8	8		89	142.96	140.35	2.933	PVC	170.42	143.25	3.5	≤50%
P-659(1)	MH-656	MH-1700	8	8		75	140.25	136.45	5.067	PVC	180.29	140.55	3.6	≤50%
P-659(2)	MH-1700	MH-658	8	8		73	140.25	136.45	5.205	PVC	180.29	140.55	3.6	≤50%
P-660	MH-658	MH-459	8	8		140	136.36	135.79	0.407	PVC	190.16	137.59	14.8	> 100%
P-627	MH-625	MH-626	8	8		400	143.5	139.83	0.917	PVC	9.87	143.57	0.8	≤50%
P-635	MH-633	MH-634	8	8		153	157.79	156.13	1.085	PVC	9.87	157.86	0.8	≤50%
P-637	MH-634	MH-636	8	8		348	156.04	146.32	2.793	PVC	19.73	156.13	1.1	≤50%
P-638	MH-636	MH-626	8	8		187	146.26	139.92	3.39	PVC	29.60	146.38	1.4	≤50%
P-629	MH-626	MH-628	8	8		86	139.75	136.93	3.279	PVC	49.34	139.9	1.8	≤50%
P-631	MH-628	MH-630	8	8		107	136.87	136.04	0.776	PVC	59.20	137.49	7.4	97%
P-632	MH-630	MH-457	8	12	SM4	104	135.99	135.25	0.712	PVC	69.07	137.48	17.9	> 100%
P-623	MH-621	MH-622	8	8		304	154.04	140.78	4.362	PVC	9.87	154.11	0.8	≤50%
P-624	MH-622	MH-453	8	8		78	140.62	137.71	3.731	PVC	19.73	140.71	1.1	≤50%
P-663	MH-661	MH-662	8	8		118	156.46	154.06	2.034	PVC	9.87	156.53	0.8	≤50%
P-665	MH-662	MH-664	8	8		374	153.96	144.93	2.414	PVC	19.73	154.05	1.1	≤50%
P-666	MH-664	MH-451	8	8		42	144.84	144.31	1.262	PVC	29.60	145.21	4.4	57%
P-613	MH-611	MH-612	6	6		14	163.36	161.87	10.643	PVC	9.87	163.43	0.8	≤50%
P-640	MH-639	MH-612	6	6		72	164.36	161.87	3.458	PVC	9.87	164.43	0.8	≤50%
P-615	MH-612	MH-614	8	8		239	161.77	154.19	3.172	PVC	29.60	161.89	1.4	≤50%

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Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-617	MH-614	MH-616	8	8		243	154.09	153.13	0.395	PVC	39.47	154.24	1.8	≤50%
P-642	MH-641	MH-616	8	8		110	159.22	153.13	5.536	PVC	9.87	159.29	0.8	≤50%
P-619	MH-616	MH-618	8	8		125	153.03	152.46	0.456	PVC	59.20	153.83	9.6	> 100%
P-620	MH-618	MH-447	8	8		128	152.36	149.04	2.594	PVC	69.07	153.82	17.5	> 100%
P-1823	MH-1919	MH-1918	12	12		400	158.52	157.52	0.25	PVC	0.00	158.52	0.0	≤50%
P-1848	MH-1940	MH-1914	8	8		166	175.57	171.65	2.361	PVC	0.00	175.57	0.0	≤50%
P-1818	MH-1914	MH-1911	8	8		180	171.65	167.4	2.361	PVC	0.00	171.65	0.0	≤50%
P-1815	MH-1911	MH-1910	8	8		36	167.4	158.13	25.75	PVC	0.00	167.4	0.0	≤50%
P-1830	MH-1925	MH-1924	8	8		142	186.01	183.03	2.099	PVC	0.00	186.01	0.0	≤50%
P-1829	MH-1924	MH-1923	8	8		25	183.03	182	4.12	PVC	0.00	183.03	0.0	≤50%
P-1828	MH-1923	MH-1921	8	8		124	182	179.6	1.935	PVC	0.00	182	0.0	≤50%
P-1827(2)	MH-1921	MH-1922	8	8		318	179.6	172.79	2.142	PVC	0.00	179.6	0.0	≤50%
P-1827(1)	MH-1922	MH-1909	8	8		57	172.79	171.4	2.439	PVC	0.00	172.79	0.0	≤50%
P-1812	MH-1907	MH-1908	8	8		41	172.43	171.99	1.073	PVC	0.00	172.43	0.0	≤50%
P-1813	MH-1908	MH-1909	8	8		98	171.99	171.4	0.602	PVC	0.00	171.99	0.0	≤50%
P-1814	MH-1909	MH-1910	8	8		261	171.4	158.13	5.084	PVC	0.00	171.4	0.0	≤50%
P-1819	MH-1915	MH-1912	8	8		122	159.83	159.06	0.631	PVC	0.00	159.83	0.0	≤50%
P-1842	MH-1937	MH-1936	8	8		70	167.1	165.45	2.357	PVC	0.00	167.1	0.0	≤50%
P-1839	MH-1933	MH-1934	8	8		297	180.75	178.87	0.633	PVC	0.00	180.75	0.0	≤50%
P-1840	MH-1934	MH-1935	8	8		322	178.87	166.92	3.711	PVC	0.00	178.87	0.0	≤50%
P-1841	MH-1935	MH-1936	8	8		80	166.92	165.45	1.838	PVC	0.00	166.92	0.0	≤50%
P-1844	MH-1936	MH-1938	8	8		77	165.45	164.54	1.182	PVC	0.00	165.45	0.0	≤50%
P-1846	MH-1938	MH-1931	8	8		109	164.54	163.94	0.55	PVC	0.00	164.54	0.0	≤50%
P-1837	MH-1931	MH-1913	8	8		309	163.94	161.81	0.689	PVC	0.00	163.94	0.0	≤50%
P-1836	MH-1930	MH-1928	12	12		119	184.83	179.31	4.639	PVC	0.00	184.83	0.0	≤50%
P-1831	MH-1926	MH-1927	8	8		113	185.8	183.16	2.336	PVC	0.00	185.8	0.0	≤50%
P-1832	MH-1927	MH-1928	8	8		401	183.16	179.31	0.96	PVC	0.00	183.16	0.0	≤50%
P-1835	MH-1928	MH-1929	8	8		204	179.31	173.56	2.819	PVC	0.00	179.31	0.0	≤50%
P-1834	MH-1929	MH-1913	8	8		387	173.56	161.81	3.036	PVC	0.00	173.56	0.0	≤50%
P-1817	MH-1913	MH-1912	12	12		95	161.81	159.06	2.895	PVC	0.00	161.81	0.0	≤50%
P-1816	MH-1912	MH-1910	12	12		420	159.06	158.13	0.221	PVC	0.00	159.06	0.0	≤50%
P-1847	MH-1910	MH-1918	12	12		271	158.13	157.52	0.225	PVC	0.00	158.13	0.0	≤50%
P-1822	MH-1918	MH-1917	12	12		168	157.52	157.09	0.256	PVC	0.00	157.52	0.0	≤50%
P-1821	MH-1916	MH-1917	8	8		273	167.39	157.09	3.773	PVC	0.00	167.39	0.0	≤50%
P-1826	MH-1917	MH-1920	12	12		133	157.09	156.68	0.308	0	0.00	157.09	0.0	≤50%
P-1825	MH-1920	MH-600	12	12		32	156.68	156.62	0.188	PVC	0.00	156.83	1.8	≤50%
P-601	MH-599	MH-600	8	8		393	158.18	156.69	0.379	PVC	107.70	158.44	3.1	≤50%
P-603	MH-600	MH-602	8	8		158	156.59	154.76	1.158	PVC	117.56	156.83	2.9	≤50%
P-605	MH-602	MH-604	8	8		31	154.66	154.21	1.452	PVC	127.43	155.33	8.0	> 100%
P-607	MH-604	MH-606	8	8		28	154.11	152.05	7.357	PVC	137.30	155.32	14.5	> 100%
P-609	MH-606	MH-608	8	8		188	152.05	149.86	1.165	PVC	147.17	155.3	39.0	> 100%
P-610	MH-608	MH-445	8	8		41	149.86	149.66	0.488	PVC	157.03	155.16	63.6	> 100%
P-1768	MH-1858	MH-1857	8	8		144	204.01	203.29	0.5	PVC	0.00	204.01	0.0	≤50%
P-559	MH-557	MH-558	8	8		76	206.81	206.41	0.526	PVC	9.87	206.88	0.8	≤50%
P-561	MH-558	MH-560	8	8		400	206.41	204.57	0.46	PVC	19.73	206.51	1.2	≤50%
P-1851	MH-1943	MH-597	8	8		165	240.45	233.77	4.048	PVC	0.00	240.45	0.0	≤50%
P-1850	MH-1942	MH-1941	8	8		93	234.23	233.77	0.495	PVC	0.00	234.23	0.0	≤50%
P-1849	MH-1941	MH-597	8	8		129	233.67	223.05	8.233	PVC	0.00	233.67	0.0	≤50%
P-598	MH-597	MH-560	8	8		287	222.95	204.57	6.404	PVC	9.87	223.02	0.8	≤50%
P-589	MH-587	MH-588	8	8		168	234.47	214.64	11.804	PVC	9.87	234.54	0.8	≤50%
P-591	MH-588	MH-590	8	8		47	214.54	213.28	2.681	PVC	19.73	214.63	1.1	≤50%
P-593	MH-590	MH-592	8	8		210	213.18	209.06	1.962	PVC	29.60	213.3	1.4	≤50%
P-595	MH-592	MH-594	8	8		109	208.96	208.37	0.541	PVC	39.47	209.1	1.7	≤50%
P-596	MH-594	MH-560	8	8		80	208.27	204.57	4.625	PVC	49.34	208.42	1.8	≤50%
P-563(1)	MH-560	MH-1857	8	8		294	204.47	203.29	0.4	PVC	88.81	204.67	2.4	≤50%
P-563(2)	MH-1857	MH-562	8	8		52	203.19	202.98	0.4	PVC	88.81	203.39	2.4	≤50%
P-565	MH-562	MH-564	8	8		77	202.88	202.57	0.4	PVC	98.67	203.12	2.9	≤50%
P-567	MH-564	MH-566	8	8		375	202.47	200.97	0.4	PVC	108.54	202.73	3.1	≤50%
P-569	MH-566	MH-568	8	8		86	200.87	200.6	0.314	PVC	118.41	201.16	3.5	≤50%
P-571	MH-568	MH-570	8	8		288	200.5	199.35	0.399	PVC	128.28	200.78	3.4	≤50%
P-1693	MH-1786	MH-1785	8	8		213	255.4	254.54	0.4	PVC	0.00	255.4	0.0	≤50%
P-1692	MH-1785	MH-1784	8	8		46	254.54	254.36	0.4	PVC	0.00	254.54	0.0	≤50%
P-1691	MH-1784	MH-1783	8	8		160	254.36	253.72	0.4	PVC	0.00	254.36	0.0	≤50%
P-1690	MH-1783	MH-1782	8	8		68	253.72	253.45	0.4	PVC	0.00	253.72	0.0	≤50%

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Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1689	MH-1782	MH-1781	8	8		122	253.45	252.96	0.4	PVC	0.00	253.45	0.0	≤50%
P-1688	MH-1781	MH-577	8	8		10	252.96	252.92	0.4	PVC	0.00	253.06	1.2	≤50%
P-579	MH-577	MH-578	8	8		240	252.92	241.07	4.938	PVC	45.11	253.06	1.7	≤50%
P-581	MH-578	MH-580	8	8		152	240.97	227.6	8.796	PVC	54.98	241.13	1.9	≤50%
P-586	MH-585	MH-580	8	8		174	233.68	227.6	3.494	PVC	9.87	233.75	0.8	≤50%
P-583	MH-580	MH-582	8	8		400	227.5	202.51	6.248	PVC	74.71	227.69	2.3	≤50%
P-584	MH-582	MH-570	8	8		57	202.41	199.45	5.193	PVC	84.58	202.61	2.4	≤50%
P-573	MH-570	MH-572	8	8		373	199.35	176.21	6.204	PVC	222.72	199.68	4.0	≤50%
P-575	MH-572	MH-574	8	8		281	176.11	173.45	0.947	PVC	232.59	176.45	4.1	51%
P-576	MH-574	MH-441	8	8		400	173.35	171.25	0.525	PVC	242.46	173.73	4.6	59%
P-1770	MH-1861	MH-1860	8	8		156	185.33	184.6	0.468	PVC	0.00	185.33	0.0	≤50%
P-1769	MH-1860	MH-1859	8	8		366	184.5	181.12	0.923	PVC	0.00	184.5	0.0	≤50%
P-539(2)	MH-1859	MH-538	8	8		193	181.02	179.99	0.534	PVC	0.00	181.02	0.0	≤50%
P-541	MH-538	MH-540	8	8		218	179.89	177.66	1.023	PVC	9.87	179.96	0.8	≤50%
P-543	MH-540	MH-542	8	8		58	177.56	177.25	0.534	PVC	19.73	177.66	1.2	≤50%
P-545	MH-542	MH-544	8	8		141	177.15	175.1	1.454	PVC	29.60	177.27	1.4	≤50%
P-547	MH-544	MH-546	8	8		324	175	172.2	0.864	PVC	39.47	175.13	1.6	≤50%
P-551	MH-549	MH-550	8	8		97	180.72	178.72	2.062	PVC	9.87	180.79	0.8	≤50%
P-553	MH-550	MH-552	8	8		148	178.62	177.73	0.601	PVC	19.73	178.72	1.2	≤50%
P-555	MH-552	MH-554	8	8		169	177.63	176.62	0.598	PVC	29.60	177.75	1.4	≤50%
P-556	MH-554	MH-546	8	8		278	176.52	172.2	1.554	PVC	39.47	176.65	1.6	≤50%
P-548	MH-546	MH-437	8	8		345	171.98	169.85	0.617	PVC	88.81	172.25	3.2	≤50%
P-513	MH-511	MH-512	8	8		276	186.12	183.48	0.957	PVC	9.87	186.19	0.8	≤50%
P-515	MH-512	MH-514	8	8		382	183.18	181.06	0.555	PVC	19.73	183.28	1.2	≤50%
P-532	MH-531	MH-514	8	8		343	192.81	189.44	0.983	PVC	9.87	192.88	0.8	≤50%
P-517	MH-514	MH-516	8	8		166	180.95	179.74	0.729	PVC	39.47	181.08	1.6	≤50%
P-1429	MH-1428	MH-675	10	10		390	188.2	186.64	0.4	PVC	9.87	188.27	0.8	≤50%
P-676	MH-675	MH-516	10	10		164	186.18	179.89	3.835	PVC	19.73	186.27	1.1	≤50%
P-519	MH-516	MH-518	10	10		401	179.7	177.06	0.658	PVC	69.07	179.87	2.0	≤50%
P-520	MH-518	MH-431	10	10		399	176.97	174.58	0.599	PVC	78.94	177.15	2.2	≤50%
P-536	MH-535	MH-429	8	8		348	186.97	186.26	0.204	PVC	9.87	187.06	1.1	≤50%
P-530	MH-529	MH-524	8	8		101	190.75	181.73	8.931	PVC	9.87	190.82	0.8	≤50%
P-523	MH-521	MH-522	8	8		268	185.31	182.26	1.138	PVC	9.87	185.38	0.8	≤50%
P-525	MH-522	MH-524	8	8		65	182.16	181.63	0.815	PVC	19.73	182.25	1.1	≤50%
P-527	MH-524	MH-526	8	8		250	181.63	179.85	0.712	PVC	39.47	181.76	1.6	≤50%
P-528	MH-526	MH-427	8	8		249	179.75	177.61	0.859	PVC	49.34	179.9	1.8	≤50%
P-534	MH-533	MH-425	8	8		173	182.49	178.79	2.139	PVC	9.87	182.56	0.8	≤50%
P-1532	MH-1477	MH-703	8	8		325	197.73	196.43	0.4	PVC	9.87	197.8	0.8	≤50%
P-790	MH-703	MH-702	8	8		67	196.33	196.06	0.403	PVC	19.73	196.43	1.2	≤50%
P-1531	MH-702	MH-1475	8	8		256	195.96	194.94	0.398	PVC	29.60	196.08	1.4	≤50%
P-788	MH-701	MH-1476	8	8		183	205.13	203.15	1.082	PVC	9.87	205.2	0.8	≤50%
P-1530	MH-1476	MH-699	8	8		66	203.05	202.35	1.061	PVC	19.73	203.14	1.1	≤50%
P-786	MH-699	MH-1475	8	8		148	202.25	194.94	4.939	PVC	29.60	202.37	1.4	≤50%
P-803	MH-1481	MH-413	8	8		238	210.13	207.36	1.164	PVC	9.87	210.2	0.8	≤50%
P-1529	MH-413	MH-1475	8	8		235	207.26	194.94	5.243	PVC	19.73	207.35	1.1	≤50%
P-792	MH-1475	MH-417	8	8		186	194.84	194.1	0.398	PVC	88.81	195.04	2.4	≤50%
P-698	MH-417	MH-419	8	8		90	183.23	182.87	0.4	PVC	98.67	183.47	2.9	≤50%
P-694	MH-419	MH-421	8	8		192	182.77	181.92	0.443	PVC	108.54	183.02	3.0	≤50%
P-700	MH-421	MH-423	8	8		285	181.82	180.68	0.4	PVC	118.41	182.09	3.2	≤50%
P-706	MH-423	MH-425	8	8		400	180.58	178.79	0.448	PVC	128.28	180.85	3.2	≤50%
P-708	MH-425	MH-427	8	8		269	178.69	177.61	0.401	PVC	148.01	179	3.7	≤50%
P-710	MH-427	MH-429	8	8		308	177.51	176.16	0.438	PVC	207.22	177.87	4.3	55%
P-712	MH-429	MH-431	8	8		170	176.06	175.14	0.541	PVC	226.95	176.42	4.3	55%
P-715	MH-431	MH-433	10	10		372	174.51	172.5	0.54	PVC	315.76	174.9	4.7	≤50%
P-717	MH-433	MH-435	10	10		392	172.5	170.07	0.62	PVC	364.32	172.9	4.8	≤50%
P-718	MH-435	MH-437	10	10		91	170.02	169.7	0.352	PVC	374.19	172.3	27.4	> 100%
P-720	MH-437	MH-439	8	8		112	169.7	169.13	0.509	PVC	472.86	172.16	29.5	> 100%
P-722	MH-439	MH-441	8	8		175	169.13	167.9	0.703	PVC	482.73	171.31	26.2	> 100%
P-724	MH-441	MH-443	8	8		244	167.9	164.82	1.262	PVC	735.05	169.93	24.4	> 100%
P-726	MH-443	MH-445	8	8		280	164.72	157.16	2.7	PVC	744.92	165.31	7.1	94%
P-728	MH-445	MH-447	8	8		47	149.66	149.1	1.191	PVC	911.82	155.13	65.6	> 100%
P-729	MH-447	MH-449	8	8		217	149	145.9	1.429	PVC	990.76	153.8	57.6	> 100%
P-730	MH-449	MH-451	8	12	SM4	258	145.8	144.66	0.442	PVC	1,000.63	146.44	7.7	68%
P-732	MH-451	MH-453	8	12	SM4	308	144.56	137.93	2.153	PVC	1,040.10	145.21	7.8	69%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-1776	MH-1868	MH-1867	8	8		30	142.07	141.93	0.467	PVC	0.00	142.21	1.7	≤50%
P-1775	MH-1867	MH-1866	8	8		188	141.93	141.07	0.457	PVC	163.11	142.21	3.4	≤50%
P-1774	MH-1866	MH-1865	8	8		290	141.07	139.69	0.476	PVC	163.11	141.35	3.4	≤50%
P-1773	MH-1865	MH-1864	8	8		138	139.56	138.87	0.5	PVC	163.11	139.84	3.4	≤50%
P-1772	MH-1864	MH-453	8	8		68	138.82	138.47	0.515	PVC	163.11	139.1	3.4	≤50%
P-733	MH-453	MH-455	8	15	SM4	265	137.93	136.8	0.426	PVC	1,232.81	138.6	8.0	55%
P-736	MH-455	MH-457	8	15	SM4	175	136.7	136.1	0.343	PVC	1,242.67	137.62	11.0	79%
P-737	MH-457	MH-459	8	15	SM4	51	136.1	135.92	0.353	PVC	1,321.61	137.48	16.6	> 100%
P-1657	MH-459	MH-1751	12	12		323	135.69	134.64	0.325	PVC	1,589.16	137.42	20.8	> 100%
P-1656	MH-1751	MH-1750	12	12		204	134.64	131.6	1.49	PVC	1,589.16	135.44	9.6	86%
P-1655	MH-1750	MH-1749	12	12		222	131.13	126.79	1.955	PVC	1,589.16	131.93	9.6	86%
P-1654	MH-1749	MH-1748	12	12		237	126.61	120.78	2.46	PVC	1,589.16	127.41	9.6	86%
P-1653	MH-1748	MH-1747	12	12		29	120.66	119.4	4.345	PVC	1,589.16	121.46	9.6	86%
P-1652	MH-1747	MH-1746	12	12		157	119.29	116.44	1.815	PVC	1,589.16	120.09	9.6	86%
P-1651	MH-1746	MH-1745	12	12		308	116.33	111.05	1.714	PVC	1,589.16	117.13	9.6	86%
P-1650	MH-1745	MH-1744	12	12		113	110.86	109.73	1	PVC	1,589.16	111.66	9.6	86%
P-1649	MH-1744	MH-1743	12	12		146	109.6	108.85	0.514	PVC	1,589.16	110.5	10.8	95%
P-1648	MH-1743	MH-1742	12	12		121	108.85	107.8	0.868	PVC	1,589.16	109.65	9.6	86%
P-1646	MH-1742	MH-1741	15	15		8	107.7	107.65	0.625	PVC	1,589.16	108.46	9.1	64%
P-1606(1)(1)(1)(2)	MH-1741	MH-1739	15	15		53	107.55	107.23	0.604	PVC	1,589.16	108.31	9.1	64%
P-1606(1)(1)(2)	MH-1739	MH-1738	15	15		6	107.13	107.1	0.5	PVC	1,814.70	107.94	9.7	69%
P-1606(1)(2)	MH-1738	MH-1737	15	15		172	107	105.98	0.593	PVC	1,814.70	107.81	9.7	69%
P-1606(2)	MH-1737	MH-1703	15	15		315	105.88	103.99	0.6	PVC	1,814.70	106.69	9.7	69%
P-1607	MH-1703	MH-1704	15	15		128	103.89	103.12	0.602	PVC	1,814.70	104.7	9.7	69%
P-1608	MH-1704	MH-1705	15	15		220	103.02	101.7	0.6	PVC	1,814.70	103.83	9.7	69%
P-1609	MH-1705	MH-1706	15	15		341	101.6	99.55	0.601	PVC	1,814.70	102.41	9.7	69%
P-1610	MH-1706	MH-1707	15	15		63	99.45	99.07	0.603	PVC	1,814.70	100.26	9.7	69%
P-1611(1)(1)	MH-1707	MH-1972	15	15		142	98.97	98.1	0.613	PVC	1,814.70	100.09	13.4	94%
P-1611(1)(2)	MH-1972	MH-1736	15	15		172	98.97	98.1	0.506	PVC	1,814.70	99.78	9.7	69%
P-1611(2)	MH-1736	MH-1708	15	15		67	98.1	94.69	5.09	PVC	1,814.70	98.91	9.7	69%
P-1612	MH-1708	MH-1709	12	12		16	92.69	90.73	12.25	PVC	1,905.65	93.56	10.4	92%
P-1613	MH-1709	MH-1710	12	12		104	90.63	90.18	0.433	PVC	1,905.65	93.32	32.3	> 100%
P-1614	MH-1710	MH-1711	12	12		58	90.08	89.87	0.362	PVC	1,905.65	92.45	28.4	> 100%
P-1615	MH-1711	MH-1712	12	12		65	89.77	89.49	0.431	PVC	1,905.65	91.96	26.3	> 100%
P-1616	MH-1712	MH-792	12	12		246	89.39	88.41	0.398	PVC	1,905.65	91.41	24.2	> 100%
P-795	MH-792	MH-794	10	18	SM1	309	86.28	85.19	0.353	PVC	1,939.05	87.08	9.6	54%
P-796	MH-794	MH-741	10	18	SM1	297	85.11	84.31	0.269	PVC	1,999.77	85.97	10.3	59%
P-744	MH-741	MH-743	10	18	SM1	237	84.1	83.26	0.354	PVC	2,240.35	84.96	10.3	59%
P-746	MH-743	MH-745	10	18	SM1	252	83.18	82.48	0.278	PVC	2,243.69	84.1	11.0	64%
P-748	MH-745	MH-747	10	18	SM1	243	82.4	81.84	0.23	PVC	2,368.03	83.42	12.2	72%
P-800	MH-747	MH-799	10	18	SM1	173	81.74	81.25	0.283	PVC	2,394.75	82.69	11.4	67%
P-1750	MH-799	MH-1839	12	18	SM1	18	81.07	80.98	0.5	PVC	2,404.77	81.96	10.7	62%
P-1751	MH-1839	MH-1840	12	18	SM1	42	80.88	80.68	0.476	PVC	2,404.77	81.77	10.7	62%
P-1752	MH-1840	MH-1760	12	18	SM1	298	80.58	79.09	0.5	PVC	2,404.77	81.47	10.7	62%
P-848	MH-846	MH-847	8	8		53	82.12	81.71	0.774	PVC	3.34	82.16	0.5	≤50%
P-850	MH-847	MH-849	8	8		136	81.71	71.09	7.809	PVC	6.68	81.76	0.6	≤50%
P-852	MH-849	MH-851	8	8		65	80.95	80.69	0.4	PVC	10.02	81.03	1.0	≤50%
P-853	MH-851	MH-803	8	8		324	80.59	79.29	0.401	PVC	13.36	80.68	1.1	≤50%
P-861(2)	MH-803	MH-1760	15	15		16	79.09	78.95	0.875	PVC	16.70	79.97	10.6	75%
P-863	MH-862	MH-855	8	8		100	81.5	81.15	0.35	PVC	61.07	81.7	2.4	≤50%
P-856	MH-854	MH-855	8	8		149	81.7	81.15	0.369	PVC	3.34	81.75	0.6	≤50%
P-858	MH-855	MH-857	8	8		150	81.15	80.36	0.527	PVC	67.75	81.34	2.3	≤50%
P-860	MH-857	MH-859	8	8		66	80.36	79.83	0.803	PVC	71.09	80.54	2.2	≤50%
P-861(1)	MH-859	MH-1760	8	8		52	79.58	79.32	0.5	PVC	74.43	79.97	4.7	61%
P-1666	MH-1760	MH-1758	15	15		355	78.91	77.43	0.417	PVC	2,495.89	79.97	12.7	90%
P-1665	MH-1758	MH-1757	15	15		165	72.77	70.54	1.352	PVC	2,495.89	73.73	11.5	82%
P-1664	MH-1757	MH-1756	15	15		278	70.44	69.26	0.424	PVC	2,495.89	71.48	12.5	89%
P-1663	MH-1756	MH-1755	15	15		400	69.16	67.46	0.425	PVC	2,495.89	70.2	12.5	89%
P-1662	MH-1755	MH-1754	15	15		400	67.36	65.66	0.425	PVC	2,495.89	68.4	12.5	89%
P-1660	MH-1754	MH-711	15	15		23	65.65	65.56	0.391	PVC	2,495.89	66.69	12.5	89%
P-845	MH-844	MH-811	8	8		276	68.3	66.85	0.525	PVC	3.34	68.34	0.5	≤50%
P-808	MH-805	MH-807	8	8		285	79.06	77.63	0.502	PVC	3.34	79.1	0.5	≤50%
P-870	MH-868	MH-869	8	8		138	82.98	81.93	0.761	PVC	3.34	83.02	0.5	≤50%
P-871	MH-869	MH-807	8	8		281	81.83	76.84	1.776	PVC	6.68	81.88	0.6	≤50%

City of Stanwood
2025 General Sewer Plan
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= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-810	MH-807	MH-809	8	8		300	77.53	68.78	2.917	PVC	13.36	77.61	1.0	≤50%
P-812	MH-809	MH-811	8	8		155	68.1	66.85	0.806	PVC	53.13	68.26	1.9	≤50%
P-1538	MH-811	MH-711	15	15		37	65.75	65.56	0.514	PVC	59.81	66.45	8.4	58%
P-801	MH-711	MH-1480	15	15		252	65.46	64.21	0.496	PVC	2,559.04	66.45	11.9	85%
P-1537	MH-1480	MH-709	15	15		249	64.1	61.73	0.952	PVC	2,702.03	65.09	11.9	85%
P-799	MH-709	MH-1479	15	15		398	61.63	55.94	1.43	PVC	2,705.20	62.62	11.9	85%
P-1536	MH-1479	MH-1444	15	18	SM11	19	55.84	55.74	0.526	PVC	2,708.37	57.07	14.8	88%
P-1446	MH-1444	MH-1436	12	18	SM11	114	56.11	55.4	0.623	PVC	2,711.53	57.06	11.4	67%
P-1440	MH-1436	MH-817	12	18	SM11	16	55.3	55.25	0.312	PVC	2,714.70	56.3	12.0	71%
P-820	MH-817	MH-819	12	18	SM8	175	55.15	54.68	0.269	PVC	2,717.86	56.22	12.8	76%
P-874	MH-872	MH-873	8	8		160	114	106.35	4.781	PVC	3.17	114.04	0.5	≤50%
P-891	MH-890	MH-873	8	8		313	109.05	106.35	0.863	PVC	3.17	109.09	0.5	≤50%
P-876	MH-873	MH-875	8	8		310	106.25	94.71	3.723	PVC	9.50	106.32	0.8	≤50%
P-894	MH-892	MH-893	8	8		144	102	96.51	3.813	PVC	3.17	102.04	0.5	≤50%
P-895	MH-893	MH-875	8	8		330	96.41	94.71	0.515	PVC	6.33	96.47	0.7	≤50%
P-878	MH-875	MH-877	8	8		186	94.61	86.76	4.22	PVC	19.00	94.7	1.1	≤50%
P-880	MH-877	MH-879	8	8		255	86.66	58.71	10.961	PVC	22.16	86.76	1.2	≤50%
P-889	MH-888	MH-879	8	8		160	60.28	58.71	0.981	PVC	3.17	60.32	0.5	≤50%
P-882	MH-879	MH-881	8	8		112	58.61	56.75	1.661	PVC	28.49	58.72	1.3	≤50%
P-886	MH-884	MH-885	8	8		300	60.5	58.23	0.757	PVC	3.17	60.54	0.5	≤50%
P-887	MH-885	MH-881	8	8		273	58.13	56.75	0.505	PVC	6.33	58.19	0.7	≤50%
P-883	MH-881	MH-819	8	8		140	56.65	55.01	1.171	PVC	37.99	56.78	1.6	≤50%
P-822	MH-819	MH-821	12	18	SM8	302	54.58	53.51	0.354	PVC	2,759.02	55.56	11.8	69%
P-1431	MH-821	MH-1430	12	18	SM8	301	53.41	52.33	0.359	PVC	2,912.96	54.42	12.1	72%
P-1659	MH-1430	MH-1752	15	18	SM11	297	52.23	51.79	0.148	PVC	2,916.13	53.64	16.9	98%
P-1673	MH-1752	MH-1766	15	15		27	51.69	51.47	0.815	PVC	2,916.13	52.72	12.4	88%
P-1672	MH-1766	MH-1765	15	15		178	51.37	49.73	0.921	PVC	2,916.13	52.4	12.4	88%
P-1671	MH-1765	MH-1764	15	15		154	49.63	48.25	0.896	PVC	2,916.13	50.66	12.4	88%
P-1670	MH-1764	MH-1763	15	15		154	48.15	46.73	0.922	PVC	2,916.13	49.18	12.4	88%
P-1669	MH-1763	MH-707	15	15		154	46.63	45.22	0.916	PVC	2,916.13	47.66	12.4	88%
P-908	MH-907	MH-905	8	8		208	110	102.67	3.524	PVC	3.17	110.04	0.5	≤50%
P-904	MH-902	MH-903	8	8		103	105	104	0.971	PVC	3.17	105.04	0.5	≤50%
P-906	MH-903	MH-905	8	8		122	103.9	102.67	1.008	PVC	6.33	103.95	0.6	≤50%
P-911	MH-909	MH-910	8	8		91	113	109	4.396	PVC	3.17	113.04	0.5	≤50%
P-912	MH-910	MH-905	8	8		474	108.9	102.65	1.319	PVC	6.33	108.95	0.6	≤50%
P-914	MH-905	MH-913	8	8		135	102.55	101.85	0.519	PVC	19.00	102.65	1.2	≤50%
P-916	MH-913	MH-915	8	8		338	101.75	85.11	4.923	PVC	22.16	101.85	1.2	≤50%
P-924	MH-922	MH-923	8	8		148	104.5	98.1	4.324	PVC	3.17	104.54	0.5	≤50%
P-926	MH-923	MH-925	8	8		107	98	92.1	5.514	PVC	6.33	98.05	0.6	≤50%
P-927	MH-925	MH-915	8	8		212	92	85.11	3.25	PVC	9.50	92.07	0.8	≤50%
P-918	MH-915	MH-917	8	8		163	85.01	71.6	8.227	PVC	34.83	85.14	1.6	≤50%
P-920	MH-917	MH-919	8	8		81	71.5	66.18	6.568	PVC	37.99	71.63	1.6	≤50%
P-921	MH-919	MH-831	8	8		190	66.08	45.52	10.821	PVC	41.16	66.22	1.7	≤50%
P-898	MH-896	MH-897	8	8		165	65.5	63.1	1.455	PVC	3.17	65.54	0.5	≤50%
P-900	MH-897	MH-899	8	8		217	63	59	1.843	PVC	6.33	63.05	0.6	≤50%
P-901	MH-899	MH-827	8	8		131	58.9	48.33	8.069	PVC	9.50	58.97	0.8	≤50%
P-828	MH-825	MH-827	8	8		246	50.37	48.23	0.87	PVC	3.17	50.41	0.5	≤50%
P-830	MH-827	MH-829	8	8		42	48.23	47.76	1.119	PVC	15.83	48.31	1.0	≤50%
P-832	MH-829	MH-831	8	8		300	47.71	45.52	0.73	PVC	19.00	47.8	1.1	≤50%
P-1535	MH-831	MH-707	15	15		38	45.42	45.22	0.526	PVC	63.32	46.16	8.9	62%
P-1534	MH-707	MH-1478	15	15		393	45.12	38.98	1.562	PVC	2,982.62	46.16	12.5	89%
P-794	MH-1478	MH-705	15	15		412	38.88	32.71	1.498	PVC	2,985.78	39.92	12.5	89%
P-1533	MH-705	MH-837	18	18		64	32.17	32	0.266	PVC	2,991.82	33.3	13.6	81%
P-840	MH-837	MH-839	10	18	SM5	239	31.9	28.41	1.46	PVC	3,022.04	32.9	12.0	71%
P-842	MH-839	MH-841	10	18	SM5	116	28.32	27.63	0.595	PVC	3,029.59	29.33	12.1	72%
P-1668	MH-841	MH-1762	18	18		45	27.6	27.45	0.337	PVC	3,037.15	28.66	12.7	76%
P-699	MH-697	MH-698	8	8		351	113	105.3	2.194	PVC	7.55	113.06	0.7	≤50%
P-701	MH-698	MH-700	8	8		426	105.2	103.2	0.469	Concrete	15.11	105.29	1.1	≤50%
P-702	MH-700	MH-692	8	8		442	103.1	80.1	5.204	Concrete	22.66	103.2	1.2	≤50%
P-693	MH-691	MH-692	8	8		190	99.5	80.2	10.158	Concrete	8.67	99.56	0.7	≤50%
P-703	MH-692	MH-1473	8	8		164	80	71.3	5.305	Concrete	38.88	80.13	1.6	≤50%
P-696	MH-694	MH-1473	8	8		224	82.5	71.2	5.045	Concrete	7.55	82.56	0.7	≤50%
P-705(1)	MH-1473	MH-1762	8	8		330	71.1	32.83	11.597	Concrete	53.99	71.26	1.9	≤50%
P-1667	MH-1762	MH-1761	18	18		51	27.35	27.18	0.333	PVC	3,091.14	28.43	13.0	77%

City of Stanwood
2025 General Sewer Plan
Appendix G - Hydraulic Analyses Results
50-Year (2074) PHF Pipe Capacity Table (With Improvements)

= Pipe Area Percent Full between 50 and 69 percent.
= Pipe Area Percent Full between 70 and 99 percent.
= Pipe Area Percent Full at or above 100 percent (surcharge conditions).

Pipe ID	US Manhole ID (Model)	DS Manhole ID (Model)	Existing Pipe Diameter (in.)	Recommended Pipe Diameter (in.)	CIP No	Pipe Length (ft.)	Pipe US Invert El. (ft.)	Pipe DS Invert El. (ft.)	Pipe Slope (%)	Pipe Material	PHF (gpm)	US HGL (ft.)	US Height of Water (in.)	US Pipe Area Percent Full (%)
P-707(2)	MH-1761	MH-706	18	18		303	27.08	26.02	0.35	PVC	3,091.14	28.14	12.7	76%
P-709	MH-706	MH-708	18	18		233	25.92	25.11	0.348	PVC	3,098.69	26.99	12.8	76%
P-711	MH-708	MH-710	15	15		59	25.01	24.59	0.712	PVC	3,106.24	26.45	17.3	> 100%
P-713	MH-710	MH-712	15	15		363	24.49	22.22	0.625	PVC	3,113.80	26.05	18.7	> 100%
P-714	MH-712	MH-71	15	15		376	22.12	19.77	0.625	PVC	3,252.18	23.57	17.4	> 100%
P-749	MH-71	MH-1391	12	24	SM3	144	19.67	10.5	6.368	PVC	4,721.67	20.83	13.9	60%
P-1392	MH-1391	MH-1375	12	24	SM3	76	10.4	5.14	6.921	PVC	4,729.64	11.56	13.9	60%
P-1389	MH-1375	MH-1374	18	24	SM3	440	4.94	-2.16	1.614	PVC	6,321.68	6.29	16.2	72%
P-1388	MH-1374	MH-1373	24	24		162	-2.26	-4.29	1.253	PVC	6,329.66	-0.91	16.2	72%
P-1387	MH-1373	MH-1372	27	27		150	-4.49	-4.51	0.013	PVC	6,337.63	-2.25	26.9	100%
P-1386	MH-1372	MH-1371	27	27		409	-4.51	-4.66	0.037	PVC	6,345.61	-2.43	25.0	97%
P-1385	MH-1371	MH-1370	27	27		151	-4.76	-5.08	0.212	PVC	6,359.97	-3.07	20.3	81%
P-1384	MH-1370	MH-1369	27	27		325	-5.08	-5.46	0.117	PVC	6,374.33	-3.22	22.3	88%
P-1383	MH-1369	MH-1368	27	27		302	-5.46	-5.89	0.142	PVC	6,388.69	-3.63	22.0	87%
P-1382	MH-1368	MH-1367	27	27		371	-5.89	-6.21	0.086	PVC	6,403.05	-3.99	22.8	90%
P-1381	MH-1367	MH-1366	27	27		302	-6.31	-6.75	0.146	PVC	6,417.40	-4.57	20.9	83%
P-1380	MH-1366	MH-1365	27	27		599	-6.85	-7.55	0.117	PVC	6,431.76	-4.98	22.4	89%
P-704	MH-1365	MH-1364	27	27		89	-7.65	-7.98	0.371	PVC	6,446.12	-5.79	22.3	88%
P-1378	MH-1364	MH-1363	27	27		263	-7.98	-8.01	0.011	PVC	6,460.48	-5.84	25.7	98%
P-1377	MH-1363	MH-1362	27	27		230	-8.01	-8.2	0.083	PVC	6,474.84	-6.22	21.5	85%
P-1641	MH-1362	WW-MAIN	24	24		23	-8.4	-8.8	1.739	Ductile Iron	6,489.20	-7.03	16.4	73%

Appendix H

2008 Biosolids Utilization Plan Report

October 15, 2007

CERTIFIED MAIL
7007 0220 0004 7250 7919

Mr. Andrew Bullington
Public Works Director
City of Stanwood
10220 270th Ave. N.W.
Stanwood, WA 98292

RE: Plan for Biosolids Lagoon and Vactor Waste Disposal

Dear Mr. Bullington,

During my site visit on August 21, 2007, Kevin Hushagen gave me a tour of the Stanwood Wastewater Treatment Plant. During my visit, I spoke with Jeff Leigh and Kevin regarding some of the concerns I had relative to current ongoing operations and previously submitted application documents.

My first concern is related to the sludge being stored in the lagoons. I understand that the engineering plans were approved by Ecology's Water Quality Program. However, there are issues in regards to the biosolids handling that are permitted under the *General Permit for Biosolids Management* that were not taken into account when approved. The lagoons are currently being used for sludge stabilization. Stabilization is not a recognized method of treatment for biosolids under either the state or federal biosolids regulations. The accumulation of sewage sludge in a treatment lagoon cell is not storage, but the accumulation of treated sludge or biosolids removed from the wastewater treatment process and placed in a lagoon cell is storage. Once the solids are removed from the wastewater treatment process, they become subject to the storage standards. This has been long-standing Ecology and EPA interpretation of storage.

The state biosolids rule, WAC 173-308, prohibits storage of solids removed from the wastewater treatment process for more than 2 years without approval from the Solid Waste and Financial Assistance Program. Facilities wishing to store treated solids for more than two years (for example, lagoon storage of the solids) must obtain approval for extended storage. In reviewing an extended storage request, Ecology's Solid Waste and Financial Assistance Program will require the facility to have a long-term plan for utilization. Ecology also requires the storage conditions will meet all regulatory requirements.

My other concern at the facility is vactor waste being collected and dumped directly into the storage lagoons. Vactor wastes are considered a solid waste, and should be disposed of as a solid waste. By dumping it into the biosolids lagoon, all of the material in the lagoons regulatorily become a solid waste. This is a problem when the lagoon is emptied, as all of the material may have to be disposed of as solid waste, instead of

beneficially reused. In WAC 173-308, "Sewage Sludge" is defined as:

> A solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash generated during the firing of sewage sludge in a sewage sludge incinerator or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.

To address these issues, you should no longer discharge any material that does not meet the definition of sewage sludge as described above into the storage lagoons. The vactor waste may be discharged into the facility headworks as an alternative, or taken to another facility that can accept this waste stream. Please submit your plan to deal with these materials.

To meet the requirements for approval of extended (over two years) storage of sludge in the lagoons, Ecology must receive a completed plan for utilization of the material, which outlines storage management, capacity considerations, an estimated timeline for cleanout and considerations for disposal or reuse. This plan should be submitted to me by February 1, 2008.

If you have any questions regarding these issues, please feel free to contact me at 425-649-7258. Please note that I will be on annual leave until November 9th. I will be happy to work with you upon my return.

Sincerely,

Marietta Sharp
Regional Biosolids Coordinator

City of Stanwood

Biosolids Utilization Plan Report
August 2008

Created By RH2 Engineering, Inc., Bothell, Washington

City of Stanwood

Biosolids Utilization Plan Report
August 2008

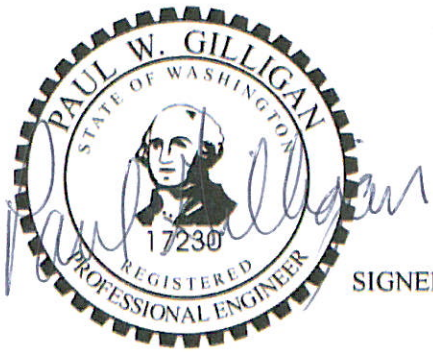
Prepared by RH2 Engineering, Inc.

Prepared for the City of Stanwood

Note: This report was completed under the direct supervision of the following Licensed Professional Engineers registered in the State of Washington.

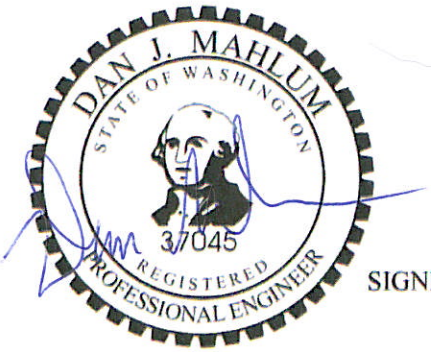
SIGNED: 8/25/08

EXPIRES 8/2/10



SIGNED: 8/25/08

EXPIRES 9/2/08



SIGNED: 8/25/08

EXPIRES 1/30/09

City of Stanwood
Biosolids Utilization Plan Report

Background and Purpose

The City of Stanwood (City) constructed a new wastewater treatment plant in 2004. As part of the expansion, two existing wastewater treatment lagoons were converted to sludge stabilization ponds. These ponds were designed to hold and, by settlement of solids, thicken the waste activated sludge (WAS) pumped from two oxidation ditches. A decant pump station was installed in each pond to take the excess water from the surface of the ponds back to the headworks of the treatment plant.

These ponds were used for sludge stabilization beginning in October 2004, and waste was discharged into each pond equally until October 2005. Since that time, all WAS has been discharged to Pond No. 2 only. Consequently, Pond No. 2 appears to be reaching its capacity to store solids. As of May 2008, the City has redirected all WAS flow to Pond No. 1 until the biosolids from Pond No. 2 can be removed and land-applied. Additionally, based on the site visit conducted by Marietta Sharp of the Washington State Department of Ecology (Ecology), it was determined that the City was in violation of the Washington Administrative Code (WAC). The State Biosolids Rule, Chapter 173-308 WAC, prohibits the storage of solids removed from the wastewater treatment process for more than two years without approval from the Solid Waste and Financial Assistance Program. Based on this Rule, Ecology has requested that the City move forward with: 1) analyzing the solids stored in the ponds; 2) planning for their removal and beneficial use; and 3) determining the most beneficial use of the solids.

Report Purpose and Organization

The purpose of this Report is to document the sampling protocol and testing plan, analyze the results of the samples and evaluate the alternatives for beneficial use of the solids currently stored in the ponds. This Report includes five sections that document the information necessary to meet this purpose. The Biosolids Production and Storage section provides information on the existing biosolids handling and storage system, and estimates the yearly production rate as well as the quantity of biosolids produced to date. Ecology has already approved the Sampling and Testing Plan section, which provides the protocol for sampling each of the ponds. The Biosolids Sampling Results and Characterization section provides results and analyses of the sampling and testing. The Biosolids Utilization section presents alternatives analyses for the removal, dewatering and ultimate use of the stored biosolids in Pond No. 2. The Report closes with Recommendations and Next Steps, providing a schedule for implementation and recommending the next steps for the City's biosolids handling program.

Biosolids Production and Storage

This section documents the existing storage capacity, the estimated solids content and the yearly solids production rate of the ponds.

Existing Pond Volume

According to the plant as-builts, the base elevation of each pond is approximately 2.9 feet. There is a weir gate in each pond with a maximum elevation of 8.4 feet. All liquid that overflows this weir is either pumped back to the headworks or allowed to flow into a 35-acre lagoon. Therefore, the total usable height of each pond is approximately 5.5 feet. Based on the dimensions of the ponds given in the as-built drawings, each pond has a capacity of 2.4 million gallons.

Currently, the liquid level of Pond No. 2 is up to the weir; therefore, Pond No. 2 is holding approximately 2.4 million gallons. The sampling log received from the City in July 2008 indicates that there is approximately 2-to-2.5 feet of water cover over the sludge blanket. In addition, the sludge depth is 3 feet on average. Using a cross-sectional profile of 58,357 square feet, and a depth of 3 feet, the sludge blanket volume is approximately 173,797 cubic feet (58,357 X 3) or 1.3 million gallons.

Pond No. 1 was only used for one year; the sludge depth is 1 foot, which equates to 58,357 cubic feet (58,357 X 1) or 436,510 gallons of sludge.

Solids Production

The KCM/Tetra Tech design parameters and actual plant data received from the City were used to develop the solids production for each cell to quantify solids production.

The design parameters from KCM/Tetra Tech indicate the following.

- The facility design projected production of solids at the facility at 1,540 pounds per day (ppd), which is an average annual production rate of 562,100 pounds per year (ppy) dry weight solids (DWS), based on a daily flow of 1.6 million gallons per day (MGD) and a five-day biochemical oxygen demand (BOD_5) of 386 milligrams per liter (mg/L).
- The sludge yield coefficient is 0.78.

The flow and load that the plant actually received in the first years of operation was less than the design capacity of the plant. Production recorded by the City from January 2006 to present is 954,955 pounds DWS. The plant data closely follows the KCM/Tetra Tech projected sludge yield coefficient (Y).

- Y projected = 0.78
- Y actual = 0.795
- Decay Rate = - 0.0623

KCM/Tetra Tech did not include the endogenous rate expected to take place in the oxidation ditch or the destruction rate of solids expected to take place in the stabilization pond. Both of these factors will decrease the accumulated solids over time. The decay rate given above was calculated based on the design parameters included in the design documents.

Review of the City's records indicates that the plant was activated in October 2004 and waste activated sludge was discharged to Pond Nos. 1 and 2 equally until October 2005. Since October 2005, all sludge has been discharged to Pond No. 2. Additionally, City records indicate that the plant influent flow, and thus the influent BOD_5, has been increasing at a growth rate of 17 percent per year since 2004. The following assumptions were made using the design approach outlined in the Water Environment Federation *Manual of Practice* (No. 11, 1977) and Metcalf and Eddy (1972 Edition) and using the growth rate of 17 percent to calculate a range of solids for each pond.

1. Endogenous respiration: High = 25 percent; Low = 10 percent
2. Stabilization Pond Destruction: High = 30 percent; Low = 10 percent

These assumptions yield the following probable range of solids for each pond:

1. Pond No. 1: High = 119,150 pounds (60 tons) DWS
   Low = 77,200 pounds (39 tons) DWS
2. Pond No. 2: High = 910,400 pounds (455 tons) DWS
   Low = 590,048 pounds (295 tons) DWS

Based on the City's sampling log data, Pond No. 2 holds approximately 1.3 million gallons of biosolids. The possible range for biosolids DWS concentration is as follows.

1. Pond No. 2: High = 8.3 percent
2. Pond No. 2: Low = 5.4 percent

Pond No. 1 has 440,000 gallons of biosolids. The possible range of biosolids DWS concentration is as follows.

1. Pond No. 1: High = 3.3 percent
2. Pond No. 1: Low = 2.1 percent

The sampling analysis received from Edge Analytical for the two ponds indicate the dry weight solids as follows.

Pond No. 1
1. High = 1.26 percent
2. Low = 0.9 percent
3. Composite = 1.1 percent

Pond No. 2
1. High = 8.07 percent
2. Low = 3.31 percent
3. Composite = 5.4 percent

These results verify the assumptions and calculations outlined above.

Yearly Solids Production Rate

Using the information above for the years 2004 through 2007, the estimation of solids production can be accomplished using the following formula:

$X = (A)*(Y)*(B)*(C)$

Where A = BOD_5 oxidized (pounds)
Y = 0.78, Growth yield coefficient
B = 100 – endogenous respiration (%)
C = 100 – destruction of solids (%).

Extended aeration ponds have typical ranges of 10-to-25 percent for endogenous respiration, and stabilization ponds have a typical range of 10-to-30 percent for destruction of solids. Since data for these parameters was not available, a conservative estimate of 10 percent for both of these parameters will be used for solids estimates in this Report.

The actual percentage of each that the wastewater facility will experience in the future will vary in accordance with the influent flow and load the facility receives and the specifics of operation for both the oxidation ditch and the stabilization ponds. In addition, the solids concentration that can be achieved in the stabilization pond will depend, to a degree, on the time the solids remain in the pond.

The sampling analysis performed by Edge Analytical, which yielded a composite concentration of 5.4 percent solids in Pond No. 2 in a volume of 1.31 million gallons (see the Biosolids Sampling Results and Characterization section), appears to verify the high range projected for both endogenous respiration in the oxidation ditch and destruction of solids in the stabilization pond. The field measurement yielded a result of 265 tons DWS of biosolids, which is close to the

calculated amount of 295 tons in Pond No. 2. This result appears to verify the approach taken for projecting biosolids production.

It has takend 3.5 years to fill Pond No. 2 to the present level if we consider that during half of the first year of operation the sludge was split equally between Pond Nos. 1 and 2 and all sludge was directed to Pond No. 2 for the following 3 years. The increase in influent BOD_5 for the oxidation ditch has been significant during this time (17 percent per year), and this fact should be considered when estimating time required to fill Pond No. 1.

Therefore, RH2 estimates that the time required to fill the remaining capacity in Pond No. 1 will be approximately 2.5 years (April or May of 2011), and the solids accumulation in Pond No. 1 will be approximately 265 tons DWS at a concentration of 5.4 percent. This estimate considers that half of the initial year's production of solids are already in Pond No. 1. The total amount of time to fill Pond No. 1 should be around 3 years.

This estimate considers that the growth rate of influent BOD_5 will level off and be less than it has been for the past three years. This estimate also assumes that the concentration of biosolids in Pond No. 1 will increase to approximately 5.4 percent in the next 2.5 years as the depth of solids increases and more time elapses, which will aid in concentration of the solids. This estimate is based on actual experience gained from operation of Pond No. 2, which closely correlates to the design parameters used for the facility. However, if growth of BOD_5 continues to increase at the high rate experienced in recent years, then it will take less than 2.5 years to fill Pond No. 1, and the City should consider this possibility when making future budget projections for solids operation of the facility.

Sampling and Testing Plan

This portion was accepted by Ecology in May 2008 so the City could move forward with testing of Pond Nos. 1 and 2. The sampling and testing plan is included to provide a full and comprehensive report for the biosolids utilization.

This section outlines the sampling plan and testing requirements for demonstrating that the solids stored in the sludge stabilization ponds comply with the Class B biosolids designation. It is important that these solids are designated as Class B so they can be land applied without further processing.

Sampling of biosolids stored in the City's sludge stabilization ponds is required to satisfy both the City's short and long-term goals. The short-term objective is to verify the quantity of sludge stored in the ponds and determine the quality of the sludge. It is anticipated that the City will be able to demonstrate that the material in the ponds qualifies as Class B biosolids and will be eligible for immediate reuse for land application.

The long-term and ultimate goal is to set up a sampling protocol for demonstrating continued compliance. These parameters are set forth in Chapter 173-308 WAC, which outlines the requirements to qualify the sludge as a Class B biosolid and the evaluation methods to ensure that quality standards are met on a continual basis. This sampling procedure outlines the equipment and methods that are to be used for an immediate and long-term sampling program for the City's sludge stabilization ponds.

Each stabilization pond has been divided into three cells (**Figure 1**). Each cell will require a grab sample at seven locations. The seven grab samples will be combined to form a composite sample so that a more representative sample from each cell is obtained. The composite samples will be taken to a lab to be analyzed for trace metals, nitrogen speciation, fecal coliform using the most probable number (MPN) method, dry weight solids content, and vector attraction reduction.

To obtain the City's immediate goal, both ponds will be emptied after the sludge has been classified as a Class B biosolid and applied for land reuse. To meet the long-term goal, the active storage pond will be sampled on a regular basis based on solids content. According to the City's *Wastewater Facilities Plan*, the facility will produce 0.77 tons of solids per day at its average annual flow when the plant reaches its design capacity. Therefore, at its design capacity, the projected production of solids is 281 tons per year. The City will discharge the facility waste to one pond. According to WAC 173-308-150, the City is required to sample once per year if the solids content is less than 290 tons.

In order to characterize the stabilization ponds for the first time, the City should conduct analyses for trace metals, nitrogen speciation, fecal coliform using the MPN method, dry weight solids content and vector attraction reduction. These results will confirm that the sludge is a Class B biosolid. Shortly before land application, the monitoring of indicator organisms is required; therefore, the vector attraction reduction, nitrogen speciation and fecal coliform tests will have to be completed again a maximum of 45 working days prior to land reuse. After the first sampling event and subsequent emptying of the ponds, the sampling procedure for trace metals, nitrogen speciation, fecal coliform and vector attraction will be conducted no more than 45 working days prior to land application.

Field Equipment

The following field equipment will be required prior to conducting sampling:

1. Gloves
2. Eye protection
3. Two clean 5-gallon buckets
4. One sterilized stainless steel 5-gallon container
5. Bound, numbered page book to use as a sampling log
6. Writing instrument
7. Sampling equipment (sounder, pond depth gage and core sampler with 1.5-inch diameter opening)
8. Deionized water
9. Laminated sampling location map
10. Boat with life jackets (to be worn at all time while operators are in the boat)
11. Sample jars and coolers supplied by the lab
12. Labels for bottles (use the same numbering as shown on the sampling location map)
13. Ice pack
14. Store-bought bleach
15. Chain of custody form supplied by the lab
16. One sterilized stainless steel 5-gallon minimum container with stainless steel mixing rod to use on the embankment
17. One glass or stainless steel funnel for use in distributing the samples from the bucket to the sample bottles

The core sampler can be purchased at various laboratory suppliers, such as Hach and Lab Safety Supply, for approximately $100.

Field Sampling Preparation

Field personnel should be provided with a copy of the Standard Practice for Sampling Industrial Chemicals (ASTM, 1992a) so that they are aware of the proper safety procedures and precautions while sampling. One week prior to the sampling event, the lab should be notified of the sampling event to ensure they are ready to accept six samples for testing of metals, nitrogen speciation, fecal

coliform, dry weight solids content, and a 30-day bench test. If the samples are to be collected at one time, the lab will supply one large cooler; otherwise, several smaller coolers will be supplied with chain of custody forms. Also, the lab should be notified that wide mouthed sampling bottles are preferred due to the biosolid consistency. Field personnel should ensure that they are prepared for the sampling event by verifying that they are in possession of the field equipment.

All items used in the sampling procedure in contact with the biosolids, with the exception of the sampling jars, are required to be sterilized. Sterilization can be accomplished using water, a clean 5-gallon bucket and household bleach. In the 5-gallon bucket, mix 1 part household bleach with 9 parts water. Using gloves, place item to be sterilized in the chlorine solution for one minute. After one minute, take the item out and rinse thoroughly with deionized water. Place on a clean surface to dry and continue sterilization of items as needed.

The sampling containers should be labeled before the sampling event. Labels should include the following.

1. Type of analysis
2. Sample identification code (this should coincide with the sampling location map)
3. Facility name, address and phone number
4. Facility contact name and phone number

The date and time the sample was taken should be added to each label during the sampling event.

If the container is to be shipped instead of delivered, follow the procedures below. Place a label on the outside of the small, plastic cased cooler with the following information.

1. Address of receiving lab and phone number
2. Shipping label per courier's standards
3. Number of samples in the cooler
4. FRAGILE and THIS END UP shipping labels

The cooler should contain an ice pack at 32 degrees Fahrenheit and packing to prevent the sample containers from breaking. Seal the cooler with tape to ensure a custody seal.

Biosolid Collection Method

Figure 1 outlines the sampling locations within the three sampling cells of each stabilization pond. In order to prepare for the sampling event, string lines should be set up prior to the sampling event. First, two lines should be set up in the north-south direction to divide each pond into thirds. Next, the ponds should be sectioned in the east-west direction into sevenths (see **Figure 1**). Refer to **Figure 1** for the coordinates of the sampling locations.

Field Sampling Procedures

The sampling event requires a minimum of three personnel. One person will collect the samples while the other navigates the boat to the sampling locations, records data and notes, and assists the sampler as necessary. The third person is stationed on the embankment to mix the composite samples, distribute the samples from the sampling containers into the sample bottles and sterilize the composite sample containers. Each composite sample requires five sample jars. Each sample jar is approximately 250 mL, with the exceptions of the fecal coliform, which requires a 120 mL jar, and the vector attraction bench test, which requires a 1,000 mL sample jar. There are seven sampling sites in each sampling cell (see **Figure 1**). Field equipment items 1 through 9 are required on the boat during the sampling event. Assemble the core sampler prior to the sampling event. Personnel are required to wear protective gear, including gloves, eyewear, and lifejackets and/or safety vests.

A core sample at each sample site is collected as follows.

1. At the first sampling site, locate the interface between the liquid and solid blanket using sounding equipment. In addition, locate the bottom of the pond using a pond bottom graduated probe. The time, depth of the interface and bottom of pond depth are to be recorded in the sampling log book by the sampling partner.
2. Insert the core sampler slowly to the pond bottom. Ensure that the core sampler reaches the bottom of the pond so that a complete stratification sample is obtained. Collect the first grab sample of the seven samples that will make up the composite per the core sampler manufacturer's instructions.
3. Remove the sampler from the water taking care to keep the sampler vertical. The partner should read the volume or depth of sludge that was removed in the column and record. Each grab sample should be approximately equal in volume (the complete depth of the sludge layer). The sampling partner should help guide the sampler into the sterilized 5-gallon stainless steel container. Dispense the sample into the container while taking care not to introduce excessive amounts of water into the bucket.
4. After the first grab sample has been collected, repeat steps 1 through 3 at the next sample locations. All grab samples in one sample cell should equal a minimum of 2 liters (0.5 gallons) per composite sample. If less than 2 liters is obtained in one sample cell, collect an equal volume of additional samples from each of the sampling locations and record.
5. After completing one sample cell, guide the boat to the location of the third partner at the pond embankment. Give the composite sample container to the third partner for distribution into the sample jars. The third partner should give the personnel on the boat a sterilized 5-gallon replacement stainless steel container. The third partner should also sterilize the core sampler using the pre-mixed chlorine solution on the embankment to prevent cross-contamination of the sampling cells. After sterilization, give the core sampler to the personnel on the boat. The third partner should thoroughly mix all the material accumulated with a mixing instrument and distribute the composite samples into the appropriate lab sample jars using a glass or stainless steel, wide-mouthed funnel. Additionally, this person should sterilize the 5-gallon stainless steel container and mixing rod in preparation for the next sample.
6. The personnel on the boat should navigate the boat to sample cell two. Perform steps 1 through 5 for each of the three sampling cells.
7. The following should be noted in the sampling log book.
    a. Purpose of the sampling event.
    b. Date, time and location of samples collected.
    c. Names of the person collecting samples and the person recording data and assisting with the sampling event.
    d. Description of the sampling point and any unusual observations.
    e. Date and time the samples were shipped or delivered to the lab.
8. When the sampling event is completed, the boat and equipment used should be thoroughly cleaned and stored until the next sampling event.

Preparing the Sample for Analysis

After all the samples have been collected, the samples should be appropriately packaged in the plastic cooler to prevent breakage during transit to the lab. In addition, the samples are required to be kept cool using an ice pack. A chain of custody form that is provided by the lab should be placed in the cooler with the following information.

1. Name of collector
2. Signature of collector
3. Date and time of collection
4. Place and address of collection
5. Requested analyses
6. Sample identification numbers that correspond with the sampling location map
7. Signatures of persons involved in the chain of possession

The following tests are required.

1. Metals – As, Cd, Cu, Pb, Hg, Mo, Ni, Se and Zn
2. Nitrogen Speciation
    a. Ammonia as Nitrogen
    b. Nitrate as Nitrogen
    c. Nitrite as Nitrogen
3. Fecal Coliform – MPN method given in MPN/gram
4. Thirty-day bench test for vector attraction
5. Dry weight solids concentration in percent

The results for the metals, nitrogen speciation, dry weight solids content and fecal coliform tests will be available in two weeks. The 30-day bench test requires 32-to-40 working days for the results to be available.

Summary

The City will collect three composite samples from each pond. Each composite sample is made up of seven grab samples. There are two stabilization ponds.

Table 2 below lists estimated costs and analytical labs for the Class B biosolid analysis.

Table 2 – Sampling Analysis Costs

	Laboratory	Test Name	No. of tests	Unit Cost	Total Cost
1	Edge Analytical	Metals	6	$140.00	$840.00
		Ammonia as Nitrogen	6	$18.00	$108.00
		Nitrate as Nitrogen	6	$18.00	$108.00
		Nitrite as Nitrogen	6	$18.00	$108.00
		Fecal Coliform	6	$32.00	$192.00
		30-day bench test	6	$38.00	$228.00
	Total				***$1,584.00***
2	City of Everett	Metals	6	130.00	780.00
	Contract Lab/ In House	Ammonia as Nitrogen[1]	6	50.00	300.00
		Nitrate as Nitrogen[1]	6	50.00	300.00
		Nitrite as Nitrogen[1]	6	50.00	300.00
		Fecal Coliform	6	50.00	300.00
		30-day bench test[2]	6	300.00	1,800.00
	Total				***$3,780.00***

1 The City of Everett sends these samples out to a contract lab. Price used is an average price that can vary. Results are within 30 days versus 2 weeks.

2 Thirty-day bench test done in-house, 40-day lead time.

Schedule

As stated previously, 45 working days prior to land application, the vector attraction reduction, nitrogen speciation and fecal coliform tests are required to be reanalyzed. Sampling for Pond Nos. 1 and 2 was completed on July 1 and 2, 2008. The sampling should be completed every year for the pond(s) that are being used for the WAS flow to monitor the characterization of the biosolids in the pond(s). As such, the next sampling event should occur on July 1, 2009.

Biosolids Sampling Results and Characterization

Using the sampling protocol above, three members of the City's wastewater crew conducted sampling on Pond No. 2 on July 1, 2008 and Pond No. 1 on July 2, 2008. RH2 Engineering observed the sampling on July 1, 2008 and documented that the sampling event was conducted per the protocol approved by Marietta Sharp on May 27, 2008. The samples were brought to Edge Analytical on July 1, 2008 for Pond No. 2 and July 2, 2008 for Pond No. 1 for analysis.

Tables 3 and **4** below illustrate the results of the lab analysis from the sampling conducted on both ponds.

Table 3 – Pond No. 1 Biosolid Results

Date Sampled	Analyte Name	Limit	Cell 1 Result	Cell 2 Result	Cell 3 Result	Units
7/02/2008	Fecal Coliform	2,000,000	50,000	36,000	75,000	MPN/g
7/2/2008	Arsenic	41	41.0	20.1	27.2	mg/Kg
7/02/2008	Cadmium	39	22.5	11.3	15	mg/Kg
7/02/2008	Copper	1,500	532	312	397	mg/Kg
7/02/2008	Lead	300	128	64.1	84.9	mg/Kg
7/02/2008	Mercury	17	2.08	1.12	1.41	mg/Kg
7/02/2008	Molybdenum	75	ND	ND	ND	mg/Kg
7/02/2008	Nickel	420	370	188	244	mg/Kg
7/02/2008	Selenium	100	ND	ND	ND	mg/Kg
7/02/2008	Silver		23.7	14.7	16.5	mg/Kg
7/02/2008	Zinc	2,800	1,364	807	1,024	mg/Kg
7/02/2008	Ammonia		10,039	5,990	6,486	mg/Kg
7/02/2008	Nitrite-N		ND	3.73	1.91	mg/Kg
7/02/2008	Nitrate-N		ND	ND	ND	mg/Kg
7/02/2008	30-Day bench test		69.96	68.68	5.13	%
7/02/2008	Total solids for calculation		0.90	1.26	1.20	%

Table 4 – Pond No. 2 Biosolid Results

Date Sampled	Analyte Name	Limit	Cell 4 Result	Cell 5 Result	Cell 6 Result	Units
7/01/2008	Fecal Coliform	2,000,000	6,000	36	83,000	MPN/g
7/01/2008	Arsenic	41	13.6	11.2	13.0	mg/Kg
7/01/2008	Cadmium	39	1.25	ND	1.06	mg/Kg
7/01/2008	Copper	1,500	195	159	173	mg/Kg
7/01/2008	Lead	300	14.4	13.2	14.8	mg/Kg
7/01/2008	Mercury	17	0.63	1.97	1.40	mg/Kg
7/01/2008	Molybdenum	75	1.86	ND	1.89	mg/Kg
7/01/2008	Nickel	420	43.8	50.6	46.3	mg/Kg
7/01/2008	Selenium	100	ND	ND	ND	mg/Kg
7/1/2008	Silver		10.4	11.2	9.4	mg/Kg
7/01/2008	Zinc	2,800	586	480	534	mg/Kg
7/01/2008	Ammonia		11,603	8,995	14,743	mg/Kg
7/01/2008	Nitrite-N		ND	ND	ND	mg/Kg
7/01/2008	Nitrate-N		0.99	ND	2.89	mg/Kg
7/01/2008	30-Day bench test		78.25	26.40	10.40	%
7/01/2008	Total solids for calculation		4.84	8.07	3.31	%

Tables 3 and **4** also compare the results of the biosolids sampling with the limits set forth by the Environmental Protection Agency's (EPA) biosolids management guidelines for Washington State.

The results for cadmium and nickel for Pond No. 1 were higher than Pond No. 2 and are closer to the limit. These metals should be investigated further. In addition, one sample had an arsenic level that was at the limit. The other two samples had a lower arsenic level and are acceptable. Vector attraction is achieved if the percentage of volatile solids is reduced by less than 15 percent. Since the biosolids will be injected into the soil immediately, the vector attraction reduction results are for information purposes only. Based on the sampling results, the sludge contained in Pond Nos. 1 and 2 can be classified as a Class B; therefore, the sludge can be land applied for beneficial use.

Biosolids Utilization

The City will be required to contract with two separate contractors for the next steps to comply with the short-term goal of removing the storage solids for beneficial use and restarting the two-year clock on solids storage. The first contractor will dredge the pond and dewater the removed biosolids for delivery to a hauling contractor. A separate hauling contractor will take the biosolids to a land application site of the City's choosing.

The intention of this Report was to find an expeditious solution for beneficial use of the biosolids generated by the City; however, time or budget required to perform a complete analysis of alternative solutions was not available. Therefore, the only alternative considered for beneficial use of biosolids was King County Metro's land application site near Mansfield, Washington. The Mansfield site was chosen because it is operational, the costs associated with it are reasonable and Everett has selected this site for beneficial use of their community's biosolids, which reinforces the judgment to select this site for the City. However, alternative sites more local than Mansfield may be considered in the future when time and budget enables an investigation and permitting process that could take several years and public hearings to gain acceptance from the City's neighbors.

Dredging and Dewatering Contractors

Contacts

1. Merrill Brothers – (574) 699-7782; Ryan; ryan@merrellbros.com
2. American Processing – (503) 949-5553; Bryon Carroll; 794 SE Greenlee Street, Dallas, Oregon

Merrill Brothers: This firm is headquartered in Indiana and has worked primarily in the Midwest; however, they have recently expanded to the Northwest. They have dredging equipment similar to a Mudcat, use screens before dewatering and prefer to use a belt press to dewater. The operation is preceeded with a site visit to conduct bench scale testing for the proper selection of a polymer, allowing them to produce dewatered solids in the 20-to 25 percent range when the equipment arrives on-site. They prefer to perform dredging during the month of July or later. A reference for the company is Chuck Dixon at (281) 444-0247 in Fairhope, Alabama.

Preliminary Cost Estimate: $250 - $375 per ton of DWS

Time Estimate: 6 – 8 weeks

American Processing: This firm is headquartered in Dallas, Oregon. They have a VMI dredge, which is similar to a Mudcat. They use screens before dewatering and prefer to use a centrifuge with a hydraulic capacity of 250 gallons per minute. They expect to get a cake in the range of 20-to-25 percent. This firm won the contract at Everett and they were referred by David Ruud of Boulder Park Transport Company. The cost estimate is based on the contractor being able to use City power

on-site, storing the biosolids on-site after dewatering, and having access to a staging area of 2,500 square feet.

Preliminary Cost Estimate: $525 - $600 per ton of DWS

Time Estimate: 4 – 6 weeks

Transport Contractors

Contacts:

1. Skagit Transportation – (360) 424-4214; Tim Sullivan (ext. 206)
2. Lynden Transport – (800) 873-2911; Marv/Nancy
3. Boulder Park, Inc. – (509) 669-3775; David Ruud

Skagit Transportation: This firm is headquartered in Mt. Vernon. They operate 30-foot tandem units; a single truckload can haul approximately 60 cubic yards of material. At 20 percent solids this amounts to approximately 10 tons of DWS and 50 tons of wet solids per truckload. They operate 27 trucks for King County and transport biosolids to a forest in Western Washington, a farm near Yakima and a farm near Mansfield.

Estimate of Cost: Currently, cost is estimated to be $45 per wet ton. Assuming biosolids at 20 percent DWS and 46 truckloads are required, the total cost would be $103,500. This estimate was qualified by Skagit Transportation as they need to evaluate each client before they can give a firm price. The estimate is also based on the high estimate for solids in Pond No. 2.

Boulder Park, Inc.: This firm had the contract for the Everett project with American Processing as the dredging and dewatering contractor. Their firm serves approximately 20 agencies, but they focused their comments on their work for King County Metro. They haul biosolids to the 55,000-acre (86-square-mile) farm near Mansfield. They operate 30-foot tandem units similar to Skagit Transportation.

Estimate of Cost: They indicated that their price for the City would be the same as it is for Everett; $45.65 per wet ton. Assuming biosolids at 20 percent DWS and 46 truckloads are required, the total cost would be $105,000. This estimate is also based on the high estimate for solids in Pond No. 2.

Site Application Responsibilities

Contacts:

1. King County Metro – (206) 263-3428; Lisa Vogel

King County Metro: Lisa Vogel is the contact for the Mansfield biosolids operation for King County. She indicated that the site is equipped to receive Class B solids. The City would be required to sign a Memorandum of Agreement if the City decides to send their biosolids to Mansfield. Lisa said that the site is lightly used considering its large size. They monitor heavy metals and the controlling nutrient nitrogen. She indicated that Metro will not have difficulty with following all the regulations in order to keep the operation sustainable. She said the biosolids are land applied where wheat is grown. She indicated that a greater number of farmers are signing up as time progresses.

Estimate of Cost: The tipping cost is minimal and has been included in the overall cost analysis.

Table 5 below provides a preliminary cost estimate for the beneficial use of the biosolids contained in Pond No. 2.

Table 5 – Cost Estimate for the Removal and Land Application of Biosolids

		Pond No. 2	
Description	Cost	High DWS = 455	Low DWS = 295
Bid Document Preparation		$25,000	$25,000
Dredging and Dewatering (per ton)	$525.00	$238,875.00	$154,875.00
Transportation and Tipping (per wet ton)	$46.00	$104,696.00	$104,696.00
Subtotal		$369,000.00	$285,000.00
Contingency		$74,000.00	$57,000.00
Tax (8.5%)		$31,000.00	$24,000.00
Total		$474,000.00	$366,00.00

Conclusions and Recommendations

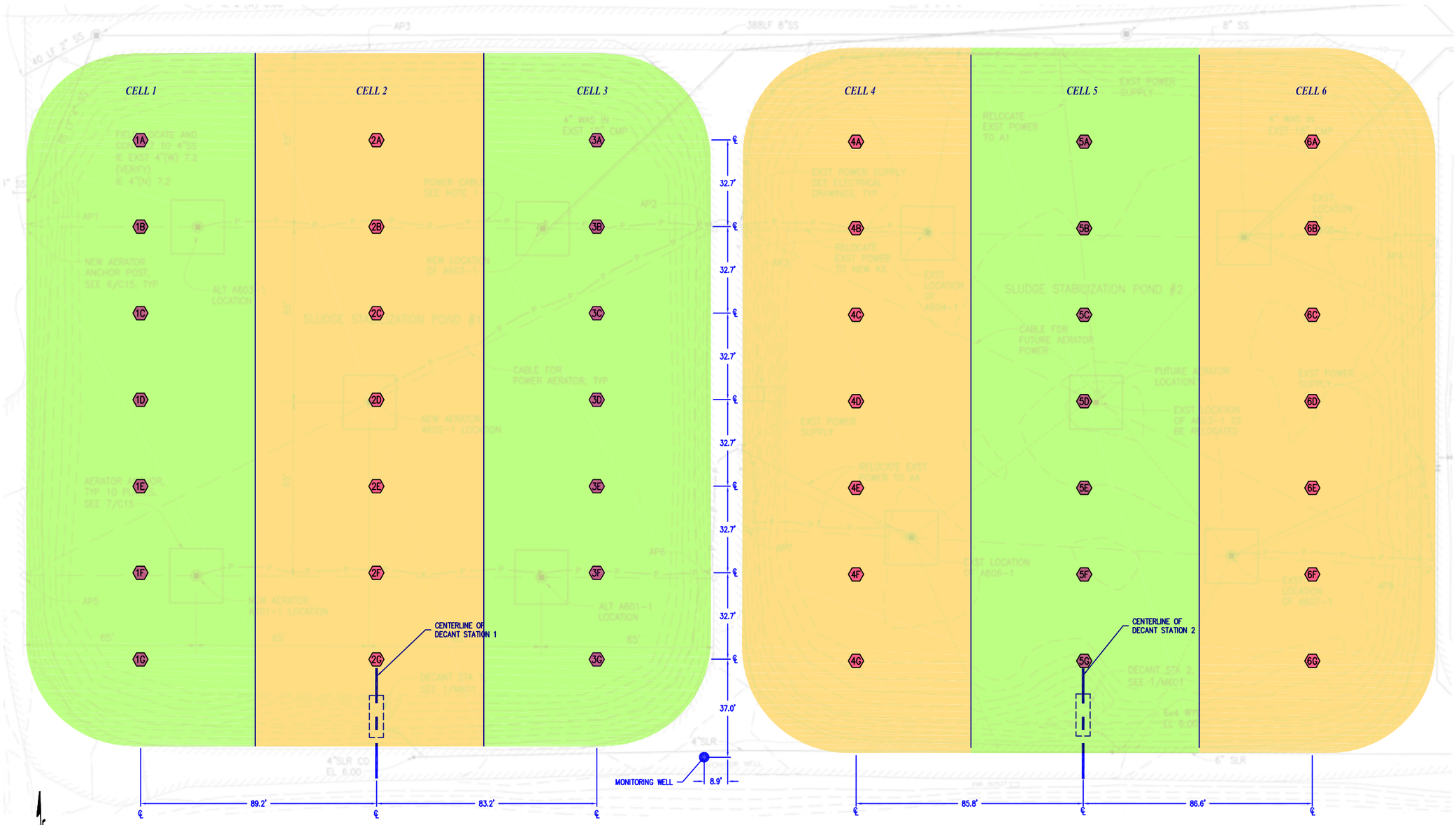
Pond No. 2 was taken off-line in May 2008 when it reached capacity, and Pond No. 1 is currently being used. Based on preliminary calculations, Pond No. 1 will reach capacity in 2011. The City will then take Pond No. 1 off-line and use Pond No. 2 until it has reached capacity.

The City completed biosolids sampling for Pond Nos. 1 and 2 in July 2008, and the results of the analyses were received by the City in August 2008. The dredging, dewatering and land application of the biosolids for Pond No. 2 has been budgeted by the City in its Capital Improvement Plan (CIP) for 2009.

This Report is only a short-term operations plan to remove the biosolids stored in Pond No. 2. It is recommended that the City investigate long-term options, including partnerships and alternate methods for biosolids management.

SLUDGE STABILIZATION POND NO. 1

SLUDGE STABILIZATION POND NO. 2



SAMPLING LOCATION MAP

1" = 20'

RICHARD H. HARBERT
STATE OF WASHINGTON
16727
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 8/3/08

DAN J. MARTIN
STATE OF WASHINGTON
37045
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 1/30/2009

CITY OF STANWOOD

FIGURE 1

PRELIMINARY

SAMPLING LOCATION MAP

RH2 ENGINEERS PLANNERS SCIENTISTS

RH2 ENGINEERING, INC.
http://www.rh2.com
mailbox@rh2.com
1.800.720.8052

BELLINGHAM OFFICE
360.676.0836
454 West Horton Road

BOTHELL OFFICE
425.951.5400
12100 NE 195th Street, Suite 100

EAST WENATCHEE OFFICE
509.886.2900
300 Simon Street, Suite 5

PORT ORCHARD OFFICE
360.876.7960
600 Kitsap Street, Suite 101

SCALE: SHOWN

0 1" 2"

DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG

PLOT: 20	DWG NO. 1
ENGINEER: BMS	
REVIEWED: KJS	
DATE: MAY 9, 2008	SHEET NO. 1 1
CLIENT: STA	
JOB NO.: 108-044	
FILENAME: SAMPLING PLAN	

Appendix I

Stanwood Wastewater Treatment Plant Nitrogen Optimization Plan

FINAL

Stanwood Wastewater Treatment Plant Nitrogen Optimization Plan

City of Stanwood, WA

Association of Washington Cities Technical Assistance Study

September 2023

Jacobs

Stanwood Wastewater Treatment Plant Nitrogen Optimization Plan

Client Name:	City of Stanwood		
Project Name:	Association of Washington Cities Technical Assistance Study		
Client Reference:	Victoria Leigh Danielson, Public Works Supervisor	**Project No:**	D3695800
Project Manager:	Amanda McInnis	**Prepared by:**	Jacobs
Date:	September 2023	**File Name:**	Stanwood WWTP_Nitrogen_Optimization_Plan
Doc Status:	Final		

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Acronyms and Abbreviations

AKART	all known available and reasonable treatment
BOD	biochemical oxygen demand
BOD_5	5-day biochemical oxygen demand
DMR	discharge monitoring report
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
lb(s)	pound(s)
lbs/day	pound(s) per day
lbs/year	pound(s) per year
mg/L	milligram(s) per liter
mgd	million gallon(s) per day
mL	milliliter(s)
MLSS	mixed liquor suspended solids
mV	millivolt(s)
NOP	Nitrogen Optimization Plan
NO_x	nitrate + nitrite nitrogen (oxidized ammonia)
NPDES	National Pollutant Discharge Elimination System
ORP	oxidation reduction potential
PSNGP	Puget Sound Nutrient General Permit
QL	quantitation level
RAS	return activated sludge
SRT	solids retention time
STEP	septic tank effluent pump
s.u.	standard units
SVI	sludge volume index
TIN	total inorganic nitrogen
TKN	total Kjeldahl nitrogen
TSS	total suspended solids
UV	ultraviolet
WWTP	wastewater treatment plant

Executive Summary

The Washington State Department of Ecology (Ecology) final Puget Sound Nutrient General Permit (PSNGP) became effective on January 1, 2022. The PSNGP limits nitrogen loadings to Puget Sound at current levels. The PSNGP applies to all 58 domestic wastewater treatment plants (WWTPs) discharging to Puget Sound, including the Stanwood WWTP.

The PSNGP requires that all total inorganic nitrogen (TIN) load dischargers covered by the PSNGP "develop, implement, and maintain a Nitrogen Optimization Plan to evaluate operational strategies for maximizing nitrogen removal from the existing treatment plant during the permit term." Each Permittee must document its actions taken, report annual TIN removal rates, report on whether annual effluent TIN loads are increasing (or decreasing), and apply an adaptive management approach. In addition, a One Time Report (Appendix B) is required that requires reporting effluent annual TIN levels.

The Stanwood WWTP is an oxidation ditch WWTP. The recommended optimization strategies to be implemented at the plant for this reporting period (January 1, 2022, through December 31, 2025) are listed in Table ES-1.

Table ES-1. Stanwood Wastewater Treatment Plant Preferred Optimization Strategies for January 1, 2022, through December 31, 2025

Optimization Strategy	Estimated Implementation Cost[a]	Optimization Category
Process nitrogen testing	$3,000 to $7,000	Improve Instrumentation
Optimize dissolved oxygen	$0	Optimize Biological Process
Continuous ORP monitoring	$2,400	Improve Instrumentation
Optimize mixed liquor recycle rates	$0	Optimize Biological Process
Replace basin 1 mixer	$28,000-32,000	Optimize Biological Process

[a] Estimated implementation costs are Association for the Advancement of Cost Engineering International Class 5 estimates with -50 percent to +100 percent accuracy range. Given the range, the costs could vary up to 2 times the listed implementation cost.

$ = 2023 U.S. dollars

ORP = oxidation reduction potential

1. Introduction

The Puget Sound Nutrient General Permit (PSNGP) requires the Stanwood Wastewater Treatment Plant (WWTP) to develop, implement, and maintain a Nitrogen Optimization Plan (NOP) to evaluate operational strategies for maximizing nitrogen removal from the existing treatment plant. This document is structured to satisfy the permit requirements. Permit language, requirements, and associated section citations have been embedded in this NOP for ease of permit compliance review and are shown in *blue italics* starting in Section 4.

2. Facility Background

2.1 Location

The Stanwood WWTP is owned and operated by the City of Stanwood, Washington, in Snohomish County. The original WWTP was built in 1963 and consisted of headworks, four 1.25-acre anaerobic primary lagoons, a 35-acre facultative lagoon, and an outfall to the Stillaguamish River.

In 2004, the City constructed a new WWTP to increase the system's total capacity to 1.5 million gallons per day (mgd). This expansion included construction of headworks, oxidation ditches and secondary clarifiers, and an ultraviolet disinfection system. The new WWTP discharges to the Old Stillaguamish River, which is tidally influenced by Port Susan and Skagit Bay in Puget Sound. The location of the WWTP and the outfall is shown on Figure 2-1.

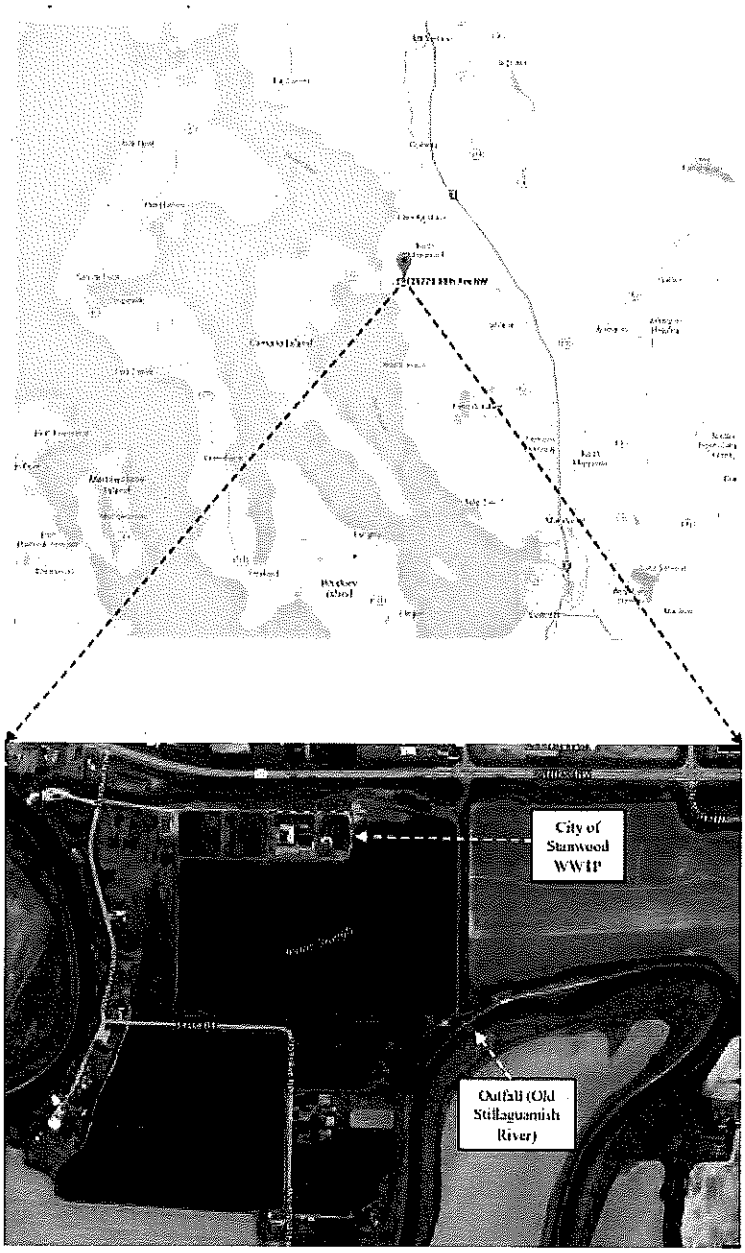

Figure 2-1. Stanwood Wastewater Treatment Plan and Discharge Location

2.2 National Pollutant Discharge Elimination System Permit, Effluent Limits

The Stanwood WWTP operates under the conditions of National Pollutant Discharge Elimination System (NPDES) Permit WA0020290, which expired on October 31, 2021, and has been administratively extended. The plant has an approved maximum monthly design flow of 1.5 mgd and a maximum monthly 5-day biochemical oxygen demand (BOD_5) loading of 4,100 pounds per day (lbs/day) and total suspended solids (TSS) loading of 4,100 lbs/day.

The current NPDES permit includes BOD_5, TSS, pH, and fecal coliform bacteria.

Under the current NPDES permit, effluent ammonia, nitrate + nitrite nitrogen (NO_x), and total Kjeldahl nitrogen (TKN) concentrations are monitored quarterly. NPDES effluent limits and maximum influent loading criteria issued for Stanwood WWTP are listed in Table 2-1.

Table 2-1. Stanwood Wastewater Treatment Plant National Pollutant Discharge Elimination System Limits and Rated Loading Capacity

Parameter	Average Monthly	Average Weekly
BOD_5	30 mg/L 376 lbs/day 85% removal of influent BOD_5	45 mg/L 563 lbs/day
TSS	30 mg/L 376 lbs/day 85% removal of influent TSS	45 mg/L 563 lbs/day
	Minimum	**Maximum**
pH	6.0 s.u.	9.0 s.u.
	Monthly Geometric Mean	**Weekly Geometric Mean**
Fecal coliform bacteria	200/100 mL	400/100 mL
Rated Capacity	**Maximum Monthly**	
Design flow	1.5 mgd	
BOD_5 influent loading	4,100 lbs/day	
TSS influent loading	4,100 lbs/day	

mg/L = milligram(s) per liter; mL = milliliter(s); s.u. = standard unit(s)

In addition to NPDES-issued monitoring requirements, all small load dischargers identified in the PSNGP also must monitor influent and effluent quality in accordance with the PSNGP. Influent and effluent monitoring requirements for nitrogen compounds are listed in Table 2-2.

Table 2-2. Puget Sound Nutrient General Permit Nitrogen Monitoring Requirements for Small Total Inorganic Nitrogen Loaders

Parameter	Units and Specifications	Sample Type
Influent Nitrogen Monitoring Requirements		
Total ammonia	mg/L as N	24-hour composite[a]
NO_x	mg/L as N	24-hour composite[a]
TKN	mg/L as N	24-hour composite[a]
Effluent Nitrogen Monitoring Requirements		
Total ammonia	mg/L as N	24-hour composite[a]
NO_x	mg/L as N	24-hour composite[a]
TKN	mg/L as N	24-hour composite[a]
TIN	mg/L as N	Calculated[a]
TIN	lbs/day	Calculated[a]
Average monthly TIN	lbs/day	Calculated[a]
Annual inorganic nitrogen, year to date	lbs	Calculated[a]

[a] For detailed monitoring requirements, see the PSNGP.

3. Process Description

3.1 Liquid Stream

The Stanwood WWTP system includes preliminary treatment followed by secondary treatment and disinfection. The plant was originally constructed in 1963, upgraded in 1973, and converted from a lagoon system to extended aeration in 2004. A process flow diagram of the Stanwood WWTP is shown on Figure 3-1.

3.1.1 Preliminary and Primary Treatment

Influent wastewater flow is pumped to the facility from the main pump station offsite and measured using an electromagnetic flow meter. Raw wastewater passes through a rock trap and a 6-millimeter mechanical fine screen. A backup manual bar screen is used when the mechanical screen is offline for maintenance. Screenings are washed with chlorinated plant water (W3) and compacted. The plant uses two carbon cannisters for treating foul air from the influent channel.

3.1.2 Secondary Treatment

Screened wastewater flows by gravity through a flow distribution channel to two extended aerated oxidation ditches for biological treatment. The oxidation ditches typically operate at a 26-day solids retention time (SRT) and at a mixed liquor suspended solids (MLSS) concentration of 2,500 mg/L. Each oxidation ditch consists of an anoxic zone and an aerobic zone. Return activated sludge (RAS) is added to the anoxic zone of the oxidation ditch. A vertical gate controls an internal mixed liquor recycle to the anoxic zone.

The aerobic zone is continuously aerated using a mechanical aerator, and a subsurface mixer helps maintain velocity and air distribution throughout the ditch. The aerators are variable speed and controlled based on a dissolved oxygen (DO) probe in each basin. Typically, one ditch is operated and the offline ditch is used for flow storage during wet weather events. In addition, flow can be diverted around the anoxic zone and the basins run in contact stabilization mode during extreme high flows. Effluent from the oxidation ditches flows by gravity to the secondary clarifier flow splitter box. The plant has two secondary clarifiers for solids removal. At the splitter box, the operators can either split the flow evenly (50/50) between the two secondary clarifiers or send all flow to one clarifier only.

3.1.3 Disinfection and Outfall

Effluent from the secondary clarifier flows by gravity to the ultraviolet (UV) disinfection system. Sluice gates are used to distribute the wastewater between the two UV channels. Each UV disinfection channel consists of two banks, each with 12 lamps. Downstream of the UV system, a Parshall flume is used for effluent flow measurement. Disinfected wastewater is discharged into the Old Stillaguamish River.

A 35-acre lagoon located downstream of the disinfection system is used for emergency storage of treated secondary or UV effluent when effluent quality is lower than desired. The stored flow can be pumped back to the plant for further treatment.

3.2 Solids Treatment

Solids are removed at the headworks and secondary clarifier. Screenings are removed in the mechanical fine screen, discharged into a dumpster, and disposed of as solid waste at a local landfill. Waste activated sludge is pumped to two 1.25-acre lagoons for stabilization. These lagoons typically are dredged every 5 years. Surface aerators add DO to create aerobic and facultative stabilization and are operated on timers.

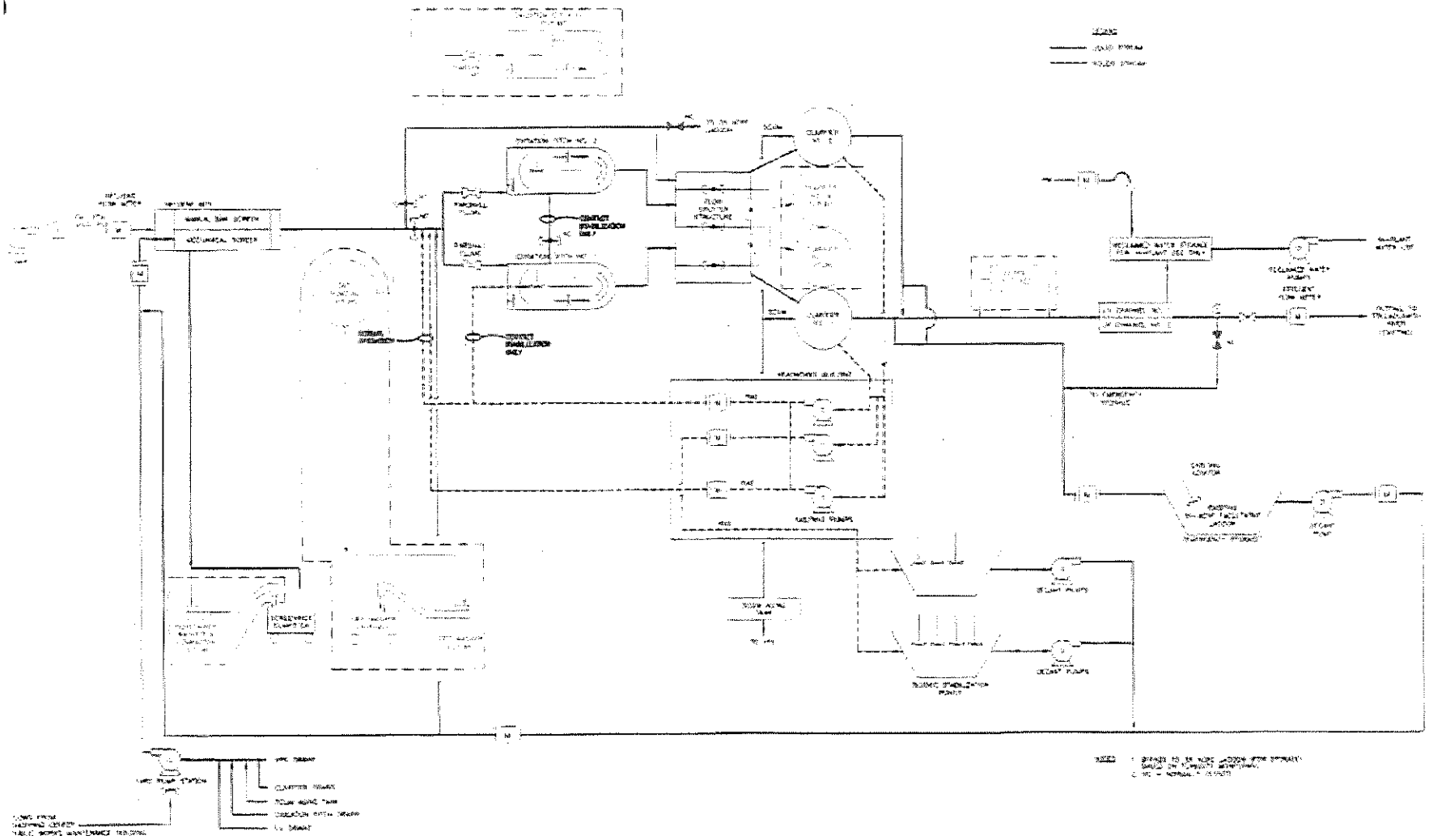

Figure 3-1. Stanwood Wastewater Treatment Plant Process Flow Diagram

4. Optimization Assessment Method

Permit Requirement: *Assess the nitrogen removal potential of the current treatment process and have the ability to evaluate optimization strategies prior to implementation (PSNGP S6.B.1). Develop a treatment process assessment method for purposes of evaluating optimization approaches during the permit term (PSNGP S6.B.1.a).*

The nitrogen removal potential of the current treatment process and optimization were assessed using the approach and steps shown in Table 4-1.

Table 4-1. Stanwood Wastewater Treatment Plant Optimization Assessment

Step	Approach	Comment
Review existing treatment process.	Virtual and in-person site visit	Oxidation ditch
Compare plant metrics to benchmarks.	Certified operators review of plant performance	Plant is nitrifying year around, but not consistently denitrifying
Set optimization goal.	Based on current performance and potential for modification	Stabilize denitrification
Review and select potential strategies.	Meet with operations staff members to vet optimization strategies; select the most cost-effective and realistic options	Complete
Continue to next steps.	Check in quarterly to review progress	None

4.1 Current Optimization Efforts

Historically, the plant has focused on biological stability, including maintaining nitrification and coping with extreme wet weather flows.

4.2 Current Process Performance

Permit Requirement: *Evaluate current (pre-optimization) process performance. Determine the empirical TIN removal rate for the WWTP (PSNGP S6.B.1.a.i).*

Figures 4-1 and 4-2 detail effluent flows and TIN concentrations and loads, respectively, for the Stanwood WWTP. The 10 mg/L shown on the graph indicates a PSNGP benchmark for an all known available and reasonable treatment (AKART) analysis. The PSNGP indicated permittees that maintain an annual TIN average of <10 mg/L through the end of 2025 and do not document an increase in their load through their DMRs do not have to submit an AKART analysis that evaluates alternatives to further reduce effluent TIN.

Permit Language: *Permittees that maintain an annual TIN average of <10 mg/L and do not document an increase in their load throughout their DMRs do not have to submit the AKART analysis (PSNGP S6.C.1)*

Stanwood WWTP has an annual TIN average of 6.6 mg/L for the year 2022, which is less than 10 mg/L, so an AKART analysis will not be conducted. The plant generally achieves complete nitrification, with two exceptions due to equipment failures. Denitrification decreased in 2020 due the failure of the DO probes, and the aerators were conservatively run at higher speeds to ensure permit limits were met. Higher aeration rates likely returned more DO to the anoxic zones decreasing the effectiveness of denitrification. In early 2021 both basins surface aerators failed causing an increase in effluent ammonia. Nitrites and nitrates constitute the majority of effluent TIN during normal operations (Figure 4-1). From July 2021 to April 2022, the plant demonstrated an ability to effectively nitrify. The effluent load data reflects the same trends as the effluent concentration data. Effluent TIN loads generally are higher in the winter than in the summer.

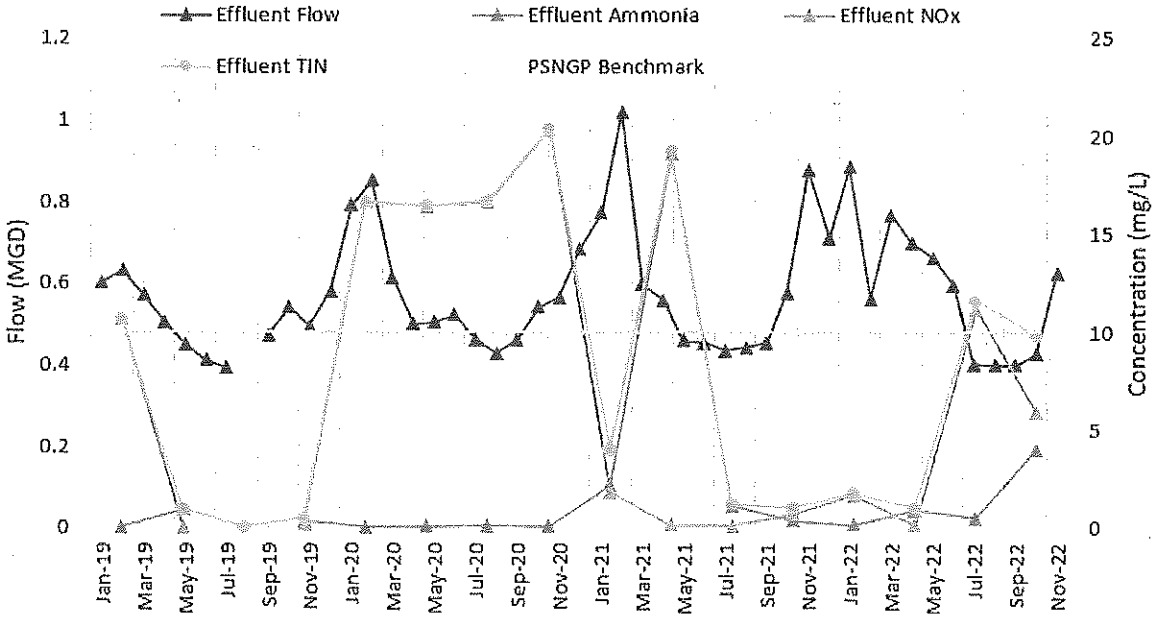

Figure 4-1. Stanwood Wastewater Treatment Plant Effluent Flow and Nitrogen Concentration

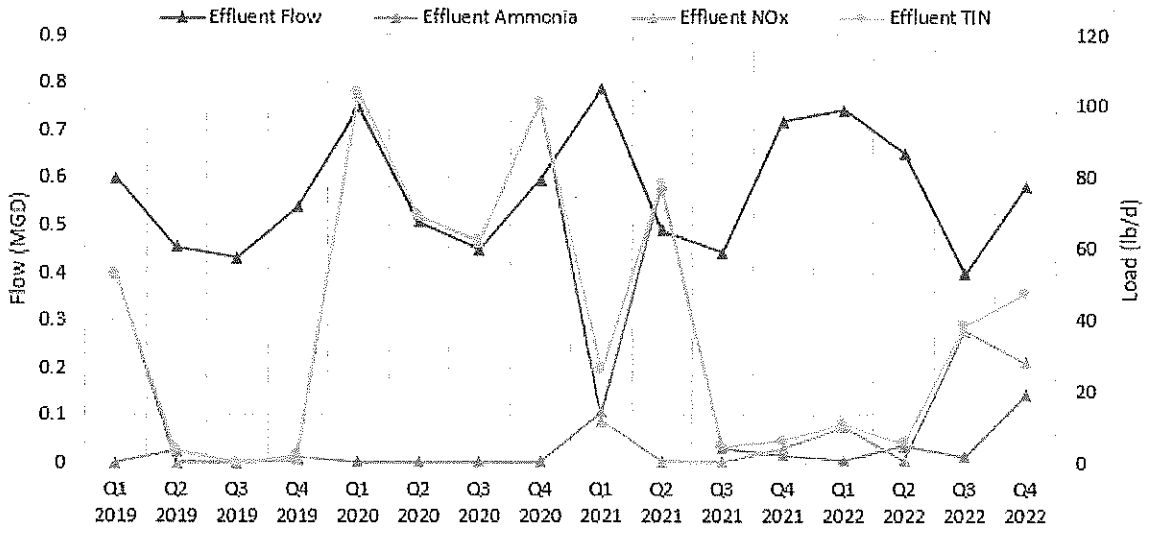

Figure 4-2. Stanwood Wastewater Treatment Plant Effluent Flow and Nitrogen Load

As required by the PSNGP, Stanwood WWTP began monitoring influent TIN in February 2022. Average monthly influent and effluent TIN loads are displayed in 4-3.

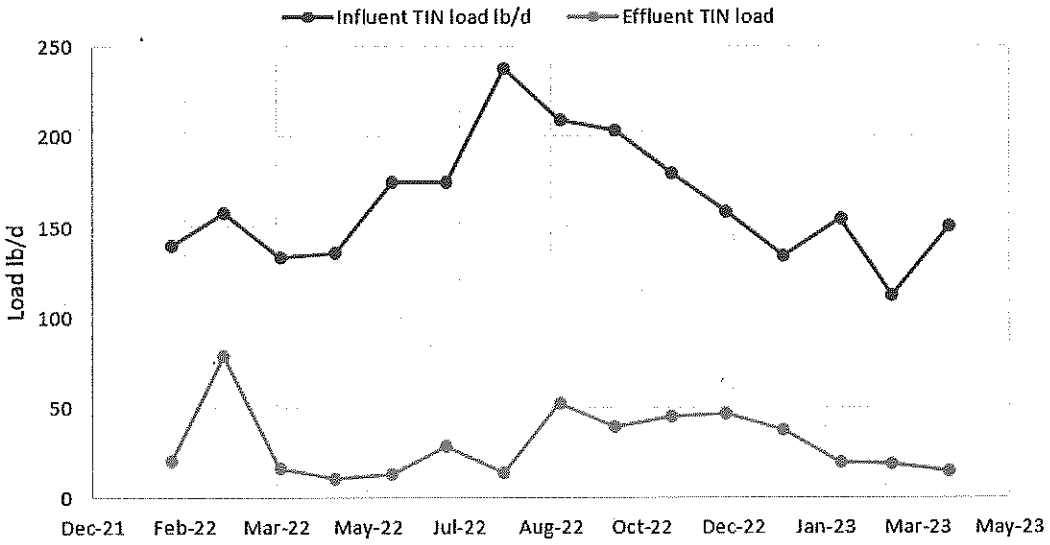

Figure 4-3. Influent and Effluent 2022 TIN loads

Figure 4-4 shows annual estimated effluent TIN loads. Estimated loads in 2020 were markedly higher because of a lack of denitrification.

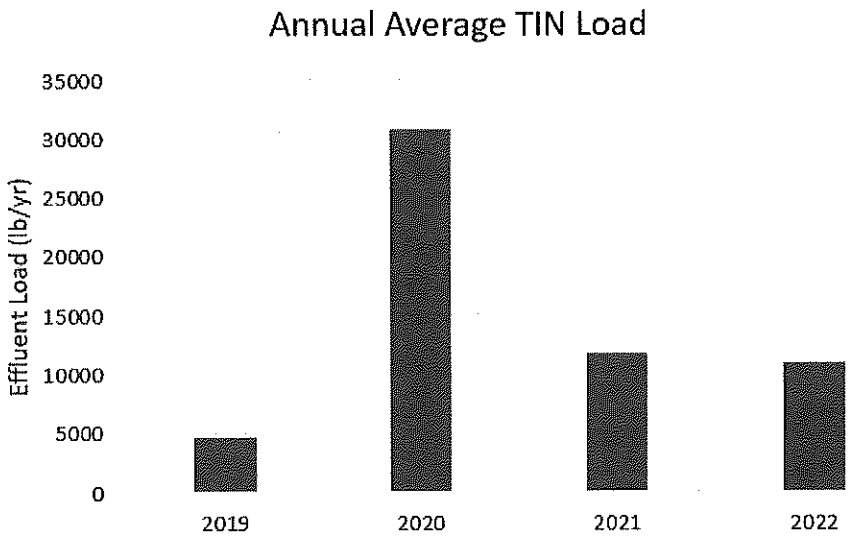

Figure 4-4. Estimated Annual Average Effluent Total Inorganic Nitrogen Loads

Table 4-2 presents these values for the last reporting period and the associated annual average TIN removal rate calculated on a percent basis.

Table 4-2. Stanwood WWTP Pre-optimization Removal Rates

Year	Annual Average Influent TIN (lbs/day)[b]	Annual Average Influent TIN (lb/yr)[c]	Average Annual Effluent TIN (mg/L)	Annual Average Effluent TIN (lbs/year)[c]	Annual Average TIN Removal Rate (%)[d]
2021[a]	-	-	6.3	11,800	-
2022	35.6	59,800	6.6	10,900	82%

Presented data are based on available influent monitoring for the reporting period.

[a] TIN is not monitored for influent flows for 2021, prior to issuance of PSNGP.

[b] Reported data are from February 2022 through April 2023.

[c] The load calculation is based on quarterly average data.

[d] Annual average TIN removal rate is based on load data

lbs/year = pound(s) per year

4.3 Determine Optimization Goal

Permit Requirement: *Determine the optimization goal for the WWTP. Develop and document a prioritized list of optimization strategies capable of achieving the optimization goal for each WWTP owned by the permittee. Update this list as necessary to continuously maintain a selection of strategies for achieving each optimization goal identified (PSNGP S6.B.1.a.iii).*

Historical data show the Stanwood WWTP is capable of both nitrification and denitrification, as expected based on the plant process configuration. Denitrification has been less stable and is the primary driver of effluent TIN. The optimization goal is to stabilize denitrification.

4.4 Potential Optimization Strategies

Permit Requirement: *Develop an initial assessment approach to evaluate possible optimization strategies at the WWTP prior to and after implementation (PSNGP S6.B.1.a.ii).*

In 2020, EPA created a combined list of possible nutrient optimization strategies based on optimization plans published from June 2020 to May 2021. Based on those studies, a list of possible optimization categories was considered for the Stanwood WWTP. Those categories are summarized in Table 4-3.

Table 4-3: U.S. Environmental Protection Agency Developed Optimization Categories

Optimization Category
Intensify/optimize biological process
Optimize clarifier performance
Improve instrumentation
Optimize controls
Equalize/reduce sidestreams
Add carbon
Chemically enhance primary treatment
Change blower operation
Add baffles to existing basins
Reduce influent loading

4.4.1 Assessment of Optimization Strategies

The Stanwood WWTP is designed to nitrify and has limited stability in denitrification; therefore, optimization strategies focus on stabilizing and increasing denitrification. The following categories are considered for optimization:

- Improve instrumentation
- Optimize biological process
- Add carbon
- Optimize controls
- Reduce Sidestreams

An assessment of potential optimization strategies to achieve stable denitrification is presented in Table 4-4 (strategies are listed in order of priority).

Table 4-4. Potential Optimization Strategies

Potential Optimization Strategy (Category)	Cost[a]	Description	Advantages	Disadvantages	Assessment	Include in Initial (2023) NOP Selection?	Consider for Adaptive Management?
Process nitrogen testing (Improve instrumentation)	Low	• Purchase process testing equipment, such as colorimetric or test-in-tube, for routine process nitrogen monitoring. • Focus testing on secondary treatment process and solids return streams.	• Cheaper than online instrumentation. • Monitor trends in performance between compliance sampling events.	Grabs and composites present a snapshot and do not capture diurnal trends.	Will evaluate different in-house testing options	Yes	Yes
Optimize dissolved oxygen concentrations (Optimize biological process)	Low	Lower DO setpoint in aeration basin by 0.25 mg/L increments, conservatively favoring BOD removal and nitrification.	• Lowers DO return to the anoxic zone and increases potential for SND in the aerated zone. • Lower aerator speed saves energy.	• Less oxidation and stability of nitrification. • May only be possible during the summer low-flow season. • Increased risk of low DO filaments.	Current set point of 1.5 mg/L, optimize after nitrogen testing equipment is on site	Yes	Yes
Continuous ORP monitoring (Improve instrumentation)	Low-Medium	• Use existing controllers, repair or replace continuous ORP probes in anoxic zones • Use to optimize MLR gate setting.	• Continuous monitoring of ORP is an indirect method of denitrification performance.	• Continuous probes require maintenance and calibration.	Investigate the existing ORP equipment and connection to SCADA	Yes	Yes
Optimize mixed liquor recycle rates (Optimize biological process)	Low	• Using process monitoring, alter MLR gate position to most efficient setting for denitrification. • Conduct exercise for both low and high flow seasons or following disruptions to denitrification.	• Balance return of nitrates and oxygen to the anoxic zone. • Results of changes are measurable within a relatively short duration.	• Gate adjustments are manual and cannot be automated based on real-time feedback. • Changes in treatment process from seasonal or other impacts may render setting less effective.	Utilize ORP probe to optimize gate setting, start from a least open position and move one position at a time until fully open	Yes	Yes

Potential Optimization Strategy (Category)	Cost[a]	Description	Advantages	Disadvantages	Assessment	Include in Initial (2023) NOP Selection?	Consider for Adaptive Management?
Replace basin 1 mixer (Optimize biological process)	High	• The submerged mixer in Basin 1 is not as effective as the mixer in Basin 2, decreasing treatment performance. • Basin 1 mixer is out of service	• More effective treatment. • Higher aeration basin velocity and MLR rates.	Replacing existing out of service equipment, very little downside	Mixer is offline, order and replace with a more effective mixer 28-32k	Yes	Yes
Monitor alkalinity (Improve instrumentation)	Low	• Measure influent and secondary clarifier effluent alkalinity.	• Ensure adequate alkalinity for full nitrification.	-Monitoring is low effort, addressing low alkalinity often involves chemical addition such as soda ash -Increased denitrification will return alkalinity and reduce the need to use an external source	Characterize as needed	No	Yes
Flow pace RAS (Optimize controls)	Medium-High	• RAS rate based on influent flow. • Add VFDs to RAS pumps and programming.	Match biological inventories to influent flows and corresponding lows to increase treatment effectiveness and maintain MLSS concentrations.	• Capital modifications required to add VFDs and programming required	RAS pumps lack VFDs	No	Yes
Run both aeration basins (Optimize biological process)	Medium	Seasonally or year-round, run both aeration basins to increase stability and TIN removal.	Increased MLSS inventory, detention times, and biological treatment capacity.	• Increased energy consumption and maintenance • Loss of flow storage from offline basin	Not needed at existing flows and loads.	No	Yes
Optimize solids stabilization blower operation and sidestream return (Reduce sidestreams)	Low-Medium	• Adjust aeration timers based on nitrate and ammonia to reduce TIN return. • Time sidestream return during off peak influent nitrogen loading times.	Reduce TIN loading on secondary system.	• Energy intensive. • Lack of complete mixing and controls in the current sludge storage pond.	Difficult reduce nitrogen release based on long solids holding times, focus on characterizing loads	No	Yes

Potential Optimization Strategy (Category)	Cost[a]	Description	Advantages	Disadvantages	Assessment	Include in Initial (2023) NOP Selection?	Consider for Adaptive Management?
Add carbon (Add carbon)	High	• Investigate/measure influent carbon to nitrogen ratios. • If carbon limited, feed an external carbon source such as acetate, methanol, or MicroC to the anoxic zones to increase denitrification.	Increase nitrate removal.	High capital cost and operations and maintenance expenses.	Likely lower limit of TIN based on past performance data.	No	Yes
Online nitrogen testing (Improve instrumentation)	High	Install continuous nitrate and ammonia probes in the secondary effluent	• Real time, daily, and diurnal process data • Immediate detection of process issues, upsets, or trends outside of targets	High upfront capital and intensive maintenance and calibration	Use process nitrogen testing first, if nitrogen is highly variable consider online instrumentation	No	Yes

[a] Low is 1% annual plant maintenance cost.

MLR = mixed liquor recycle; SND = Simultaneous nitrification denitrification; VFDs – variable frequency drives

4.5 Initial Strategy Selection and Predicted Performance

Permit Guidance: *The Permittee may exclude from the initial selection any optimization strategy considered but found to exceed a reasonable implementation cost or timeframe. Documentation must include an explanation of the rationale and financial criteria used for exclusion determination (PSNGP S6.B.1.a.iv).*

For the purposes of this study, projects with costs that exceed 1 percent of annual plant maintenance cost were not considered optimization. The following are strategies with costs greater than 1 percent of annual maintenance that were excluded from selection:

- Add carbon – investigate necessity and high cost
- Replace Basin 1 mixer – high cost
- Flow pacing RAS – high cost

Permit Guidance: *By December 31, 2022, identify the optimization strategy selected for implementation. Document the expected percent TIN removal (or the expected reduction in effluent load) for the optimization strategy prior to implementation (PSNGP S6.B.1.b).*

4.5.1 Strategy 1: Process Nitrogen Testing

Results from compliance nitrogen samples, typically sent to offsite laboratories, often are delayed several days and are ineffective for use in process control changes. Having the ability to monitor ammonia, nitrite, and nitrate onsite would improve (shorten) the response time to make process changes such as blower operation and wasting. Nitrogen monitoring equipment can vary from simple test strips and colorimetric methods up to use of a spectrophotometer. If the plant wants to complete permit-required testing in house, a spectrophotometer and test-in-tube type setup may be the most efficient. Nitrogen testing can be run as frequently as supplies and staff are available, but ideally between 3 days per week and once per week would increase the process understanding over current permit-required frequencies.

4.5.2 Strategy 2: Optimize Dissolved Oxygen

Both aeration basins include online DO probes located near the effluent weir gate and surface aerators on variable frequency drives along with the ability to control aerator speed based on DO setpoint. The extended aeration process has demonstrated a consistent ability to fully nitrify but has been less effective at denitrification. Optimizing the dissolved oxygen from current setpoints of around 1.5 mg/L to lower oxygen concentrations will both decrease the return of DO to the anoxic zones and possibly create some anoxic treatment within the aerated zone. It is recommended to decrease the DO setpoint very slowly, in 0.1 to 0.25 mg/L increments over long durations, such as week- to month-long intervals. The long durations will give adequate time to measure and observe changes in TIN removal and observe for any adverse changes, such as the emergence of low DO filaments. It is recommended to take DO profiles with a handheld probe at different locations to confirm the conditions measured by the continuous probe reflect the rest of the basin. The profiles should be taken before and after setpoint changes.

If adverse conditions are observed, reverse the last setpoint change. Adverse conditions are more likely if the DO is less than 1 mg/L and this generally is not recommended but may be possible. Also, DO setpoints will need to be optimized seasonally with attention paid to SRT.

4.5.3 Strategy 3: Continuous ORP Monitoring

The aeration basin anoxic zones are equipped with controllers and pole mounts for continuous ORP probes. Without drivers for nitrogen removal in the past the probes were not kept in service. An initial assessment of the existing controllers, mounts, probes, and connections to SCADA should be conducted to determine what is needed to place the probes in service. One probe could be kept in service and rotated between basins or both basins could be outfitted with continuous probes. When creating anoxic conditions with the absence of or very low DO, the process can be further monitored using ORP. ORP

typically will range from -50 to 50 mV for effective denitrification and the ORP will decrease as the concentration of nitrates is lowered.

4.5.4 Strategy 4: Optimize Mixed Liquor Recycle Rates

When first implementing this strategy, rely on the ORP probes to set the MLR rates. The optimization of the mixed liquor recycle rate is controlled by the return gate position. The fully open position maximizes the return of nitrates, but also increases the return of dissolved oxygen. Strategy 4 is linked to Strategy 2 in that if the DO at the end of the ditch is lowered, then more ML (with nitrates) can be returned without returning too much oxygen. Starting with the gate minimally open, monitor the ORP and take a nitrate grab from the end of the anoxic zone. The gate then can be moved one position further open at a time, following the average detention time of the anoxic zone, repeating ORP and nitrate measurements. Use the pre-drilled gate position holes to pin the selected position in place. The gate should be opened until ORP, and nitrate concentrations significantly increase, at which point the gate can be closed back one position. Repeat this activity seasonally, at least twice per year, including low flow/high temperature and high flow/low temperature seasons. The optimization can be completed over the course of a day or over several weeks. With online ORP data the gate position adjustment can happen as often as weekly.

4.5.5 Strategy 5: Replace basin 1 mixer

The mixer in basin 1 is out of service and reported to be less effective than the basin 2 mixer. Replacing the mixer and getting it back in service will increase DO distribution, prevent solids settling, and increase contact between MLSS and pollutants including nitrogen. When a new mixer is purchased, it is recommended choosing a mixer compatible with the existing electrical, mounts, and controls and if possible, use the more effective mixer style from basin 2.

4.5.6 Predicted Performance

When implemented, selected strategies are expected to maintain recent effluent TIN concentrations between 6.0 and 6.5 mg/L more reliably over an extended period of time. Table 4-5 outlines associated TIN effluent loading for the Stanwood WWTP.

Table 4-5. Expected Performance of Selected Optimization Strategies

Anticipated Effluent TIN Concentration (mg/L)	Anticipated Effluent TIN Load (lbs/year)	Pre-optimization (2022) Effluent TIN Load (lbs/year)	Reduction in Effluent TIN Load (%)
≤6.5	≤11,800	10,900–11,800	0–5%[a]

[a] Reduction in effluent TIN load based on pre-optimization loads from 2021 and 2022.

Note: Anticipated effluent TIN concentrations were determined on the assumption that the plant is successful in denitrification optimization. The performance values are representative of potential performance if optimization strategies are fully and properly implemented and operated. Given normally occurring variations in wastewater characteristics, temperatures, service area characteristics, and other parameters, the actual TIN reduction achieved may differ from the projected values. The City should carefully monitor and proactively adapt its TIN optimization efforts based on the WWTP performance achieved.

Implementation of this strategy will span the entire reporting period. After the first year, this strategy may be modified or improved following observation and analysis of TIN and supporting metrics.

5. Optimization Implementation

5.1 Implementation Cost and Timeline

Permit Requirement: *Permittee must document implementation of the selected optimization strategy as it applied to the existing treatment process during the reporting period. Permittees must document adaptive management applied to the optimization strategies following initial implementation through the permit term (PSNGP S6.B.2).*

Describe how the strategy was implemented during the reporting period, following permit coverage. Including: initial implementation costs, length of time for full implementation, start date, anticipated and unanticipated challenges, any impacts to the overall treatment performance as a result of process changes (PSNGP S6.B.2.a).

Table 5-1 lists capital costs and dates associated with implementation actions.

Table 5-1. Implementation Cost and Timeline for Actions

Optimization Strategy	Initial Implementation Cost[a]	Implementation Start	Implementation Duration
Process nitrogen testing	$3,000 to $7,000	2023	Ongoing[b]
Optimize dissolved oxygen	$0	2023	1 Year[c]
Continuous ORP monitoring	$2,400	2024	Ongoing[b]
Optimize mixed liquor recycle rates	$0	2024	1 Year[c]
Replace basin 1 mixer	$28,000-32,000	2023	1 Month

[a] Estimated implementation costs are Association for the Advancement of Cost Engineering International Class 5 estimates with -50 percent to +100 percent accuracy range. Given the range, the costs could vary up to 2 times the listed implementation cost.

[b] Duration corresponds to the time period over which performance will be studied and evaluated.

[c] Duration corresponds to the time required to implement the change

$ = 2023 U.S. dollars

5.2 Additional Implementation Considerations

5.2.1 Adaptive Management Practices

Permit Requirement: *If the TIN loading increased, apply adaptive management, re-evaluate the optimization strategies and the resulting performance to identify the reason. Select a new optimization strategy for implementation and/or revise implementation for better performance. Document any updates to the implementation schedule and overall plan. (PSNGP S6.B.2.c).*

The optimization strategies selected will be evaluated on an annual basis. If selected options do not achieve the expected results, additional strategies may be selected from Table 4-4 or strategies not considered to date may be evaluated. Understanding the nitrogen removal effectiveness of the plant will help guide both optimization and capital planning, including effluent discharge alternatives.

5.2.2 Anticipated and Unanticipated Challenges

Before implementation, the following anticipated challenges were identified:

- Cost of purchasing and maintaining instrumentation

- Limited control of solids processing and return, resulting in high nitrogen and solids return to the process
- Lack of redundant aerators in the aeration basins

These challenges will exist throughout the deployment of this strategy. The following unanticipated challenges were not considered:

- Growth in service area above current projections
- Continued abnormally high inflation hampering funding for optimization and plant improvements
- Extreme climate events related to precipitation and temperature

6. Influent Nitrogen Reduction Measures and Source Control

Permit Requirement: *Investigate opportunities to reduce influent TIN loads from septage handling practices, commercial, dense residential and industrial sources (PSNGP S.B.3).*

6.1 Review of Non-Residential Nitrogen Sources

Permit Requirement: *The investigation must review non-residential sources of nitrogen and identify any possible pretreatment opportunities. (PSNGP S6.C.3.a).*

There are few industries (seafood packaging, metal works, and vehicle servicing) in the service area. All these industries have their own pretreatment, and it would be prudent to measure nitrogen concentrations and loads from the sources most likely to impact the treatment plant such as seafood packaging.

6.2 Review of Dense Residential and Commercial Areas

Permit Requirement: *The investigation must identify potential strategies for reducing TIN from new multi-family/dense residential developments and commercial buildings (PSNGP S6.C.3.b).*

As of December 2013, there were approximately 2,143 sewer service connections throughout the City's sewer system. Of these connections, 1,738 were single/multi-family residential services, 121 were light commercial, 42 were low income and senior housing, and 242 were other (RH2 2015). The projected growth rate through 2035 was 2.2%.

Considering the small percentage of land allocated to commercial activities and no anticipation of higher strength wastewaters from high-density residential areas, addressing these sources is not practical to reduce influent TIN loads. Considering the residential and commercial activities, there is no need to evaluate alternate nitrogen management options within the service area.

6.3 Review of Septage Receiving

Stanwood WWTP currently does not receive any septage.

7. References

RH2. 2015. *City of Stanwood Comprehensive Sewer System Plan*. February.

Appendix A
One-time Report Questions for Small Total Inorganic Nitrogen Loaders

Washington State Department of Ecology One-time Report Questions for Small Loaders

Stanwood Wastewater Treatment Plant, 2026

One-time report questions to which responses are currently recorded are included in Appendix A. Questions that have to be filled out by the permittee in future (Questions 2, 10, 11, 12, and 13) are included under Table B2 in Appendix B.

1. Attach a document describing your initial assessment process **(Table 4-1)**, your optimization goal **(Section 4.3)**, the list of prioritized optimization strategies identified **(Table 4-4)**, and the strategy implemented in 2022. If optimization strategies were found to not have a reasonable implementation cost or timeframe, include a description of the feasibility and cost analysis that led to the exclusion of any approach(es) **(Section 4.5)**.
3. Did your facility stay below a 10 milligrams per liter (mg/L) annual average TIN concentration? **(Table 4-2)**

   If Q2 = **Yes and Q3 = Yes, no further questions.**

4. What is your pre-optimization empirical TIN removal rate? **Refer to Table 4-5.**
5. Did you maintain your reassessment approach after year 1? If No, attach a document describing assessment revisions that occurred each year over the permit term.
6. What is your expected TIN removal with the preferred optimization strategy? **Refer to Table 4-5.**
7. Attach a document describing optimization implementation, including costs, time for full implementation, start date, challenges, and impacts to treatment performance. **Refer to Sections 5.1 and 5.2.**
8. What was the TIN removal rate observed each year during the reporting period? **Refer to Table 4-2.**
9. Attach a document describing your ongoing investigations to reduce influent TIN loads from septage handling practices, commercial/dense residential, and industrial sources. **Refer to Section 6.**

Appendix B
Future Worksheet for Small Total Inorganic Nitrogen Loaders

B.1 Load Evaluation

Permit Requirement: *Each Permittee listed in Table 11 must review effluent data collected during the reporting period to determine whether TIN loads are increasing. (PSNGP S6.B.2.b.). Using all accredited monitoring data, determine facility's annual average TIN concentration and load from the reporting period (PSNGP S6.B.2.b.i). Determine the treatment plant's TIN removal rate at the end of each year. Compare the removal rate with the pre-optimization rate identified in Table 4-4. (PSNGP S6.B.2.b.ii).*

To measure the success of selected optimization strategies relative to PSNGP requirements, all accredited monitoring data for this reporting period (January 1, 2022, to December 31, 2025) will have to be compiled by the permittees on an annual basis to populate Table B1.

Table B1. Evaluation of Annual Average Effluent Total Inorganic Nitrogen Metrics

Monitoring Period	Annual Average Influent TIN Concentration (mg/L)	Annual Average Influent TIN Load (lb/year)	Annual Average Effluent TIN Concentration (mg/L)	Annual Average Effluent TIN Load (lbs/year)	Annual Average TIN Removal Rate (%)	Pre-Optimization TIN Removal Rate (%)[b]
January 1, 2022, through December 31, 2022	35.6	59,800	6.6	10,900	82% [a]	82%
January 1, 2023, through December 31, 2023						82%
January 1, 2024, through December 31, 2024						82%
January 1, 2025, through December 31, 2025						82%

% = percent

lbs/year = pound(s) per year

mg/L = milligram(s) per liter

TIN = total inorganic nitrogen

[a] Annual average TIN removal rate is based on influent and effluent load.

[b] Note that the monitoring period from January 2022 through December 2022 is considered for the pre-optimization TIN removal rate.

Permit Requirement: *Strategy Assessment. Quantify the results of the implemented strategy and compare to the performance metric identified in S6.B.1.b. If the TIN loading increased, apply adaptive management, re-evaluate the optimization strategies and the resulting performance to identify the reason. Select a new optimization strategy for implementation and/or revise implementation for better performance. Document any updates to the implementation schedule and overall plan. (PSNGP S6.B.2.c.).*

Tables B1a through B1c provide a review of effluent TIN data listed in Table B1 and document revised strategy implementation for better performance, if required. Permittees will have to populate these tables on an annual basis.

Table B1a. Review of Total Inorganic Nitrogen Data

Description	Permittee Input
According to accredited data in Table B1, in 2023 TIN loads have:	[Increased/Decreased/Remained constant]
According to accredited data in Table B1, the 2023 empirical TIN removal rate met or exceeded the pre-optimization removal rate.	[Yes/No]
List the optimization strategy the plant is currently implementing.	
If the pre-optimization TIN removal rate was not met or exceeded, and TIN loads have increased, then populate the next three rows:	
List reasons for the TIN load increase.	
List modified or new optimization strategy or strategies that will be implemented	
List updates to the implementation schedule.	

Table B1b. Review of 2024 TIN Data and Revised Strategy Implementation

Description	Permittee Input
According to accredited data in Table B1, in 2024 TIN loads have:	[Increased/Decreased/ Remained constant]
According to accredited data in Table B1, the 2024 empirical TIN removal rate met or exceeded the pre-optimization removal rate.	[Yes/No]
List the optimization strategy the plant is currently implementing.	
If the pre-optimization TIN removal rate was not met or exceeded, and TIN loads have increased, then populate the next three rows:	
List reasons for the TIN load increase.	
List modified or new optimization strategy or strategies that will be implemented.	
List updates to the implementation schedule.	

Table B1c. Review of 2025 TIN Data and Revised Strategy Implementation

Description	Permittee Input
According to accredited data in Table B1, in 2025 TIN loads have:	[Increased/Decreased/ Remained constant]
According to accredited data in Table B1, the 2025 empirical TIN removal rate met or exceeded the pre-optimization removal rate.	[Yes/No]
List the optimization strategy the plant is currently implementing.	
If the pre-optimization TIN removal rate was not met or exceeded, and TIN loads have increased, then populate the next three rows:	
List reasons for the TIN load increase.	

Description	Permittee Input
List modified or new optimization strategy or strategies that will be implemented.	
List updates to the implementation schedule.	

B.2 Report Questions

Permittees are required to submit the single report online, pursuant to Special Condition S9.E. Appendix A contains questions already completed. Table B2 provides One-Time Report questions for small loaders that have to be filled out by the permittee after the development of the optimization report.

Table B2. Report Questions

Question	Response (Yes/No)
2. Did your plant meet or exceed the pre-optimization empirical TIN removal rate in each year of this permit and maintain or reduce TIN loads? Also refer to Tables B1a through B1c.[a]	
10. Did you submit the required AKART analysis on or before 12/31/2025?[b]	
11. Did you submit discharge monitoring reports according to the required schedule?[c]	
12. Are you retaining all applicable records?[d,e]	
13. Did you follow non-compliance notification requirements?[f]	

[a] If "No," then attach a document describing how you revised your optimization strategy in response to the evaluation in each of the prior permit years, and document your adaptive management steps, your assessment process, and the new optimization strategy or strategies you identified, and your updated optimization goal(s) and performance metric(s).

[b] If "No," date document was or will be provided.

[c] If "No," attach a document describing the missed monitoring activities and the corrective action taken.

[d] If "No," attach a document describing the missing records and the corrective action taken and/or planned.

[e] Permit Requirement: *"The Permittee must retain records of all monitoring information (field notes, sampling results, etc.), optimization documents submitted with the one-time report, and any other documentation of compliance with permit requirements for a minimum of five years following the termination of permit coverage. This period of retention must be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology. (PSNGP S9.F.)*

[f] If "No," attach a document describing the noncompliance and the corrective actions taken and/or planned.

Appendix J
Safety Manual

CITY OF STANWOOD

EMPLOYEE ACCIDENT PREVENTION PROGRAM

Effective Date: September 2021
Revised: January 2025

CITY OF STANWOOD
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Section 1

Commitment to Safety

The personal safety and health of each employee within the City of Stanwood is of primary importance. We are committed to protecting our employees and property from accidental loss by developing an Accident and Illness Prevention Program (APP). The City of Stanwood leadership and management will ensure the implementation of this program by dedicating time and resources to comply with all current and future safety & health codes and regulations. We want every employee to have a safe and productive work environment and return home each day free from injury.

In fulfilling this commitment, the City will provide and maintain a safe and healthy work environment. We will strive to eliminate any foreseeable hazards, which may result in personal injuries/illnesses, fires, security losses, and damage to property.

All activities will be conducted (at a minimum) in accordance with the Department of Occupational Safety and Health/Washington Industrial Safety and Health Administration (DOSH/WISHA) requirements. The City will provide adequate training, proper equipment, and develop safe work procedures and practices to assure all activities will be performed safely and efficiently.

The responsibility for implementing this policy is management's. However, the City of Stanwood expects its staff and supervisory personnel to share and champion these goals. Supervisors are responsible for the safety of their employees and as a part of their daily duties must check the workplace for unsafe conditions, observe employees for unsafe acts, and promptly respond to eliminate any hazards identified. Supervisors are trained and expected to be leaders, setting a proper example by showing dedication and support for all policies, laws, and regulations. In addition, all employees are responsible for performing their jobs in accordance with their department's safety rules and procedures.

We encourage all employees to be continually committed to our goals, to show leadership by setting good examples, and to actively participate in identifying ways to make the City of Stanwood a safer place to work.

Safety and Health Responsibilities

Management Responsibilities

All leaders should continually build and support a culture and environment that clearly demonstrates to employees that safety is a vital part of their personal and professional activities. Leaders are responsible for implementing systems and programs that uphold the City of Stanwood's safety culture and values.

City of Stanwood leadership and management assume the responsibility for the safety and health program and ensure the program remains relevant and effective in practice.

Department leadership reports – or designates reporting responsibility for – all fatalities and hospitalizations within 8 hours and all amputations and enucleations (eye removal) within 24 hours to the Department of Labor and Industries (1-800-4BE SAFE).

City of Stanwood management will:

- Make certain that a citywide Safety Committee is formed and is carrying out its responsibilities as described in this program.
- Ensure that sufficient employee time, supervisor support, and funds are allocated for safety programs and priorities, safety equipment, and training.
- Evaluate supervisors each year to make sure they are sufficiently trained, accountable for their reports' safety performance, and are carrying out their responsibilities as described in this program.
- Fully investigate incidents and ensure corrective action is taken to prevent the hazardous conditions or behaviors from happening again.
- Ensure corrective action and discipline are administered consistently and fairly.
- Maintain or assign maintenance for the record of injuries and illnesses and posts the record per program guidelines.
- Set a good example by following established safety rules and attending required training.
- Work with subcontractors to ensure both their workforce, and your staff, are following the agreed-upon safety program for any worksite.
- Ensure safety performance is included in each manager's, supervisor's and worker's annual review or appraisal.
- Acknowledge and reward safe work practices and behaviors.

Supervisor Responsibilities

City of Stanwood supervisors will:

- Ensure that each of their direct reports has received an initial orientation of the City's safety program before beginning work.
- Make certain that each direct report is competent or receives training on safe operation of equipment or tasks before starting work on that equipment or project.
- Ensure that each employee receives required personal protective equipment (PPE) before starting work on a project requiring PPE.
- Do a daily walk-around safety check of the work area and promptly correct any hazards identified.
- Spend dedicated time observing employees working. Promptly provide reminders, refresher training, and/or corrective action as necessary.
- Document employee evaluations.
- Set a good example for employees by following safety rules and attending required training.
- Investigate all incidents in assigned area and report findings to management in accordance with safety program expectations.
- Engage management to update work practices or equipment that will improve employee safety.
- Enforce all safety rules.

- Acknowledge and reward safe work practices and behaviors.

Employee Responsibilities
The health and safety of each employee is a major responsibility; all employees share this obligation for themselves and those working with them. Employees must treat safety as one of their most important job responsibilities, watching for potential hazards and constantly being aware of the people and equipment around them.

To ensure a safe workplace, every employee will:
- Observe and comply with all safety signs, rules, and policies as described in this program.
- Report all on-the-job injuries promptly, following the City's reporting policy.
- Correct or report any identified unsafe conditions or equipment.
- Report all near-miss incidents to your supervisor promptly in accordance with the reporting policy.
- Incorporate safe practices into all activities.
- Attend and participate in safety meetings.
- Always use personal protective equipment (PPE) where it is required. Ensure it is in good condition and fits properly before starting job tasks.
- Not remove or attempt to defeat any safety device or safeguard provided for employee protection.
- Operate equipment safely. This includes not operating equipment where training has not been provided or where required certification has lapsed.
- Report all equipment damage or failure to your supervisor immediately and mark/tag the equipment to identify it as damaged until repairs have taken place.
- Engage management and supervisors about problems that affect your safety or working conditions.
- Make suggestions to your supervisor, safety committee representative or management about changes you believe will improve employee safety.

New Employee Orientation
The supervisor must orient new employees to on-the-job health and safety requirements, including those who are new to a location, as they relate to the job being performed. This must take place before the employee is allowed to do the work.

Components of orientation
- Total description of the City's Accident and Illness Prevention Program.
- Hazard-specific safety programs, policies and rules applicable to the job.
- Recognizing hazards of the workplace.
- Procedures on how to report hazards, near misses, and accidents.
- Proper lifting techniques and how to use available lift aids.
- Ergonomics in the office and operations.
- Use of tools, equipment, and procedures necessary to carryout work assignments safely and efficiently.
- Housekeeping procedures.

- Fire protection and emergency evacuation, including who is on the fire evacuation team and actions to take in the event of a fire alarm.
- Locations, types, and use of fire extinguishers.
- Emergency numbers.
- First Aid kit locations and training.
- Driver training.
- Purpose and techniques for use of any personal protective equipment (PPE) required on the job.

Reporting Accidents, Near Misses, and Safety Hazards

Employees are required to report any injury or work-related illness to their immediate supervisor regardless of seriousness. The employee must use an *Employee's Report of Accident* form to report injuries (see appendix).

Accident/Injury Reporting Procedures
Employees will:

- Immediately notify your supervisor of the injury or accident.
- Seek first aid or medical attention as needed.
- Complete any necessary paperwork.

Supervisors will:

- Investigate a serious injury or illness using procedures in the *Accident Investigation* section of the APP.
- Complete an *Accident Investigation Report* form within 24 hours.
- Give the *Employee's Report of Accident* and the *Accident Investigation* to the Human Resources Manager.

The Human Resources Manager will:

- Determine from the *Employee's Report of Accident* form and *Accident Investigation* report, and any L&I claim documents whether it must be recorded on the OSHA Injury and Illness Log and Summary (OSHA 300 and 300A forms).
- Enter a recordable incident onto OSHA logs within six days of the City becoming aware of it.
- If the injury is not recordable, add incident to the Minor Injury Log, which is used to record non-OSHA recordable injuries and near misses.
- Each month before the scheduled safety committee meeting, make any new injury reports and investigations available to the Safety Committee for review and discussion.

The Human Resources Manager will post a signed copy of the OSHA log summary for the previous year on the safety bulletin board each February 1 through April 30. The log will be kept on file for at least 5 years. Any employee can view an OSHA log upon request at any time during the year.

Return to Work/Time Loss Certification. The injured employee must take this form to his/her physician. (See Appendix). The form must be completed by the physician and returned to the employee's supervisor within two business days of receiving it from the physician.

In addition, if your doctor says you are unable to report for work the following day under regular status, the following form must also be completed:

Modified Work Form. The injured employee must provide the City with a copy of their Modified Work Form. The form must be completed by the physician and returned to the employees' supervisor.

Reporting Hazards

- Take immediate action to correct any unsafe condition, piece of equipment, or work practice.
- If you, or a co-worker, cannot correct the unsafe condition, report it to your supervisor.

Report to Your Supervisor

- Unsafe work practices.
- Unsafe working conditions.
- Accidents of all kinds including vehicle accidents.
- Near misses. (See Appendix for Accident and Hazard Report forms)

Accident Investigation Procedures

All accidents and near misses should be investigated. The seriousness of the accident will determine the extent of the investigation. The purpose of the investigation is to produce factual information that leads to corrective action in order to prevent further accidents from occurring.

Who Conducts the Investigation?

- Immediate supervisor
- Safety Committee
- Management

Investigation Procedures

The investigation should take place as soon as possible after the incident. Following are a list of procedures that encompass a thorough investigation report:

- Report the accident
- Arrival at the scene
- Gather information
- Preserve evidence
- Interview witnesses
- Take photos
- Draw sketches

- Find root causes
- Determine corrective actions
- Provide recommendations
- Write a report

All accident investigations should result in some kind of change or control.

Recommendations for change/control should include:
- Engineering control/changes-encompassing those actions that include physical changes to the work environment.
- Administrative control/changes-include procedural, operating or training procedures.

The Safety Committee will review accident investigation reports to ensure corrections have been made.

Accident investigations Involving Labor and Industries
Some serious accidents will require reporting to the Department of Labor and Industries. If any worker is killed or admitted for inpatient hospitalization, the City must report the accident to L&I within 8 hours. If any worker suffers an amputation or loss of an eye, the accident must be reported within 24 hours. If the City, for any reason, is not notified of the accident until after the deadline, the accident should be reported immediately.

To report accidents to L&I, call 800.423.7233; a message may be left if no one answers the phone call.

If a serious accident occurs and L&I is expected to investigate, the first priorities after caring for and protecting workers are to control and maintain the accident scene. In scenarios where hazardous equipment or environments are involved, stabilize and secure the equipment so they do not pose a danger, then secure the scene. If no hazards are posed by equipment or environment, then securing the scene is the priority.

Once an L&I compliance officer presents themselves to the location, they should always be accompanied by an authorized staff member who can monitor their progress and scope of investigation, help answer any questions, and explain the accident as understood by the City. This staff liaison will duplicate in notes and photographs the work of the compliance officer, so the City is aware of the information gathered by the compliance officer.

Selected management member(s) will, after notifying L&I, select an employee to serve in this liaison position, and will brief them on duties of that position ahead of L&I officials' arrival. Individuals selected for this duty must be in a management or supervisory position and have adequate knowledge of the working duties and environment and the governing safety policies and expectations.

Accident Investigation Training
Staff who will undertake accident investigations must receive training on the purpose, expected work product, and recommended methods of accident investigations. Staff who conduct investigations will receive training select frequency of training. Selected staff will ensure training is completed for those eligible to conduct investigations and will remove staff who do not receive training from the list of eligible investigators.

Safety Committee

The purpose of the City of Stanwood's Safety Committee is to assist and supplement management's efforts to provide a safe and healthy workplace for its employees. The safety committee provides the structure and space for employees to become involved and participate in providing a safe workplace and affect the environment where they work.

Duties and Responsibilities
The safety committee will have core duties that assist the City of Stanwood in creating a safe work environment. The safety committee will have opportunities to provide services outside these main duties (e.g. education campaigns) with the approval of management.

The Committee will:

- Evaluate accident investigations conducted since the last meeting to determine if the cause of the unsafe act or unsafe condition involved was properly identified and corrected.
- Conduct self-inspections of the facility: Members of the safety committee inspect work areas to discover unsafe practices or conditions.
- Review safety and health inspection reports to assist in correction of identified unsafe condition or practices.
- Evaluate the accident and illness prevention program with a discussion of recommendations for improvement.
- Provide to management recommendations on safety needs and considerations.

In no instance shall the Safety Committee be asked to manage the City of Stanwood's safety program or provide oversight of it. The Safety Committee will not be tasked with the enforcement of safety rules; management and enforcement will solely be the job of management.

Safety Committee Organization
Committee members serve one-year terms. There are no limits to the number of consecutive terms a member can serve on the committee.

The number of management personnel on the committee will not exceed the number of employees selected by their workgroups.

The City of Stanwood will appoint a management liaison. The purpose of this position is to allow direct communication with the executive officer of the City. The employee in this position should be management level and sit on the committee.

Committee members represent each work area or facility of the City. All department or facilities will provide at least one member of staff for the safety committee and ensure that employee makes themselves available for safety committee meetings and duties.

Committee Meetings
The safety committee will meet on a monthly basis. An agenda will be created and made available for committee members five days ahead of the committee meeting to allow for review and preparation. Meeting minutes will be taken and then made available to member before the next meeting for review and amendment if necessary.

Meetings may last beyond the one-hour limit only by majority vote of the committee.

Committee Positions
Chair – elected annually by the committee and shall:
- Start and end meetings on time
- Summarize discussion and call for votes
- Make certain that minutes are kept
- Ensure that agendas are provided to the committee five days prior to the meeting

Vice Chair – elected annually by the committee and shall in the Chair's absence:
- Start and end meetings on time
- Summarize discussion and call for votes
- Make certain that minutes are kept
- Ensure that agendas are provided to the committee five days prior to the meeting

Secretary – elected annually by the committee and shall:
- Prepare agendas and distribute to committee members at least five days prior to the meeting
- Prepare minutes of the meeting and distribute to committee members
- Assist the chair as requested

Terms
The term of all employee members shall be one year. Committee position selections will occur each December, with the Chair and Vice Chair elected annually during the first meeting in January. Should a vacancy occur, a new member shall be elected prior to the next scheduled meeting and shall hold that seat until December.

Committee Member Responsibilities
Each member has the responsibility to:
- Attend committee meetings
- Participate and engages with topics
- Report for fellow employees on various hazards or unsafe work practices

- Report to employees the safety efforts of the City of Stanwood
- Assist with educational campaigns around safety
- Review recent incidents and accidents, and provide recommendations for improvements
- Report on special assignments
- Report on inspections undertaken at committee's request

It is understood that a thriving safety committee cannot function only within the hour of the committee meeting. To allow for optimal committee efficiency, the City will allow committee members to work on committee duties during their regular work hours.

For larger projects that will take considerable time, committee members must coordinate with their supervisors or managers to determine how this work can be scheduled with minimal interference to core job duties.

First Aid

The City of Stanwood has determined that first aid services are consistently available from the North County Regional Fire Authority, 28407 Pioneer Hwy, Stanwood, WA 98292. Based on this availability, the City of Stanwood does not obligate any employees to provide first-aid services to co-workers as part of their job duties. Employees who are certified may still choose to provide first aid on a voluntary basis until medical services arrive and is done on a "Good Samaritan" basis. Volunteers will not undertake work that exceeds their level of skill or certification.

The City of Stanwood will provide first-aid training for those who are interested. This will allow staff to render such services if they are comfortable. All supervisors at fixed facility sites shall be required to hold first-aid and CPR certification; this requirement does not obligate providing services.

First Aid Procedures Following Accidents

As first aid services will be provided by an outside source, the priority must be contacting emergency services to call for help. If you or a co-worker is involved in an accident, you must:

- Ensure no further damage to yourself and/or the injured person
- Get first aid or medical assistance (dial 9-1-1)
- Transport the injured individual to the nearest medical services center (only if necessary)
- Report the incident immediately to your supervisor

If involved in a situation involving blood:

- Avoid skin contact with blood/OPIM (other potential infectious materials) by letting the victim help as much as possible. Use gloves provided in first aid kits.
- Remove clothing with blood on it after rendering help. Secure the clothing per instructions in bloodborne pathogen control plan.
- Wash thoroughly with soap and water to remove blood.
- Report such first aid incident exposures to blood/OPIM to supervisor.

First Aid Kits
The City will ensure that first aid kits will be readily available for all employees. These kits will be easily accessible and clearly marked, with identifying signs indicating positions within facilities. First aid kits will be housed in containers that protect supplies from damage, deterioration, and contamination. First aid kits will be portable to enable moving them to the location of injured individuals; if kits are mounted, they shall be affixed in a way where they are easily disconnected and moved.

First aid kits will be unique to the facilities and exposures of work duties. Each department manager will be accountable for ensuring first aid kits provide adequate supplies for any unique hazard particular to the facilities or duties of their employees. It is also the duty of department managers to ensure that first aid kits continue to reflect the hazards of the facility and are updated as necessary based on changes in work duties, environments, or equipment.

First Aid Kit Stocking
To ensure expected supplies are in first aid kits when the need arises, kits should be regularly inventoried and re-stocked. All first aid kits within the City will be inventoried and re-stocked annually, or as needed. This work will be done by Alpine Fire & Safety (vendor).

All expired or out-of-date equipment or medicine should be removed from kits and disposed of properly and in a way that ensures others will not attempt to use the expired supplies.

First Aid Kit Locations
First aid kits are available at the following locations:

- City Hall, 10220 270th Street NW
- City Shop, 26729 98th Avenue NW
- WWTP Operations Building, 26729 98th Avenue NW
- Police Department, 8727 271st Street NW

It is the department manager's responsibility to update this list when first aid kits are moved or retired from service so that the inventory remains accurate.

Emergency Washing Facilities
Certain hazardous chemicals or other exposures may require the availability of emergency washing facilities, including showers and eye wash stations. The City of Stanwood's departments have reviewed the Safety Data Sheets (SDS) for all inventoried chemicals and considered all other hazards requiring washing facilities; based on this review, the following facilities are required to house these stations.

Emergency shower locations:
- City Shop, 26729 98th Avenue NW
- WWTP Operations Building, 26729 98th Avenue NW

Emergency eye wash stations:

- WWTP Operations Building (Lab), 26729 98th Avenue NW

Emergency Preparedness

In case of fire

An evacuation map for the building is posted at all City offices near the primary entrance. It shows the location of exits and where to assemble outside. A fire evacuation drill will be conducted once a year during the first week of April. All fire extinguishers will be serviced on a yearly basis. This includes examining for pitting, cracks and corrosion.

If you discover a fire

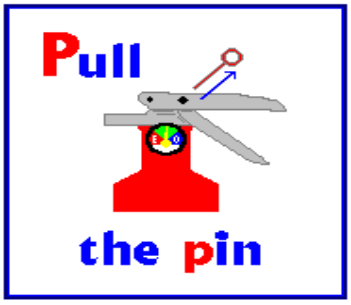
Call 911 and inform a supervisor.
If the fire is small (such as a wastebasket fire) and there is minimal smoke, you may try to put it out with a fire extinguisher
If the fire grows or there is thick smoke, do not continue to fight the fire.
Tell other employees in the area to evacuate.
Go to the designated assembly point outside the building.

If you are a Supervisor notified of a fire in your area

Tell your employees to evacuate to the designated assembly location. Check that all employees have been evacuated from your area.
Verify that 911 has been called.
Determine if the fire has been extinguished. If the fire has grown or there is thick smoke, evacuate any employees trying to fight the fire.
Tell supervisors in other areas to evacuate the building.
Go to the designated assembly point and check that all your employees are accounted for. If an employee is missing, do not re-enter the building! Notify the responding fire personnel that an employee is missing and may be in the building.

Training and Education: Annually, the City is required to provide fire extinguishers training and education. It will be provided for the familiarization and general use principals of extinguisher operation and their capabilities.

It's easy to remember how to use a fire extinguisher if you can remember the acronym **PASS,** which stands for Pull, Aim, Squeeze, and Sweep.

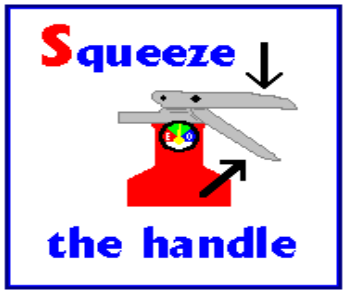


Pull the pin.

This will allow you to discharge the extinguisher.

Aim at the base of the fire.

If you aim at the flames (which is frequently the temptation), the extinguishing agent will fly right through and do no good. You want to hit the fuel.



Squeeze the top handle or lever.

This depresses a button that releases the pressurized extinguishing agent in the extinguisher.

Sweep from side to side until the fire is completely out.

Start using the extinguisher from a safe distance away, then move forward. Once the fire is out, keep an eye on the area in case it re-ignites.

In case of earthquake

The west coast of the United States is subject to earthquakes. There will be no advance warning. The shock will be your only warning. An earthquake drill will be conducted each year during the first week of September**.** In the event of an earthquake:

If you are inside a building:

- Drop under a desk or table, cover your head and hold on. Stay away from windows, heavy cabinets, bookcases or glass dividers.
- When the shaking stops, the Building Official or their designee(s) are to check for damage and available evacuation routes then begin an evacuation of their area to the designated assembly location.
- Evacuation should proceed as quickly as possible since there may be aftershocks.
- Offer assistance to people who need help (elderly, mobility impaired, etc.)
- Supervisors must account for each employee in their work group as quickly as possible.
- First Aid certified employees should check for injuries and help evacuate injured employees. Do not attempt to move seriously injured persons unless they are in immediate danger of further injury.
- If a gas odor is in the building, tell a supervisor to turn off the gas at the main. Open windows.
- Supervisors and First Aid employees must not re-enter the building once evacuation is complete.
- Do not approach or touch downed power lines or objects touched by downed power lines.
- Do not use the phone except for emergency use.
- Turn on a radio and listen for public safety instructions.

If you are outside:

Stand away from buildings, trees, telephone and electric lines.

If you are on the road:

Drive away from underpasses/overpasses. Stop in a safe area. Stay in the vehicle.

Safety Bulletin Board

In all City facilities where employees congregate, a safety bulletin board will be provided to assist in transmitting important and statutorily required safety information to staff. The bulletin board and its presentation of current and appropriate materials is the responsibility of each department manager. Department managers may choose to assign duties related to the board to staff, but they may not delegate responsibility.

Bulletin board contents

Safety bulletin boards should provide the following information:

- All safety-related information required by local, state and federal agencies
- OSHA 300A form (summary of injury and illness log) [February 1 – April 30]
- Safety committee meeting minutes
- Instructions on reporting accidents and near-misses or observed hazards
- L&I workers' compensation information poster
- Equal Employee Opportunity Rights- ADA Americans with Disability Act

Section 2

Personal Protective Equipment

Hazard Assessment

Personal Protective Equipment (PPE) is an item or items used to protect the eyes, face, head, body, arms, hands, legs, and feet such as goggles, helmets, head covers, gloves, rubber slickers, disposable coveralls, safety shoes, protective shields, and barriers.

In order to comply with all occupational safety and health standards, rules, and regulations required by the Department of Occupational Safety and Health Act (DOSH) and Washington Industrial Safety and Health Act (WISHA), a Hazard Assessment was conducted of all job tasks according to WAC 296-800-16005.

PPE alone should not be relied on to provide protection for our employees. PPE should be used after all other reasonable means of reducing hazards have been carried out.

The City of Stanwood has identified hazards in the workplace and we have taken the following steps to minimize/eliminate those hazards:

- Considered other ways to get hazardous jobs done.
- Reduced hazardous materials or processes.
- Applied engineering controls to reduce or eliminate hazards.

The purpose of conducting a Hazard Assessment was to identify the sources of hazards or potential hazards that are present or associated with each particular work group in the City's work environment.

The **Hazard Assessment** was conducted in the following manner:

1. A walk-through survey of all work group areas was conducted at the City of Stanwood. Sources of hazards to workers and co-workers were identified and documented according to Core Rules 296-800-16005.

2. Data was organized and reviewed by management and the Safety Committee following the job hazard assessments in order to analyze hazards in the environment and enable proper selection of protective equipment.

3. After gathering and organizing the data, an estimate of the potential for injuries was made. Each basic hazard was reviewed and a determination made as to the type, level of risk, and seriousness of potential injury from each hazard found.

Personal Protective Equipment General Guidance

Personal Protective Equipment (PPE) protects employees and helps in controlling

exposure to the risks of injury against workplace hazards. When the eyes, face, hands, extremities, or other parts of the body are exposed to workplace hazards that cannot be controlled by other means, then PPE must be worn. PPE is the last line of defense and is not a substitute for engineering or administrative controls, or good work practices, but should be used in conjunction with those controls. Remember, using PPE does not eliminate the hazard, and if the PPE fails or is used improperly, exposure to the hazard may occur.

Responsibilities

Supervisor/ Lead Worker:

- Ensure that the required personal protective equipment is made available to, maintained properly and worn by the employee.

Employees:

- Responsible for wearing and/or using all safety equipment provided for its intended purpose.
- Following all safety policies and instructions.

Equipment and Usage

Hard Hats and/or Head Protection

- Shall be worn performing construction, repair or inspection work.
- Construction sites where cranes, backhoes, scaffolding are present and whenever overhead hazards exist.
- Trenches and hazardous confined spaces.
- Wherever the Supervisor, Lead Worker, Safety Representative or their designee determines that a hazard exists.
- Hair netting and/or other such protection shall be worn by an employee who has hair long enough to present a hazard while working around machinery.

Reflective Clothing

Approved reflective and protective clothing will be required when:

- Employees are working within Public right-of-way or are exposed to vehicular traffic.
- Employees conducting maintenance or other operations during evening and night hours.
- Whenever the Supervisor, Lead Worker, Safety Representative or their designee determines that visibility danger is present.

Note: All flaggers shall have a flagging card issued by the proper authority. All flaggers will wear a hard hat, reflectorized outer garment and carry an approved sounding device such as a whistle or air horn. During emergency situations, Police personnel are exempt when involved for traffic control. (It is recommended a reflectorized vest or coat should be used.)

Eye and Face Protection
Eye and face protectors shall be provided and worn where machines or operations present the hazards of:

- Flying Objects
- Glare
- Liquids
- Injurious Radiation
- Or a combination of these hazards.

Respiratory Protection
Respirators shall be provided when such equipment is necessary to protect the health of the employee. The employee shall use the provided respiratory protection in accordance with the instructions and training received as outlined in the City's Respiratory Protection Program for Voluntary Use of Respirators.

Full Body Harness and Lifelines

- Where workers are employed above the floor, water surface, or the ground and it is impractical to provide temporary floors, staging, ladders, or safety belts, lifelines or life nets shall be provided and used by employees.
- No employee shall enter a sewer, sewer flue, storm sewer duct, waterline, tunnel or other similar places without first notifying his supervisor. He shall wear a full body harness with a lifeline attached, when conditions require it.
- The line shall be held by a fellow worker stationed at the opening which he enters. In such cases, signals shall be agreed upon and responded to immediately.
- Employees working over or on water, where a danger of drowning exists, shall wear a U.S. Coast Guard approved lifesaving device.

Shirts or Protective Clothing

- Shirts or approved clothing shall be worn by all employees. No employee at any time shall work without some type of protective clothing above the waist.
- Safety Chaps: Shall be worn by operator anytime a chain saw is in use.

Safety Shoes and Boots
When provided by the City, safety shoes or boots shall be worn.

Hearing Protection
Shall be worn when the noise level reaches: 85 dBA

Responsibility
It shall be the responsibility of the Supervisor, Lead Worker and Safety Representative or their designee to ensure that the required personal protective equipment is made available to, maintained properly by the employee and that all safety precautions are in use on all job sites according to the procedures set forth in this policy. Employees shall also be responsible for wearing and/or using all safety equipment provided for its intended purpose, and for following all safety policies and instructions.

Disciplinary Action
The City of Stanwood is concerned about the safety of each employee and their fellow crew members on the job site. Therefore, each employee shall be made aware of this policy and supplied with the necessary protective equipment by their department supervisor.

Any Supervisor, Lead Worker, Safety Representative or their designee that does not enforce, or any employee not following the conditions of this policy could face disciplinary action up to and including termination.

Personal Protective Equipment Hazard Assessment

Written Certification

The Hazard Assessment was conducted for the City of Stanwood by department staff and reviewed by supervisors.

The information shown below provides an overview of exposure controls and PPE that may be needed for a variety of tasks that have potential hazards.

Personal Protective Equipment Required

Streets and Parks Divisions			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
Power Brush	Dust, flying particles, foot hazard, and loud noises	Keep all machine guards in place and follow equipment guidelines	Safety googles, hand, foot and hearing protection
Backhoe	Tipping over, striking underground utilities, contact with overhead obstacles	Site inspection (stable/level ground), machine inspection, underground utility locates, proper training	Hard hat, safety glasses, gloves, hearing protection and steel-toed boots
Ditch Witch	Rotating or moving parts, striking existing utility while excavating,	Do not wear jewelry or loose clothing, verify location of previously marked underground hazards, ensure all guarding is in place, mark jobsite clearly, and follow all regulations for excavating and trenching	Hard hat, gloves, safety glasses, hearing protection
Asphalt Grinder	Flying particles, dust and sparks, airborne silica dust	Keep guards in place, follow equipment guidelines, and implement dust control procedures	Hard hat, safety glasses, gloves, hearing protection and steel-toed boots
Welding	Electric shock, metal sparks, molten and hot metal, UV IR and visible light, falling, dropping, rolling and sharp objects	Local exhaust ventilation, excellent general ventilation, and shielding	Insulating mats or blankets, insulated/heat and puncture/cut resistant gloves, safety shoes, safety glasses, welding shield or helmet with eye shade
Shop Metal Grinder	Flying particles, metal sparks and chips, falling, dropping, rolling and sharp objects, noise	Local exhaust ventilation, keep guard in place, excellent general ventilation, and shielding	Heat and puncture/cut resistant gloves, hearing protection, coat or heavy shirt for protection, safety shoes, safety glasses and full face shield
Striping	Traffic, vapors, mist, fumes, flammables	Local exhaust, good general ventilation	ANSI Class 2 hi-vis safety vest, safety glasses, safety shoes, chemical and liquid resistant gloves. ***Full face shield required when cleaning applicator gun.***

Streets and Parks Divisions			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
Street Sweeper	Traffic, dust exposure, noise	Traffic control measures (warning lights), Pre-operation inspection, equip sweeper with dust suppression feature, operate sweeper according to manufacturer guidelines	High-visibility clothing, dust mask, gloves, safety glasses, hearing protection, and steel-toed boots
Drill Press	Rotating or moving parts, flying particles, noise	Confine long hair/beards to prevent entanglement in machinery (e.g., up via bun, pinned-up ponytail, or hairnet). Do not wear any loose clothing and jewelry	Safety glasses, face shield, steel-toed boots, hearing protection
Wood Chipping	Rotating or moving parts, flying debris, noise, tripping hazard, dust	Keep guards in place, do not wear any loose clothing and jewelry, pre-operation inspection, work zone management, operate chipper according to manufacturer guidelines	Safety glasses/face shield, hearing protection, boots, abrasion/cut resistant gloves, hard hat, high-visibility outerwear if chipping within 15 feet of roadway.
Bucket Truck	Tip over, electrocution, fall hazard	Use stabilizers or outriggers to increase stability when bucket is elevated, guardrails to prevent falls, work zone management, maintain safe distance from overhead power lines	Hard hat, hi-vis clothing, safety goggles, gloves (cut-resistant), safety shoes, fall arrest/restraints
Sidewalk Grinder	Moving parts, flying concrete particles, airborne silica dust, noise	Keep guard in place, do not wear loose clothing and jewelry, use vacuum attachments or water sprays to minimize dust, work zone management	Safety glasses/face shield, hi-vis clothing, dust mask, safety boots, hearing protection, hard hat, gloves (cut-resistant)
Air Lance for Crack Sealing	Air pressure injury, flying debris, noise, dust exposure,	Use safety nozzles, dust control measures (water spray or vacuum), work zone management	Safety glasses/face shield, dust mask, safety boots, hearing protection, hard hat, gloves (temperature-resistant), hi-vis clothing
Propane Torch	Molten and hot metal, sparks, UV, IR and visible light, falling, dropping, rolling and sharp objects	Local exhaust ventilation, excellent general ventilation, shielding	Heat and puncture/cut resistant gloves, flame resistant clothing, safety shoes, hard hat, filter lens spectacles or goggles, or safety glasses and hand shield, with appropriate eye shade
Gas Leaf Blower	Flying debris, noise, dust	Debris shield, work zone management,	Safety glasses, gloves, hearing protection, safety boots, dust mask. Hi-vis clothing
Hot Mix Asphalt	Burns, fumes, vapors	Use thermometers to monitor asphalt temperature and ensure safe handling. Ensure adequate ventilation in	Safety glasses, heat-resistant gloves, long sleeved apparel, hi-vis clothing, steel-toed boots

Streets and Parks Divisions			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
		enclosed spaces. Work zone management. Use SOPs for safe mixing, transporting and applying hot mix asphalt	
Saw Cutting	Lacerations, flying debris, dust, noise	Blade guards in place, water sprays or vacuum systems to minimize dust, work zone management	Safety glasses, hearing protection, dust mask, hard hat, cut-resistant gloves, hi-vis clothing, safety boots
Chain Saw	Cuts/lacerations, kickback, noise, burns, dust, flying debris	Maintain a sharp and properly tensioned chain, start the chainsaw on the ground or on another stable surface, never in the air, avoid cutting above shoulder height to maintain better control and visibility, stand to the side of the chainsaw, not directly behind it, to minimize the risk of kickback. Avoid cutting with the tip of the chainsaw bar to reduce the risk of kickback. Never touch the chainsaw chain while the engine is running or if it is hot.	Hard hat, face shield or safety goggles, hearing protection, abrasion/cut resistant gloves, chainsaw chaps or pants with built-in protective material, boots with reinforced toe caps and soles.

Wastewater Division			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
Ultraviolent Repair and Maintenance	Mercury exposure to broken UV lamps and direct exposure to UV light generated by the devices	Follow proper Lockout/Tagout procedures for the equipment.	UV safety eyewear, UV face shield, long sleeved, tightly woven clothing that covers the body, and gloves with no gap between the cuff and glove.
Remove Rag Accumulations at WWTP	Moving parts, flying debris, pathogens, chemicals, slips, trips or falls. Drowning risk when working near water.	Install guards on all moving parts, use conveyors or automated rag removal systems when able, ensure proper ventilation. Always follow SOPs and safety protocols. When working near water bodies, install guardrails or barriers to prevent accidental falls, and use slip resistant materials for walkways and work areas near water.	Leak and chemical resistant gloves, life jacket, face masks, safety goggles and face shield. Water resistant clothing, steel-toed boots.
Cleaning wet wells at lift stations (out of confined space)	Exposure to raw sewage, wet and slippery surfaces and noise	Always follow SOPs and safety protocols. Ensure safe access with stable platforms or ladders, maintain proper drainage, install slip-resistant flooring.	Gloves - heavy-duty chemical, liquid, temperature, abrasion/cut and slip resistant gloves, protective sleeves, face mask, safety goggles and face shield, water

Wastewater Division			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
			resistant coveralls or disposable suits, steel toed boots and hard hats to protect against overhead hazards. Hearing protection.
Cleaning wet wells at lift stations (in confined space)	Oxygen deficiency, toxic gases, sewage, engulfment, slips, trips and falls, electrical hazards, noise	Continuous gas detection systems, ventilation, emergency rescue equipment (harnesses, retrieval systems), follow permit systems to ensure safe entry, monitoring and work practices, follow SOPs and all safety protocols. Conduct regular confined space training.	Mask, gloves – heavy duty abrasion/cut resistant, slip resistant and protective sleeves, , safety goggles and face shield. Water resistant clothing, steel-toed boots with anti-slip soles and heat/cold protection. Hearing protection. Hard hats to protect against overhead hazards.
Wastewater Treatment Plant Repairs	Exposure to chemicals, sewage. Moving parts, flying debris, electrocution, wet or uneven surfaces, confined spaces, and noise	Adequate ventilation, machine guards, safety showers, eyewash stations and first aid kits. Follow SOPs and safety protocols. Complete permit process for working in confined spaces. Conduct routine inspections of equipment, PPE, and work areas.	Chemical-resistant gloves, mask, safety goggles/glasses, face shield, protective water-resistant clothing, steel-toed boots, slip resistant soles, hard hat to protect against falling objects or overhead hazards, and hearing protection.
Cleaning Clarifiers	Wet surfaces, uneven ground, raw sewage, drowning, chemicals, engulfment, confined space, noise	Adequate ventilation, machine guards, safety showers, eyewash stations and first aid kits. Follow SOPs and safety protocols. Complete permit process for working in confined spaces. Conduct routine inspections of equipment, PPE, and work areas.	Chemical-resistant gloves, mask, safety goggles/glasses, face shield, protective water-resistant clothing, steel-toed boots, slip resistant soles, and hearing protection.
Painting (WWTP, Buildings, Lift Stations)	Exposure to chemicals – Solvents and paints, raw sewage, airborne dust, flying particles, wet surfaces and uneven grounds particularly on ladders or scaffolding, fire hazard	Adequate ventilation, drops cloths or tarps to contain paint spills, ensure ladders are stable and safety compliant, provide safety showers, eye wash stations and fire extinguishers. Follow SOPs for painting.	Mask/respirator, chemical-resistant gloves, safety glasses/goggles/face shield, protective clothing (long sleeved shirts and pants or disposable coveralls). Steel-toed boots, slip-resistant sole and waterproof, hard hat when working on ladders, hearing protection, and fall protection if working from heights of 10 feet or more.

Wastewater Division			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
Camera Inspections	Traffic hazards, confined space low oxygen levels, toxic gases, engulfment, chemicals, uneven surfaces, wet conditions, or obstacles around manholes	Set up traffic cones, barriers, and warning signs, ventilate confined spaces to minimize gases, use portable lighting, have emergency response equipment onsite. Follow SOPs for entering confined spaces.	High visibility vest, hard hat, heavy duty chemical resistant gloves, face masks/respirator, safety goggles, protective clothing (long-sleeved shirts and pants or disposable coveralls), steel toed boots, with slip resistant sole, waterproof.
Cleaning oxidation ditches	Exposure to pathogens, contact with disinfectants, wet and slippery surfaces, engulfment, airborne dust, flying particles, noise, falling objects	Ventilation, slip resistant materials for walkways, availability of safety showers, eyewash stations and first aid kits. Install guards on all equipment, use gas detection system. Follow SOPs. If working from heights of 10 feet or more use fall protection.	Heavy duty chemical, liquid/leak, abrasion/cut resistant gloves, protective sleeves, safety goggles and face shield. Protective clothing – water resistant coveralls or disposable suits, hard hat, and hearing protection.
Sewer Line Locates	Traffic hazards, exposure to paint and solvents, uneven surfaces	Adequate ventilation when using paint, traffic control measures (cones, barriers and warning signs), use paint spray equipment according to manufacturer's instruction.	High visibility vest, hard hats, chemical-resistant gloves, safety goggles, appropriate respiratory protection, long sleeved shirts and pants, steel toed boots with slip resistant sole.

Water Division			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
Brush Mowing	Moving parts, flying debris, and noise	Ensure equipment has proper guards in place, use debris shields or barriers to protect against flying debris. Follow SOPs. Inspect all equipment for safety.	Safety glasses/goggles, hearing protection, gloves to protect hands from cuts, abrasions and chemicals. Hard hats, long-sleeved shirts and pants, steel-toed boots, and high visibility vest.
Saw Cutting (asphalt/concrete)	Lacerations, flying debris, dust, noise	Blade guards in place, water sprays or vacuum systems to minimize dust, and work zone management	Safety glasses, hearing protection, dust mask, hard hat, cut-resistant gloves, hi-vis clothing, safety boots.
Mole Operations under Roadway	Traffic, confined space, mechanical, ground stability, noise, biological from chemical contaminants in the soil.	Traffic control, ventilation in confined spaces, shoring, emergency equipment, such as first aid kits and rescue devices. Follow SOPs and safety protocols.	High-visibility vests, hard hats, gloves to protect from cuts, abrasions, and chemicals. Safety goggles, hearing protection, long-sleeved shirts and pants. Steel-toed boots, with slip

Water Division			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
			resistant soles and waterproof.
Repair Water Leak	Confined space, flying particles, airborne dust, drowning or injury from fast moving water or flooding in work area, electrical, contaminants in water, wet surfaces, uneven terrain. Traffic hazards. Noise.	Ventilation in confined spaces, drainage and containment, use shoring to prevent ground collapse, emergency equipment, such as first aid kit and rescue devices. Follow SOPs and safety protocols.	High-visibility vests, hard hats, safety goggles, heavy duty chemical and slip resistant gloves. Long-sleeved shirts and pants. Steel-toed boots, with slip resistant sole and waterproof. Hearing protection. Appropriate respiratory protection.
Cedarhome Well Cleaning	Exposure to disinfectants or cleaning chemicals, confined space, wet surfaces and uneven ground.	Ventilation in confined space, accessibility to safety shower, eyewash station and first aid kits. Follow SOPs and safety protocols.	Safety Goggles or face shields, heavy-duty chemical-resistant gloves. Long-sleeved shirts and pants, steel-toed waterproof boots with slip resistant sole. Appropriate respiratory protection.
C12 Pump Repair/Rebuild Treatment Plant	Moving parts, exposure to chemicals such as cleaning agents and lubricants, and noise.	Ensure all moving parts are properly guarded. Ventilate the work area to disperse harmful vapors. Accessibility to eyewash station and first aid kits. Follow SOPs and safety protocols.	Safety glasses or goggles. Hard hat to protect from overhead hazards, heavy-duty chemical and cut resistant gloves. Long-sleeved shirts and pants. Steel-toed waterproof boots, with slip resistant sole. Hearing protection and appropriate respiratory protection.
Chlorine Mixing Treatment Plant	Chemical exposure (skin, eyes and respiratory system) Environmental hazards. Slip, trip and fall on wet surfaces.	Adequate ventilation in mixing area, secondary containment system to capture spills or leaks. Accessibility to emergency showers and eyewash stations. Gas detection systems to monitor chlorine levels in the atmosphere. Follow SOPs and all safety protocols.	Safety goggles or face shield. Appropriate respiratory protection. Chemical resistant gloves Long-sleeved shirts, pants and chemical resistant coveralls. Steel-toed waterproof boots with slip resistant sole.
Ferric Transfer Treatment Plant	Chemical exposure and toxic fumes (skin, eyes and respiratory system) Environmental hazards. Slip, trip and fall on wet surfaces. Mechanical from pumps and hoses used in transfer process.	Adequate ventilation in areas where ferric compounds are stored. Secondary containment system (e.g., spill trays) to capture leaks or spills during transfer. Accessibility to emergency showers and eyewash stations. Follow SOPs and all safety protocols.	Safety goggles or face shield. Appropriate respiratory protection (e.g., N95 mask). Heavy duty chemical resistant gloves. Long-sleeved shirts, plants and chemical-resistant coveralls. Steel-toed

Water Division			
Task(s)	**Potential Hazard**	**Controls**	**PPE**
			waterproof boots with slip resistant sole.
Water Sampling and Testing Treatment Plant	Chemical exposure to disinfectants, reagents and preservatives. Biological hazard from exposure to contaminants in water being sampled. Slip, trip and fall on wet surfaces. Traffic hazards if sampling occurs near roadways.	Adequate ventilation in areas where chemicals are used. Use secondary containment for chemical storage to prevent spills and leaks. Utilize tools and equipment designed to minimize risks (e.g., spill-proof sampling containers). Follow SOPs and all safety protocols.	Safety goggles or face shields. Heavy duty, disposable (e.g., nitrile) chemical resistant gloves. Long-sleeved shirts, pants, and/or disposable coveralls. Steel-toed waterproof boots with slip-resistant sole. Appropriate respiratory protection. High-visibility vest when sampling near traffic.

Hearing Conservation

The City of Stanwood has established a hearing conservation program to help protect the hearing of individual employees who have exposure to hazardous noise levels at work. Hazardous noise is sound that exceeds the 85 dBA threshold. At levels above this threshold, the City will consider various controls and testing to monitor employee hearing and noise exposure.

Noise Monitoring and Exposure Determinations
The City of Stanwood will conduct noise surveys to identify which work areas and groups have exposure to hazardous noise. Both sound level meters and dosimetry equipment will be used in this effort. Representative testing will be used, whereby one employee whose common work duties align well with co-workers' will be monitored and the results will be considered valid for all aligned employees. This will allow for efficiency in survey work.

If any employee feels they have been misclassified by such testing, and they were erroneously included or excluded from the program, it is their responsibility to report this to their supervisor along with an explanation as to why they feel an error has occurred. The department manager will determine if new survey work is appropriate to address the concern. If it is determined that no new work is needed, an explanation must be provided to the concerned worker within five working days of the decision being made.

Noise survey work will be repeated on a regular basis; the City has determined that noise surveys will be repeated every five years (the first survey was completed in 2024). Survey work should also be done if any evidence arises that suggests there may be unidentified noise hazards. Such evidence can be work-related hearing loss identified in staff during audiometric testing, noise complaints from workers, or a change in equipment or operational policies that changed the effectiveness of engineering controls.

Past noise surveys are kept electronically in a secured access file by year in the Human Resources Medical directory.

Noise surveys will be kept for thirty (30) years following separation from employment, and then destroyed in accordance with state retention rules.

All employees or represented employees whose tests results show a noise exposure exceeding 85 dBA TWA_8 (a time-weighted average exposure covering an 8-hour shift) shall be included in the hearing conservation program.

Hearing Conservation Program
The hearing conservation program elements will only apply to those determined to have exposure to hazardous noise through noise survey work.

The following elements collectively make up the hearing conservation program:

- Baseline and annual audiometric testing
- Provision of hearing protection (ear plugs and ear muffs)
- Annual training regarding the City's hearing conservation program
- Engineering and administrative controls to reduce employee exposure
- Signage around areas where noise levels equal or exceed 115 dBA.

The following work groups are covered under the City's hearing conservation program:

- All Public Works Maintenance Workers
- All Wastewater and Water Utilities Personnel

Baseline and Annual Audiometric Testing

Before being exposed to any noise levels of 85 dBA at work, a baseline audiogram will be performed on all new employees or employees transitioning into positions covered by the hearing conservation program. The organization will also provide annual testing to monitor any exposed employees for occupational hearing loss.

Baseline assessment provider information:

Cheri Thornton
Washington Audiology
635 Andover Park West, Suite 111
Tukwila, WA 98188
Email: cheri@washingtonaudiology.com
Direct Line: (253) 243-7659
Main Office: (206) 764-3330
Fax: (206) 762-6971

Annual testing provider information:

Cheri Thornton
Washington Audiology
635 Andover Park West, Suite 111
Tukwila, WA 98188
Email: cheri@washingtonaudiology.com
Direct Line: (253) 243-7659
Main Office: (206) 764-3330
Fax: (206) 762-6971

Testing providers will advise the organization if there are any individuals with documented hearing loss that is occupationally-related – identified by a standard threshold shift. For those individuals, the organization will include the hearing loss on the OHSA Injury and Illness log (300 form). This recordkeeping will be the responsibility of the Human Resources Manager.

It is the City's right to seek a second testing opinion when the initial audiometric testing shows hearing loss that the provider links to work duties. This re-testing must be done

within 30 days of the original test. If the new test does not confirm the threshold shift, or the relation to occupational exposure, then the hearing loss will not be added to the injury log.

When there is a recordable hearing loss related to work duties, it is the responsibility of the employee's department to review exposures. The City should review the hearing conservation program to determine if there were any failings that led to the exposure which caused the hearing loss. Where failings are identified, the City will consider updates to the program to prevent similar losses in the future.

Hearing Protection
The City will strive to remove any barriers to use of hearing protection. Multiple types of hearing protection will be offered.

- Earplugs
- Earmuffs
- Communication Headsets

If none of the stocked options are viable for employees because of ear size or other physical/medical reasons, the City will review the situation to see what other reasonable alternatives exist. Those desiring to use different hearing protection than those models offered by the City due to personal preference must receive permission by their department manager before doing so. The City must ensure the protection meets minimum requirements and provides the correct amount of noise reduction (noise reduction rating, or NRR).

Annual Training
Workers in the hearing conservation program will receive training on the program, its intent, and the responsibilities of the City and staff. Training must be done before first exposure, and then annually thereafter.

The training will include:

- The effects of noise on hearing
- Noise controls used in the workplace
- Purpose of hearing protection (differences and advantages/disadvantages of assorted types)
- Instructions about selecting, fitting, using, and caring for hearing protection
- The purpose and procedures for program evaluation

Noise Controls
The City currently implements both engineering and administrative controls to limit worker exposure to noise. The following are the engineering and administrative controls in use by the City.

Engineering controls:

- Sound Barriers: Installation of walls or partitions to block noise from equipment.

- Acoustic Panels: Absorptive materials on walls and ceilings to reduce reverberation.
- Vibration Isolation: Mounting machinery on vibration-dampening pads to minimize noise transmission.
- Equipment Modifications: Using tools and machines designed for lower noise output.
- Maintenance: Regular maintenance of equipment to ensure optimal operation and reduce noise.

Administrative controls:

- Work Scheduling: Limiting noisy operations to specific times to reduce exposures.
- Training: Educating employees on noise hazards and proper use of hearing protection.

It shall be the duty of all supervisors to ensure that their direct reports and all those working at or visiting their facilities are wearing hearing protecting in compliance with this program and the known noise hazards identified in the completed survey.

Signage

The City will affix signs at the entrances and at boundaries of all work areas where employees may be exposed to noise equaling or exceeding of 85 dBA. The signs must clearly indicate that the area experiences high-noise and that hearing protection is required.

Hazardous Chemical Communication Program

Each City employee will be informed about the chemicals which they may be exposed to, the hazards associated with those chemicals, and the precautions that are necessary to avoid and control the hazards while in the performance of their job duties. The City of Stanwood is committed to the prevention of exposures that result in injury and/or illness and to compliance with all applicable state health and safety rules. To make sure that all affected employees know the dangers of all hazardous chemicals they may encounter or be exposed to in the fulfillment of their duties, the following hazardous chemical communication program has been established.

All City employees will participate in the Hazard Communication Program. This written program is available electronically on the City's Shared Drive for review by any interested employee.

Container labeling

The Department Manager or designee is responsible for container labeling procedures, including the review and updating of procedures and labels as needed. The responsible party must verify that all containers received for use will have the following required label elements, in accordance with WAC 296-901-14012(1):

A. Product identifier;
B. Signal word;
C. Hazard statement(s);
D. Pictogram(s);
E. Precautionary statement(s); and
F. Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party.

With the inclusion of the Globally Harmonized System (GHS) standard in updated safety rules, label elements have become more standardized. Labels from vendors and manufacturers will be similar in both content and appearance. Any labels produced for use by the City of Stanwood will follow the requirements set forth in WAC 296-901-14012.

In instances where chemicals are moved from the properly labeled container they were shipped in and not used immediately, labels shall be affixed to the new container. These labels must contain at a minimum, the elements identified as (a) through (d) in the list above.

As allowed by WAC 296-901-14012(8), portable containers filled with hazardous chemicals that are used immediately by the employee performing the transfer, do not need to be labeled. However, if the chemical is left in the container after use or if the original employee cedes possession of the container, it must be labeled according to the City policy outlined above.

It is imperative that employees exposed to hazardous chemicals understand the warnings that GHS labeling provide them. To assist in this understanding, an interpretation of required labeling elements is here provided:

Product identifier: the name or number used on a label. It provides a unique means by which the user can identify the chemical. The product identifier used must permit cross-references to be made among the list of hazardous chemicals required in the written hazard communication program, the label and the SDS.

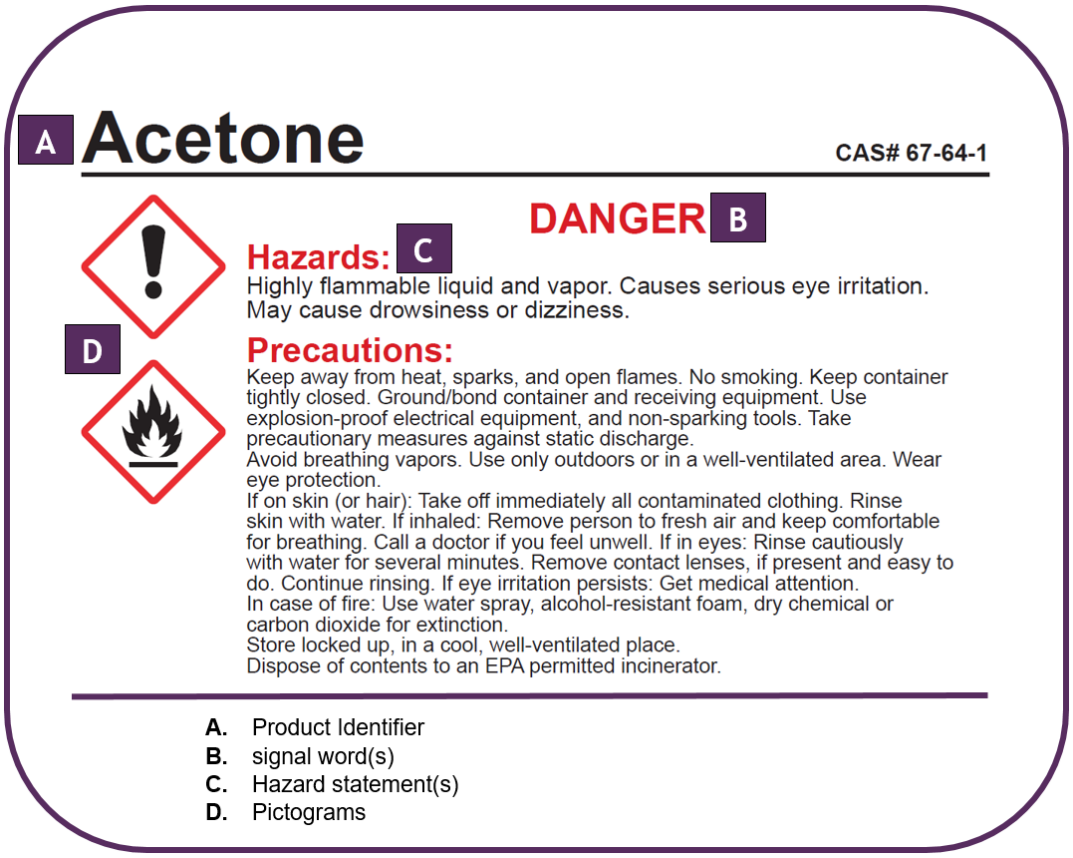
Signal word: a word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The signal words used in this section are “danger” and “warning.” “Danger” is used for the more severe hazards, while “warning” is used for the less severe.

Hazard statement: a statement assigned to a hazard class and category that describes the nature of the hazard(s) of a chemical including, where appropriate, the degree of hazard.

Pictogram: a composition that may include a symbol plus other graphic elements, such as a border, background pattern, or color, that is intended to convey specific information about the hazards of a chemical. Eight pictograms are designated under this standard for application to a hazard category.

Precautionary statement: a phrase that describes recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, or improper storage or handling.

Figure 1. Sample GHS-compliant label



Safety Data Sheets

The Public Works Supervisor(s) or their designee are responsible to establish and monitor the City's SDS program. This person will make sure procedures are developed to obtain the necessary SDSs and will review incoming SDSs for new or significant health and safety information. If this new information necessitates additional training for exposed employees, they will notify the Human Resources Manager so necessary training may be provided. This person will see that any new information is passed on to affected employees.

SDSs are available to all employees by accessing the VelocityEHS mobile app or website as follows:

Downloading the App

Go to your device's App Store and download the **SDS/Chemical Management** Mobile App.

The app can be downloaded to the following devices:

- Pads, iPhones, and iPods with iOS 9 or later
- Android tablets and smartphones with Android 4.4 or later

You will choose to skip domain entry and click **"Don't have a Username or Password?"** This will direct you to a screen where you can scan the City's QR code (below) to access the chemical management system.

A list of all known Hazardous Chemicals used by the City of Stanwood employees on any job is available at: https://chemmanagement.ehs.com/9/8AA9A7EC-00FC-4772-BB62-DCCF221D3DDE

SDSs will be available to all employees during each work shift (see above). If an SDS is not available, or a new chemical in use does not have an SDS, immediately contact the Public Works Supervisor.

Employee Information and Training

The Public Works Supervisor is responsible for the hazard communication training program. Both current and new employees of the City will attend all necessary and required training courses and will receive information on the following through this training:

- An overview of the requirements contained in the GHS and Hazard Communication Standard.
- Hazardous chemicals present at the employee's work area.
- Physical and health risks of the hazardous chemicals they are exposed to.
- The symptoms of overexposure.
- How to determine the presence or release of hazardous chemicals in the employee's work area.
- How to reduce or prevent exposure to hazardous chemicals through use of control procedures, work practices, and personal protective equipment.
- Steps the City has taken to reduce or prevent exposure to hazardous chemicals.
- Procedures to follow if employees are overexposed to hazardous chemicals.
- How to read labels and SDSs in order to obtain hazard information.
- Location of the SDS books and written Hazard Communication Program.

The Human Resources Manager will be responsible for keeping training records, including who attended what training and the subject of the trainings.

Before introducing a new chemical hazard in any department, each employee in that department or work area will be given information and training as outlined above on the new chemical. Refresher training will be provided to both individuals and groups as needed at the discretion of the employer.

Much of the training material needed to cover the topics identified above may be obtained in the SDSs kept by the City, as illustrated in Figures 2 and 3. Information on exposure controls and signs of over-exposure are given within the SDS for each

chemical. Trainers shall review SDSs of chemicals being trained on to collect appropriate information for training sessions.

Figure 2. SDS for Acetone, Section 8. Information on how to prevent or reduce exposure.

SECTION 8: Exposure controls/personal protection

8.2. Exposure controls

Appropriate engineering controls	:	Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure.
Materials for protective clothing	:	GIVE EXCELLENT RESISTANCE: No data available. GIVE GOOD RESISTANCE: butyl rubber. tetrafluoroethylene. GIVE LESS RESISTANCE: chlorosulfonated polyethylene. natural rubber. neoprene. polyurethane. PVA. styrene-butadiene rubber. GIVE POOR RESISTANCE: nitrile rubber. polyethylene. PVC. viton. nitrile rubber/PVC.
Hand protection	:	Gloves.
Eye protection	:	Protective goggles.
Skin and body protection	:	Head/neck protection. Protective clothing.
Respiratory protection	:	Wear gas mask with filter type A if conc. in air > exposure limit.
Other information	:	Do not eat, drink or smoke during use.

Figure 3. SDS for Acetone, Section 11. Symptoms of overexposure.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Symptoms/injuries after inhalation	:	EXPOSURE TO HIGH CONCENTRATIONS: Feeling of weakness. Irritation of the respiratory tract. Nausea. Vomiting. Headache. Central nervous system depression. Dizziness. Narcosis. Excited/restless. Drunkenness. Disturbed motor response. Respiratory difficulties. Disturbances of consciousness.
Symptoms/injuries after skin contact	:	ON CONTINUOUS EXPOSURE/CONTACT: Dry skin. Cracking of the skin.
Symptoms/injuries after eye contact	:	Irritation of the eye tissue.
Symptoms/injuries after ingestion	:	Dry/sore throat. Risk of aspiration pneumonia. Symptoms similar to those listed under inhalation. AFTER ABSORPTION OF HIGH QUANTITIES: Irritation of the gastric/intestinal mucosa. Change in the haemogramme/blood composition. Change in urine output. Affection of the renal tissue. Enlargement/affection of the liver.

Hazardous Non-Routine Tasks

Periodically, employees are required to perform hazardous non-routine tasks. (Some examples of non-routine tasks are confined space entry and tank cleaning. Prior to starting work on such projects, each affected employee will be given information by the supervisor/lead about the hazardous chemicals they may encounter during these activities.

It is also the responsibility of the Public Works Supervisor to identify and obtain SDSs for the chemicals the contractor is bringing into the workplace. If there are any chemicals that your employees are not familiar with and have been trained on, the City shall provide necessary training for its affected employees on the new chemical exposures.

Inventory of Hazardous Chemicals

The complete inventory of all chemicals used by our employees in each City location is available by accessing the VelocityEHS mobile app or website as follows:

Downloading the App

Go to your device's App Store and download the **SDS/Chemical Management** Mobile App.

The app can be downloaded to the following devices:

- Pads, iPhones, and iPods with iOS 9 or later
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You will choose to skip domain entry and click **"Don't have a Username or Password?"** This will direct you to a screen where you can scan the City's QR code (below) to access the chemical management system.

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Respirable Crystalline Silica Awareness Program

This Respirable Crystalline Silica Program was developed to prevent employee exposure to hazardous levels of respirable crystalline silica that could result through construction activities or nearby construction activities occurring on worksites. Respirable crystalline silica exposure at hazardous levels can lead to lung cancer, silicosis, chronic obstructive pulmonary disease, and kidney disease.

Scope

All work involving chipping, cutting, drilling, grinding, or similar activities on materials containing crystalline silica can lead to the release of respirable-sized particles of crystalline silica (i.e. respirable crystalline silica). Crystalline silica is a basic component of soil, sand, granite and many other minerals. Quartz is the most common form of crystalline silica. Many materials found on constructions sites include crystalline silica; including but not limited to – cement, concrete, asphalt, pre-formed structures (inlets, pipe, etc.) and others. Consequently, the City has developed this program to address and control these potential exposures to prevent our employees from experiencing the effects of occupational illnesses related to respirable crystalline silica exposure.

This program applies to all employees who have the potential to be exposed to respirable crystalline silica when covered by the WISHA Standard. The standard applies to all occupational exposures to respirable crystalline silica in construction work, except where employee exposure will remain below 25 micrograms of silica per cubic meter of air (25 $\mu g/m^3$) as an 8-hour time-weighted average (TWA) under any foreseeable conditions.

Exposure control methods
The majority of exposures Stanwood employees will have are covered in “Table 1” of the respirable crystalline silica rules. This resource identifies the equipment and tasks that create the majority of silica dust exposures that need controlling. When the work being undertaken by employees of the City are indistinguishable from the task identified in Table 1, the City must fully and properly implement the engineering controls, work practices, and respiratory protection specified for the task in the table.
The task(s) being performed by Stanwood staff are:

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
1	Stationary masonry saws	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
2a	Handheld power saws (any blade diameter) when used outdoors	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	N95 (or greater efficiency) filtering facepiece or half mask
2b	Handheld power saws (any blade diameter) when used indoors or in an enclosed area	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or greater efficiency) filtering facepiece or half mask	N95 (or greater efficiency) filtering facepiece or half mask
3	Handheld power saws for cutting fiber-cement board (with blade diameter of 8 inches or less) for tasks	• Use saw equipped with commercially available dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
	performed outdoors only	• Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.		
4a	Walk-behind saws when used outdoors	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
4b	Walk-behind saws when used indoors or in an enclosed area	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or greater efficiency) filtering facepiece or half mask	N95 (or greater efficiency) filtering facepiece or half mask
5	Drivable saws for tasks performed outdoors only	• Use saw equipped with integrated water delivery system that continuously feeds water to the blade. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
6	Rig-mounted core saws or drills	• Use tool equipped with integrated water delivery system that supplies water to cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
7	Handheld and stand-mounted drills (including impact and	• Use drill equipped with commercially available shroud or cowling with dust collection system.	None	None

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
	rotary hammer drills)	• Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.		
8	Dowel drilling rigs for concrete for tasks performed outdoors only	• Use shroud around drill bit with a dust collection system. • Dust collector must have a filter with 99% or greater efficiency and a filter cleaning mechanism. • Use a HEPA-filtered vacuum when cleaning holes.	N95 (or greater efficiency) filtering facepiece or half mask	N95 (or greater efficiency) filtering facepiece or half mask
9a	Vehicle-mounted drilling rigs for rock and concrete	• Use dust collection system with close capture hood or shroud around drill bit with a low-flow water spray to wet the dust at the discharge point from the dust collector.	None	None
9b	Vehicle-mounted drilling rigs for rock and concrete	• Operate from within an enclosed cab and use water for dust suppression on drill bit.	None	None
10a	Jackhammers and handheld powered chipping tools when used outdoors	• Use tool with water delivery system that supplies a continuous stream or spray of water at the point of impact.	None	N95 (or greater efficiency) filtering facepiece or half mask
10b	Jackhammers and handheld powered chipping tools	• Use tool with water delivery system that supplies a continuous stream or spray	N95 (or greater efficiency) filtering	N95 (or greater efficiency) filtering

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
	when used indoors or in an enclosed area	of water at the point of impact.	facepiece or half mask	facepiece or half mask
10c	Jackhammers and handheld powered chipping tools when used outdoors	• Use tool equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	None	N95 (or greater efficiency) filtering facepiece or half mask
10d	Jackhammers and handheld powered chipping tools when used indoors or in an enclosed area	• Use tool equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism.	N95 (or greater efficiency) filtering facepiece or half mask	N95 (or greater efficiency) filtering facepiece or half mask
11	Handheld grinders for mortar removal (i.e., tuckpointing)	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	N95 (or greater efficiency) filtering facepiece or half mask	Powered air-purifying respirator (PAPR) with P100 filters

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
		• Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.		
12a	Handheld grinders for uses other than mortar removal for tasks performed outdoors only	• Use grinder equipped with integrated water delivery system that continuously feeds water to the grinding surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
12b	Handheld grinders for uses other than mortar removal when used outdoors	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.	None	None
12c	Handheld grinders for uses other than mortar removal when used indoors or in an enclosed area	• Use grinder equipped with commercially available shroud and dust collection system. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	N95 (or greater efficiency) filtering facepiece or half mask

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
		• Dust collector must provide 25 cubic feet per minute (cfm) or greater of airflow per inch of wheel diameter and have a filter with 99% or greater efficiency and a cyclonic pre-separator or filter-cleaning mechanism.		
13a	Walk-behind milling machines and floor grinders	• Use machine equipped with integrated water delivery system that continuously feeds water to the cutting surface. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
13b	Walk-behind milling machines and floor grinders	• Use machine equipped with dust collection system recommended by the manufacturer. • Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. • Dust collector must provide the air flow recommended by the manufacturer, or greater, and have a filter with 99% or greater efficiency and a filter-cleaning mechanism. • When used indoors or in an enclosed area, use a HEPA-filtered vacuum to remove loose dust in between passes.	None	None
14	Small drivable milling machines (less than half-lane)	• Use a machine equipped with supplemental water sprays designed to suppress dust.	None	None

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
		• Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.		
15a	Large drivable milling machines (half-lane and larger) for cuts of any depth on asphalt only	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions.	None	None
15b	Large drivable milling machines (half-lane and larger) for cuts of four inches in depth or less on any substrate	• Use machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust. • Operate and maintain machine to minimize dust emissions.	None	None
15c	Large drivable milling machines (half-lane and larger) for cuts of four inches in depth or less on any substrate	• Use a machine equipped with supplemental water spray designed to suppress dust. • Water must be combined with a surfactant. • Operate and maintain machine to minimize dust emissions.	None	None
16	Crushing machines	• Use equipment designed to deliver water spray or mist for dust suppression at crusher and other points where dust is generated (e.g., hoppers, conveyers, sieves/sizing or vibrating components, and discharge points). • Operate and maintain machine in accordance with	None	None

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
		manufacturer's instructions to minimize dust emissions. • Use a ventilated booth that provides fresh, climate-controlled air to the operator, or a remote control station.		
17a	Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	• Operate equipment from within an enclosed cab.	None	None
17b	Heavy equipment and utility vehicles used to abrade or fracture silica-containing materials (e.g., hoe-ramming, rock ripping) or used during demolition activities involving silica-containing materials	• When employees outside of the cab are engaged in the task, apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None
18a	Heavy equipment and utility vehicles for tasks such as grading and	• Apply water and/or dust suppressants as necessary to minimize dust emissions.	None	None

Construction task or equipment operation		Engineering and work practice control methods	Required respiratory protection	
			≤ 4 hours/shift	>4 hours/shift
	excavating but not including demolishing, abrading, or fracturing silica-containing materials			
18b	Heavy equipment and utility vehicles for tasks such as grading and excavating but not including demolishing, abrading, or fracturing silica-containing materials	• When the equipment operator is the only employee engaged in the task, operate equipment from within an enclosed cab.	None	None

For tasks performed indoors or in enclosed areas, provide a means of exhaust as needed to minimize the accumulation of visible airborne dust;

For tasks performed using wet methods, apply water at flow rates sufficient to minimize release of visible dust;

For measures implemented that include an enclosed cab or booth, ensure that the enclosed cab or booth:

- Is maintained as free as practicable from settled dust;
- Has door seals and closing mechanisms that work properly;
- Has gaskets and seals that are in good condition and working properly;
- Is under positive pressure maintained through continuous delivery of fresh air;
- Has intake air that is filtered through a filter that is 95% efficient in the 0.3-10.0 μm range (e.g., MERV-16 or better); and
- Has heating and cooling capabilities.

Where an employee performs more than one task included on OSHA's Construction Standard Table 1 during the course of a shift, and the total duration of all tasks combined is more than four hours, the required respiratory protection for each task is the respiratory protection specified for more than four hours per shift. If the total duration of all tasks on Table 1 combined is less than four hours, the required respiratory

protection for each task is the respiratory protection specified for less than four hours per shift.

Respiratory Protection
Where respiratory protection is required by this program, the City of Stanwood will provide each employee an appropriate respirator that complies with the requirements of the City's respiratory protection program and the DOSH Respiratory Protection Standard (WAC 296-842).

Respiratory protection is required where specified by Table 1, for tasks not listed in Table 1, or where the company has not fully and properly implemented the engineering controls, work practices, and respiratory protection described in Table 1. Situations requiring respiratory protection include:

- Where exposures exceed the PEL during periods necessary to install or implement feasible engineering and work practice controls;
- Where exposures exceed the PEL during tasks, such as certain maintenance and repair tasks, for which engineering and work practice controls are not feasible; and
- During tasks for which an employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL.

Housekeeping
The City of Stanwood does not allow dry sweeping or dry brushing where such activity could contribute to employee exposure to respirable crystalline silica unless wet sweeping, HEPA-filtered vacuuming, or other methods that minimize the likelihood of exposure are not feasible.

The City of Stanwood does not allow compressed air to be used to clean clothing or surfaces where such activity could contribute to employee exposure to Respirable Crystalline Silica unless:

- The compressed air is used in conjunction with a ventilation system that effectively captures the dust cloud created by the compressed air; or
- No alternative method is feasible.

Medical Surveillance
Medical surveillance will be made available for each employee who will be required to use a respirator for 30 or more days per year due to their respirable crystalline silica exposure. Medical surveillance (i.e. medical examinations and procedures) will be performed by a PLHCP and provided at no cost to the employee at a reasonable time and place.

The City of Stanwood will make available an initial (baseline) medical examination within 30 days after initial assignment, unless the employee has received a medical examination that meets the requirements of the respirable crystalline silica standard within the last three years. The examination shall consist of:

- A medical and work history, with emphasis on past, present, and anticipated exposure to respirable crystalline silica, dust, and other agents affecting the respiratory system in addition to any history of respiratory system dysfunction, including signs and symptoms of respiratory disease (e.g., shortness of breath, cough, wheezing), history of tuberculosis, and smoking status and history;
- A physical examination with special emphasis on the respiratory system;
- A chest X-ray (a single postero-anterior radiographic projection or radiograph of the chest at full inspiration recorded on either film [no less than 14 x 17 inches and no more than 16 x 17 inches] or digital radiography systems;
- A pulmonary function test to include forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) and FEV1/FVC ratio, administered by a spirometry technician with a current certificate from a NIOSH-approved spirometry course;
- Testing for latent tuberculosis infection; and
- Any other tests deemed appropriate by the PLHCP.

The City of Stanwood will make available medical examinations that include the aforementioned procedures (except testing for latent tuberculosis infection) at least every three years. If recommended by the PLHCP, periodic examinations can be more frequently than every three years.

The City of Stanwood will ensure that the examining PLHCP has a copy of the respirable crystalline silica standard, this program, and the following information:
- A description of the employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to respirable crystalline silica;
- The employee's former, current, and anticipated levels of occupational exposure to respirable crystalline silica; and
- A description of any personal protective equipment (PPE) used or to be used by the employee, including when and for how long the employee has used or will use that equipment.

The City of Stanwood wiill ensure that the PLHCP explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of each medical examination performed. The written report shall contain:
- A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;
- Any recommended limitations on the employee's use of respirators;
- Any recommended limitations on the employee's exposure to respirable crystalline silica; and;
- A statement that the employee should be examined by a Specialist if the chest X-ray is classified as 1/0 or higher by the B Reader, or if referral to a Specialist is otherwise deemed appropriate by the PLHCP.

The City of Stanwood will also obtain a written medical opinion from the PLHCP within 30 days of the medical examination. The written opinion shall contain only the following in order to protect the employee's privacy:

- The date of the examination;
- A statement that the examination has met the requirements of the respirable crystalline silica standard; and
- Any recommended limitations on the employee's use of respirators.

If the employee provides written authorization, the written opinion shall also contain either or both of the following:

- Any recommended limitations on the employee's exposure to respirable crystalline silica; and/or
- A statement that the employee should be examined by a Specialist if the chest X-ray is classified as 1/0 or higher by the B Reader, or if referral to a specialist is otherwise deemed appropriate by the PLHCP.

If the PLHCP's written medical opinion indicates that an employee should be examined by a Specialist, the City of Stanwood will make available a medical examination by a specialist within 30 days after receiving the PLHCP's written opinion. The City of Stanwood will ensure that the examining Specialist is provided with all of the information that the employer is obligated to provide to the PLHCP.

The City of Stanwood will ensure that the Specialist explains to the employee the results of the medical examination and provides each employee with a written medical report within 30 days of the examination. The written report will contain:

- A statement indicating the results of the medical examination, including any medical condition(s) that would place the employee at increased risk of material impairment to health from exposure to respirable crystalline silica and any medical conditions that require further evaluation or treatment;
- Any recommended limitations on the employee's use of respirators; and
- Any recommended limitations on the employee's exposure to respirable crystalline silica.

In addition, the City of Stanwood will obtain a written opinion from the Specialist within 30 days of the medical examination. The written opinion shall contain the following:

- The date of the examination;
- Any recommended limitations on the employee's use of respirators; and

If the employee provides written authorization, the written opinion shall also contain any recommended limitations on the employee's exposure to respirable crystalline silica.

Program Evaluation

This program will be reviewed and evaluated on an annual basis by the Public Works Supervisors unless changes to operations, the respirable crystalline silica standard (WAC 296-840), or another applicable DOSH standard require an immediate re-validation of this program.

Lock-Out / Tag-Out Program

Hazardous Energy Control
The control of hazardous energy (Lockout/Tagout, LOTO) helps protect and safeguard employees while they perform servicing and maintenance on machines and equipment in which the unexpected energization or startup of the machine or equipment, or the release of stored energy, could occur and cause injury or death.

Scope
Lockout/tagout procedures apply when:

- employees are performing servicing and maintenance, and there is a potential for injury from unexpected start-up or release of stored energy, or
- service and maintenance take place during normal production, if employees:
  - must remove or bypass a guard or safety device; or
  - must place any part of their body into the danger zone

Exceptions:
When working on electric equipment receiving power only through a cord and plug, if unplugging the equipment eliminates the possibility of unexpected energization, start up, or release of stored energy and the plug is kept under the exclusive control of the employee doing the service or maintenance, then LOTO procedures do not apply.

Service and maintenance during normal production operations do not need to apply LOTO if the employee servicing the equipment is not required to remove or bypass a guard or other safety device or place any body part into the point of operation or other hazardous area of the machine.

Minor tool changes, adjustments, and other minor service during normal production do not need to apply LOTO if they are routine, repetitive, and integral to the use of the equipment for production and the work is done using measures which provide effective protection from hazards.

Hazard Identification
Hazardous energy presents itself in many forms, including electrical, mechanical, hydraulic, pneumatic, gravity, chemical, and thermal. It is the responsibility of all supervisors and leads to determine what hazardous energy exposures they have that fall under the scope of LOTO rules identified in the above section.

Each department should do a thorough review of equipment and system maintenance/work to determine what hazards they have exposure to which they should be using LOTO to control. The list of identified hazards should be reviewed annually, at minimum, to ensure the department is controlling against all known hazards.

The inventory should identify the type of hazard, what machine or system it is located within, and how the staff should control the hazardous energy.

Lockout/Tagout Determinations
For each machine/system and maintenance/work interaction that falls within the scope of LOTO, departments must determine what level of protection is sufficient and required. It is always the City's position that lockout methods are preferred to tagout alone, as the former uses positive methods that prohibit accidental re-energization of systems that the latter does not include.

All work where the machine will take a lock-out device must use one. For those machines and systems that cannot accept a lockout device, department management must approve use of a tagout-only system. A tagout system can only be used if all the following conditions are met:
1. The tagout device is attached where you would have put the lockout device
2. The tagout system provides the same level of employee protection as a lockout system.
3. You can demonstrate that the tagout system:
    a. Meets all tagout requirements of this chapter.
    b. Includes additional safety measures to provide the same level of safety as a lockout system.

Employee Determinations
For all work done which falls under LOTO, the department must determine all employees that fall into two categories: authorized worker and affected workers. Authorized workers are those who locks or tags out machines in order to work on them. Affected employees are those who are required to use or operate those machines or may be in the areas where machines may be locked or tagged out.

De-energization Procedures and Locking Out Devices
While machine specific shutdown procedures will vary due to types of energies, isolating devices, and reception of lock-out devices, the same general steps shall be taken on all equipment de-energizing under the LOTO program.

The accepted procedures for de-energization is as follows:
1. Prepare for shutdown
2. Shut down equipment
3. Isolate all energy sources
4. Apply locks and/or tags
5. Release stored energy
6. Verify equipment isolation

When preparing for shutdown, staff will ensure all equipment and tools are removed from the area of the machine. Equipment-specific procedures will be reviewed to ensure the authorized employee is aware of all hazardous energy types and the energy-isolating devices being used on the equipment. Authorized employees at this time will

also notify affected employees of the impending work and provide details regarding scope and duration of work.

When shutting down equipment, staff will follow the manufacturer's recommended steps and shut the equipment down in normal process. All switches and buttons moved to the off position.

Using energy-isolating devices, isolate the machine or equipment from the energy source(s) that power it. Follow machine-specific procedures to ensure all energy sources are accounted for and isolated.

Once the machine is isolated from its energy source, use a positive locking method to ensure the machine or equipment cannot be inadvertently started or re-energized. The machine-specific procedures will dictate what type of locking device to use in conjunction with the energy-isolating device. Along with locks, place tags along with the lock at the energy-isolating device location. These tags should be specific to the type of lock and energy-isolation used and should clearly note a LOTO situation and what workers should not do.

Release the blocked or stored energy. Different energy types will require different work here. Staff may need to vent gases, block or disconnect lines, block elevated parts, or drain fluids. Ensure all energy sources identified in the machine-specific procedures are addressed here.

Verification of equipment isolation is done by attempting normal startup. There should be no re-energization or startup of the machine. If there is, go back to energy-isolation and release steps, verifying that all energy types and sources have been identified and addressed. Once attempted startup yields no response, return the control to the off/neutral position. The machine is ready for maintenance work.

Re-energization Procedures

To re-energize machines after maintenance work is complete, follow these general steps:

1. Inspect work areas for items and equipment pieces; remove those not belonging to area
2. Employees safely positioned or removed
3. Affected employees notified or impending re-energization
4. Remove lock-out devices
5. Re-energize equipment
6. Inform affected employees of process completion.

Energy Control Procedures

The City must have machine-specific instructions for each machine or piece of equipment that falls under the LOTO scope. These procedures identify for each type of hazardous energy and the appropriate steps necessary to disconnect the machine from its energy source(s) and lock out the energy-isolating device in use.

Each department/facility shall maintain their list of machine-specific procedures. The City will hold an inventory of the location of those list locations. It will be the duty of the Public Works Supervisors to review all procedures and ensure they comply with requirements and provide enough information on the energy type/source and lock-out devices for the procedure to be done safety.

Energy control procedures will be reviewed annually to ensure they are still correct and provide the best instructions for staff. Department management will be responsible to complete this work or may delegate the assignment with the requirement to review all updates prior to final approval.

Group Locks
Some maintenance requires more than one individual working on a machine at a time. In cases where multiple individuals are working on the same machine or area, procedures must be undertaken to ensure all authorized workers are safe for re-energization; the group process must afford the same level of protection as an individual lock.

Where multiple people are working on a single machine there will be a primary authorized employee designated. This employee has overall responsibility for the service or maintenance being done. This person is the first to place their lock on, and the last to remove it, when the work is completed. Each additional authorized employee shall put their lock on via a group lockout device, lockbox, or a comparable mechanism. Individual workers must only remove their locks when their work is completed.

Coordination with Outside Employers
When outside employers bring staff into the City of Stanwood facilities to perform work, it is the duty of the Public Works Supervisors to ensure that roles and expectations for LOTO have been discussed and agreed upon. Before work begins, department personnel should communicate the City's LOTO program, make sure internal staff understand the outside employer's LOTO procedures, and any variance from the City's program is clearly agreed upon. In such instances, affected employees should be advised of the variance from the normal LOTO procedures before work begins.

Training for Authorized and Affected Employees
Training is required for both affected and authorized employees under the LOTO program.

Affected employees must be trained on:
- The purpose and function of the energy control program, and
- Skills necessary to carry out their responsibilities
- Purpose and use of energy control procedures
- Procedures in use in their area
- The prohibition against attempting to re-energize or re-start a device that has been locked-out or tagged out.

Authorized employees must be trained on:

- The type and magnitude of energy present in their workplaces
- Recognizing the sources of hazardous energy as present in their facilities
- The designated means of isolating devices from energy sources and then locking out that isolation device
- Procedures in use in their area
- The prohibition against attempting to re-energize or re-start a device that has been locked-out or tagged out

If tagout is used without lockout devices, additional training is required. If any tagout device meets the criteria for use, the department director is responsible to ensure all training meets the standards in WAC 296-803-60010.

Employees shall be retrained when periodic audit, process review, or passive monitoring shows a deviation from expected procedures. Re-training may also be needed when changing job assignments or new equipment or energy sources are brought into facilities.

Procedures Audits

A primary way the City of Stanwood monitors the effectiveness of safety programs is through audits. With the LOTO program, procedure audits review the staff's ability to perform LOTO procedures according to policy and machine-specific procedures.

These audits will take place in each division where LOTO occurs at least annually. There should be an audit done for each machine-specific procedure in the department's program. Note: It is not required that all audits be done in immediate succession but can be spread out through the year. All audits should be documented. For each audit the following should be recorded:

- What energy control procedures are being audited
- Date of the review
- Employees included in the review
- Person doing the review

Audits should also review the staff's ability to properly use lockout and tagout devices. These can be undertaken at the same time as procedure audits, or separately. All staff should be reviewed to ensure they know how to appropriately use all locks in their area and how tags should be applied. The Public Works Supervisors are responsible for audits in their departments along with documentation of all such audits.

Audit results and reports should directly impact the training provided to staff on LOTO subject matter. Departments will review audits to determine if particular subject matter needs refresher training or if specific individuals needs to have additional training on any particular subjects.

Confined Space Entry Program

The confined space entry program is developed to establish protective measures and to ensure your employees' safety and health when they enter, work in, and exit from confined spaces. The aim of this program is to make entry into, and work in, confined spaces safe and routine; this will be accomplished by ensuring all preliminary work and training is completed by staff and they are following safety protocols during the entirety of the work assignment.

Scope of Confined Space Work
This program addresses work done in areas that present exceptionally hazardous environments to employees. For an area to be considered a confined space, it must meet three criteria elements:

1) Large enough and arranged so an employee could fully enter the space and work,
2) Has a limited or restricted means of entry or exit, and
3) Not primarily designed for continuous human occupancy

The City's confined space entry program is especially focused on permit-required confined spaces (PRCS) as these spaces pose by far the greatest risk to employees. A permit-required confined space meets all points of the general definition above, and includes at least one of the following hazards:

- Engulfment hazard,
- Configuration hazard,
- Atmospheric hazard, or
- Other recognized hazard

These hazards could impair the ability to self-rescue and/or result in situations that present an immediate danger to life or health (IDLH).

Identification and Inventory of Confined Spaces
Identification of confined spaces will be overseen by the Public Works Supervisors. Each department will be responsible for reviewing their facilities for permit-required confined spaces. For public areas (any area outside facilities) departments will be responsible for areas where work is performed. Department management does not need to perform all identification work but must provide a final sign-off on all identifications of permit-required confined spaces. For spaces where multiple departments work, department managers will meet and determine how identification work will be assigned.

Identifying permit-required confined spaces is a two-step process. First, all confined spaces within the City must be identified. Again, this includes spaces in public areas where staff do work. Second, these spaces identified in step 1 must be examined for actual and potential hazards of the type defined in the section above. Those spaces that meet both requirements are deemed to capable of causing death or serious harm and are classified as permit-required confined spaces.

Employees who take part in this identification process should record their work on the provided identification forms. Each identified PRCS should provide details on location, what department accesses it, and what actual or potential hazards exist.

The database that is the result of the identification work noted above is now a key tool for controlling access to PRCS and training employees who must access those spaces. For this tool to be useful it must be accurate; this database must be reviewed by each department annually to determine if any information is out of date. It is the responsibility of the Public Works Supervisors to ensure this work is done for their work areas. The confined space program administrator will be sent department confirmations that this work has been done for each department and will follow up with any department not fulfilling this responsibility.

Employee Awareness and Access

It is required that the City of Stanwood make affected employees aware of the locations of PRCS that impact them, and to advise these employees of specific dangers posed by any PRCS that affects them. To help employees be fully aware of the dangers they work around, the City of Stanwood will post signs on or around entries to PRCS identifying them as such. These signs will be consistent in nature and be specific regarding the space being a PRCS.

The City will also protect employees and the public by limiting access to PRCS. The same methods used to prevent unauthorized employees from entering PRCS should also generally work for the public. The City will keep unauthorized employees and the public out of PRCS by methods such as using padlocks, bolted covers, use of special tools to remove covers, along with employee training, and permanently closing the space, such as welding it closed.

Program Administrator

To ensure that the confined space entry program is consistent in application and effective in practice, the City of Stanwood will appoint an employee to the position of program administrator. This individual will have overall responsibility for the program. This person must have sufficient training and experience with PRCS entry to competently oversee the program development, implementation, and evaluation of effectiveness.

The City has appointed the Public Works Supervisor (Utilities) as program administrator for the confined space entry program. The program administrator will have last-word authority on all elements of the confined space entry program. All updates to the program must be signed-off on by the program administrator.

The administrator should review all incidents where unexpected hazards were experienced in PRCS, rescue was necessary, where unauthorized entry occurred, or where entry procedures were deviated from. The program administrator should also do spot reviews of entry permits, looking for any areas of emphasis or concern they may have identified.

The program administrator will ensure that all personnel who are designated as part of entry teams have had sufficient training and certified themselves as capable of performing the tasked work. If additional training is necessary for any employee, it is the obligation of the program administrator to ensure it is received.

Designated Employee Roles

Entry teams are comprised of more than just the entrant. It is essential that all personnel that play a role in PRCS entry be sufficiently trained and competent in their job duties. To further ensure all personnel receive sufficient training and oversight, the City has identified all staff who have active roles in PRCS entry. All personnel that serve in the following capacities must be identified by role:

- Attendants
- Competent persons
- Entrants
- Entry supervisors
- Rescuers
- Program administrators
- Atmospheric testers (if not otherwise already listed)

It is possible that under different circumstances or at different PRCS locations a single individual may hold more than one of these positions. When this is the case, they must be trained and competent in all areas.

Each department/facility is responsible for identifying all personnel with active PRCS roles. For each individual, it should identify the exhaustive list of roles they play. Each department will provide up-to-date lists to the program administrator of personnel with active roles. It is the department's responsibility to ensure updates to the administrator when personnel changes occur.

Identifying personnel by the active roles played will help the program administrator and department management ensure the employees receive the proper level of training and certification.

Confined Space Entry Process

When entering a PRCS, consistent processes should be used whenever possible. The following are the established preparatory and work steps for PRCS entry.

1) Review of entry procedures
2) Fill out entry permit
3) Lockout/tagout and any other preliminary tasks to secure the confined space
4) Evaluation and control of hazards (including atmospheric testing)
5) Ventilation of space and inerting process
6) Equipment check (tripod, harness, communication, etc.)
7) Entry and work completed
8) Removal of personnel and equipment from space
9) Closure and securing of space

10) PRCS permit closed and retained

Permit Entry Procedures

Consistent application of proven safety procedures helps ensure employee safety in confined spaces. To help make entry into PRCS a consistent effort, the City has created a set of permit entry procedures. A copy of entry procedures should always be present when PRCS entry occurs, and either the attendant of another party on the entry team should be reviewing the process against the procedures to ensure the entry work is in compliance with the written and established procedures.

(1) Staff must identify and evaluate before employees enter, potential hazards from:
(a) The permit-required confined space; and
(b) The work to be performed.

(2) Staff must complete an entry permit before entry is authorized, documenting that they have completed the means, procedures and practices necessary for safe entry and work.

(3) Staff must make sure that entrants have an opportunity to observe any monitoring or testing, or any actions to eliminate or control hazards, performed to complete the permit.

(4) Staff must identify the entry supervisor and make sure the entry supervisor signs the entry permit, authorizing entry, before the space is entered.

(5) Staff must make the completed permit available to entrants or their authorized representatives at the time of entry, so they can confirm the implementation of the pre-entry preparations. Do this by either posting the completed permit at the entry location, or by any other equally effective means.

(6) Staff must make sure the duration of the permit does not exceed the time required to complete the assigned task or job identified on the permit.

(7) You must note any problems encountered during an entry operation on the permit. Use the information to make appropriate revisions to your program, entry operations, means, systems, procedures and practices.

Coordinating with Outside Employers

Circumstances may occasionally require personnel from outside employers to enter City of Stanwood-controlled confined spaces. When workers from outside the City must enter a PRCS, certain requirements must first be met. It is the responsibility of the Public Works Supervisor to ensure these requirements are met. The Public Works Supervisor should also advise the program administrator of outside entry teams operating in PRCS.

- Provide a copy of their confined space program and PRCS entry procedures
- Discuss assistance from organization employees in active roles

- Determine methods to be used where programs differ
- Determine who has authority over the PRCS entry and work being done

The contracting department will obtain a copy of the entry permit to keep for program records. Even if no City employees entered the space or had any exposure, such records are valuable tools for program review.

Rescue Procedures
A critical role on the entry team is that of rescuer. For the City, rescue services will be provided by North County Regional Fire Authority/Arlington Fire, 28407 Pioneer Hwy, Stanwood, WA 98292. It is the responsibility of the entry supervisor to confirm the availability of rescue resources ahead of a PRCS entry. Rescue service providers should be made aware of all PRCS they may be asked to provide rescue services in. It is the Public Works Supervisor's responsibility to provide the rescue services provider information on the PRCS needing rescue services coverage.

It is a City priority to attempt to schedule practical rescue training sessions with the rescue service provider. The program administrator will lead coordinating efforts for training.

It is the duty of the entry supervisors to ensure that rescue services are available at the time entry begins. If rescue services become unavailable, the supervisor must immediately cancel the permit and entrants must exit the PRCS. If entry again becomes viable, a new permit should be issued.

Permits
Written permits are required for all PRCS entry in spaces controlled by the City. The permit acts as a checklist to ensure that all necessary precautions have been taken and safety procedures are followed as intended. The permit also acts as documented evidence regarding actual exposures that entrants to spaces experience.

All departments are to use the confined space entry permit. It is the duty of program administrator to ensure that the permit used by the City meets all requirements and provides all necessary information.

Retention schedules for permits are based on what exposure the workers experience. For entries where permits show actual exposure to hazardous atmospheres, the permit must be kept and maintained as employee exposure records per WAC 296-802 and treated as other exposure/medical records. Permits that do not show exposure may be maintained under the normal retention schedule.

Alternate Methods of Entry
Under certain circumstances, staff can enter a PRCS without the use of a permit system. The self-assessment question that determines eligibility is this:
- can physical hazards be eliminated, and
- can atmospheric hazards be eliminated or controlled?

If a review of the space shows that both parts of the question be answered affirmatively, then that space is eligible for entry using alternative methods. For this option to be viable, you must also show through monitoring data that the use of continuous forced air ventilation will maintain the permit-required confined space for safe entry and that in the event the ventilation system stops working, entrants can exit the space safely.

If alternative entry methods are decided upon, the entry supervisor must provide written documentation to entrants before entry that includes the following information:

- Location of the space
- Date of entry
- Duration of the entry
- The identified hazards of the space and any additional hazards created in space by the work being done
- The specific measures used to eliminate the hazards
- The ventilation system used to control atmospheric hazards, the instruments used to test the atmosphere, and the results of atmospheric testing showing a non-hazardous atmosphere.
- All conditions that will trigger an evacuation of the space
- The name, title, and signature of the entry supervisor ensuring safe entry procedures.

If an entrant, for any reason, must enter the space prior to the completion of hazard elimination, it must be done in accordance with the permit entry process.

If at any time an unexpected or previously unidentified hazards presents itself during an alternative methods entry, the entrants should exit the confined space immediately and a further determination should be made by the entry supervisor if that hazard can be eliminated, or if a permit entry is required at that point.

Entry records used under alternative methods of entry should be maintained as part of confined space recordkeeping.

Training

All employees who hold designated roles within the confined space entry program must receive training that is commensurate with their levels of duties and exposure. Training for employees should be done by someone who is qualified and trained. The trainer selected by the City will have successfully demonstrated the ability to solve problems relating to the subject matter, work, or project, either by:

- Possession of recognized degree, certificate, or professional standing; or
- Extensive knowledge, training and experience.

All designated employees will receive training before they are presented with exposures related to PRCS entry. This training will cover all elements of their assigned duties. Additional training will be provided any time a change in duties occurs or new hazards are discovered that the employee has not been previously trained on. Retraining will

also occur when the program administrator, entry supervisor, or anyone else notes deviation from procedures in PRCS entry or the employee show inadequate knowledge of entry procedures and their assigned tasks.

The training focus for the City is on outcomes; the City expects all trained employees to show practical proficiency in their confined space duties. This is demonstrated through practical training exercises and period review of work process thereafter. The City also may elect to have confined space designated employees take comprehensive written exams to show proficient knowledge of the subject.

Training Topics
Confined space entry training will generally focus on the following subjects, but will not be limited to them:

- Roles and responsibilities;
- Hazards of the permit space;
- Procedures from your program created to protect employees, such as methods used to isolate and control hazards, equipment use, equipment maintenance and evacuation;
- For individuals not authorized to perform rescue, the dangers of attempting unauthorized rescue.

When employees complete training, the trainer must certify their competency and proficiency in their selected duties. The City will ensure that the certification meets the following standards:

- It contains each employee's name, the trainer's written or electronic signature or initials, and the dates of training.
- It is available for inspection by employees and their authorized representatives.

Respiratory Protection Program

The City of Stanwood recognizes there are some environmental hazards that cannot be completely controlled or segregated from employees in some areas or facilities. Additionally, there are some work duties undertaken which create the respiratory hazards staff then need protection from. It is both these exposures: naturally occurring and work-induced, that the City's respiratory protection program covers.

Exposure determinations
In an effort to fully understand what respirable hazards exist for staff, the City is committed to undertaking required environmental sampling. This is a two-step process for the City and respective departments.

Step one is to determine what potential exposures it might be worthwhile to monitor though environmental sampling. This step is approached in a variety of ways. First, departmental leadership meets with teams that work in environments that are potentially hazardous or who work with hazardous chemicals or substances which have the potential to create hazardous environments. Leadership collects information from these

groups regarding what they know and presume causes hazardous environments they need protection from. Additionally, departmental leadership should review chemical and other documentation to determine if the chemicals or reactive process they are used in can or may create respiratory hazards.

Once the list of potential exposures is compiled, department leadership will determine what hazards will be sampled for. In this determination, management will be liberal in its coverage for monitoring and testing. The City will contract with an industrial hygienist to conduct environmental monitoring for work practices and environments.

The results of these monitoring services will drive what exposures need to be addressed through further mitigation techniques, and then finally respirator use.

Employee Notifications
All personnel that work with or may contact the harmful substances or environments must be notified of:

- The existence of the substance or environment and appropriate counter measures.
- Possible harmful effects.
- Protective equipment to be used; its limitations, proper fitting (techniques), and other pertinent information to its use.
- Any other information pertinent to protecting them from possible harm.

Hazard Elimination
Hazard elimination by engineering methods such as improved ventilation, or administrative controls like, elimination of source, or removal of people is considered the first priority. Where such controls are unsuccessful or not feasible, respiratory protection equipment will be used.

Additionally, where hazardous environments are caused at least in part by use of hazardous chemicals, the department will review purchasing options to determine if a less- or non-hazardous substitution exists that is budgetarily feasible and sufficiently effective. If such alternatives exist, the department will substitute the old chemical for the less- or non-hazardous one.

Respirator Selection
Careful respirator selection, fit-testing, proper care of your respirator, employee training, medical assessment of employee health and recordkeeping are covered in this section.

Types and brands of respirators vary widely, ranging from simple dust masks to supplied air respirators like those firefighters wear. The following is a description of the main types of respirators the City makes available to staff.

When determining what type of respirator is appropriate for the task or environment, affected employees should consider the following selection criteria:

- Expected or estimated chemical concentration
- PEL (permissible exposure limit) of chemical in question

- Form of contaminant (gas, vapor, dust, or fume)
- Does the contaminant create an IDLH (immediate danger to life and health) atmosphere
- Will the contaminant, at estimated exposure, irritate the eyes
- Is skin absorption a concern

Based on the responses to these questions, the appropriate level of respiratory protection should be obvious to employees.

Filtering Facepiece Respirators (dust masks)
These simple, two-strap disposable dust masks are designed only for dusts. They are not as protective as other respirators, but do an adequate job in many cases, unless the dust is toxic or copious. All dust masks bought by the City will be (minimally) NIOSH 95 rated.

Cartridge Respirators
Cartridge respirators come in half-and full-face options. Full-face respirators provide a higher protection factor, so these masks should be worn with more severe exposures. These respirators have removable cartridges that filter out either dust, chemicals or both. Selecting the correct cartridges is essential since they are designed for particular types of chemicals or dust.

Cartridges are available for solvents, ammonia, chlorine, acids and other chemicals. The cartridges must be changed out or replaced periodically, especially for chemicals, since they can absorb only so much contaminant before breakthrough occurs. A few cartridges are equipped with end-of-service indicators that show when a cartridge should be replaced.

Full-face masks should be worn in instances where exposures prose risks to skin absorption or irritation or eye protection is necessary.

Supplied Air Respirators (Airline and SCBA)
The respirators that provide the greatest level of protection are supplied air respirators. These come in two forms, SCBA (self-contained breathing apparatus) and airline respirators (where a compressor pushes air through a hose to a respirator).

Some work duties that require supplied air are firefighting, sandblasting, confined space work, and chemical leak/spill response.

Supplied air is needed in particular circumstances:
- Oxygen deficiency (<19.5%)
- IDLH (immediately dangerous to life and health) atmospheres

Emergency Escape Respirators
Emergency escape respirators, as the name implies, can only be used for one thing – to escape or exit from a room or building in an emergency, usually a large chemical release, leak or spill, or when a supplied air respirator fails or runs out of air. An escape respirator is typically a small bottle or tank of air connected to a face piece that supplies 5-10 minutes of air. Some supplied air respirators will have an auxiliary bottle of air for escape that connects to the existing face piece.

Medical Evaluations
Prior to use of respirators and fit testing, the City must seek a medical opinion from a licensed health care provider regarding any employee's ability to wear a respirator. The purpose of this evaluation is to determine if the wearing of a respirator would cause any negative or adverse health effects, such as skin irritation or difficulty breathing.

The Human Resources Manager will be responsible for gathering and maintaining medical records relating to respiratory use.

The City will send a medical evaluation to employee's medical providers. This questionnaire asks them to identify any known issues that may be exacerbated by respirator use, or any reason why the employee cannot wear a respirator.

If the employee chooses, or the medical provider feels the need, they can meet to discuss the medical evaluation, and the City will cover the cost of that appointment.

Once the evaluations are returned to the City, management will determine if any potential respirator user is not able to use respirators or if a special type of respirator is needed. In these circumstances, department management will determine if it is needed to change job duties for the worker or purchase specialized equipment to enable the worker to have respiratory protection.

Additional medical evaluations will be conducted in the following situations:
- Our medical provider recommends it.
- Our respirator program administrator decides it is needed.
- An employee shows signs of breathing difficulty.
- Changes in work conditions that increase employee physical stress (such as high temperatures or greater physical exertion).

Fit Testing
All employees who wear tight-fitting respirators will be fit-tested before using their respirator, or prior to changing models. Fit testing will be repeated annually. Fit testing will also be done when a different respirator face piece is chosen, when there is a physical change in an employee's face that would affect fit, or when our employees, or medical provider notify us that the fit is unacceptable. No beards are allowed on wearers of tight-fitting respirators. Respirators are chosen for fit testing following procedures in the WISHA Respirator Rule. Fit testing is not required for loose-fitting, positive pressure (supplied air helmet or hood style) respirators.

Training
Minimum training shall include the following:

- Instruction in the nature of the hazard, whether acute, chronic, or both, and an appraisal of what may happen if the respirator is not used or fails.
- Explanation of why more positive control is not immediately feasible. This shall include recognition that every reasonable effort is being made to reduce or eliminate the need for respirators.
- A discussion of why this is the proper type of respirator for a particular purpose.
- A discussion of the respirator's capabilities and limitations.
- Instruction and training in actual use of the respirator (especially a respirator for emergency use) with close and frequent supervision to assure that it continues to be properly used.
- Classroom and field training to recognize and cope with emergency situations.
- Other special training as needed for special use.

Training shall provide the employee an opportunity to handle the respirator, have it fitted properly, test face piece to face seal, wear it in normal air for a familiarity period and wear it in a test atmosphere where applicable.

Maintenance and Care of Respirators

Inspection
All respirators shall be inspected routinely before and after use. A respirator that is not routinely used but is kept ready for emergency use, shall be inspected after each use and at least monthly to ensure that it is in satisfactory working condition. Public Works Supervisors will oversee inspections and ensure inspections are occurring as scheduled and are documented. It is important that care be taken with respirators to eliminate all physical abuse and a designated location shall be provided for the respirators after their use for cleaning and inspection.

Self-contained breathing apparatus shall be inspected monthly. Cylinders shall be fully charged according to the manufacturer's instructions. It shall be determined that the regulator and warning devices function properly.

A record shall be kept of inspection dates and findings for respirators maintained for emergency use.

Cleaning and Disinfecting
Routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to ensure that proper protection is provided for the wearer.

Each worker should be briefed on the cleaning procedure and be assured that they will always receive a clean and disinfected respirator. Such assurances are of greatest significance when respirators are not individually assigned to workers.

Respirators maintained for emergency use shall be cleaned and disinfected after each use.

The following procedure is to be followed in cleaning and disinfecting respirators:

- Remove any filter, cartridges, or canisters.
- Wash face piece and breathing tube in cleaner-disinfectant or detergent solution. Use a hand brush to facilitate removal of dirt.
- Rinse completely in clean, warm water.
- Air-dry in a clean area.
- Clean other respirator parts as recommended by manufacturer.
- Inspect valves, head straps, and other parts; replace with new parts if defective.
- Insert new filters, cartridges, or canisters; make sure seal is tight.
- Place in plastic bag or container for storage.

Disposable respirators shall be discarded after each day's use. If to be used intermittently during the day, they must be placed in a sealed plastic bag and labeled with the user's name.

Voluntary Respirator Use

This voluntary use program is to be implemented in conjunction with the City of Stanwood's broader respiratory protection program. That program contains information on considered exposures, exposure determinations, and methods of hazard elimination implemented by the City.

The City recognizes and accepts that there are situations, tasks, and environments where employees desire to use respirators for protection, but where hazards do not present an exposure significant enough to mandate such use. In such situations the City has approved voluntary use of respirators.

Before first use under this program, an employee must meet with their supervisor to discuss this policy and ensure intended use is appropriate and not a mandatory use circumstance, receive basic training and overview of respirator use, and sign the voluntary respirator use agreement form (See Appendix).

Voluntary Use Program Administrator
The program administrator for the voluntary use program is the Public Works Utilities Manager. The program administrator will ensure that those eligible for voluntary use, but not already in the respiratory protection program will receive necessary training to understand the program, have access to approved respirators, and have signed the voluntary use agreement form.

Respirators Approved for Voluntary Use
The only respirators that are approved for voluntary use are filtering facepiece respirators, commonly referred to as disposable respirators or dust masks. Filtering

facepiece respirators are negative pressure air purifying particulate respirators that differ from other respirators because the filtering media itself is the mask.

To be a certified filtering facepiece respirator, the mask must be NIOSH approved, double strapped and clearly labeled with both a letter designation (N, R, P) indicating resistance to oil degradation and a filtering efficiency (95, 99, 100). Single strap varieties of “nuisance particle” masks are not certified by NIOSH and should not be considered an approved respirator. Masks that do not meet NIOSH standards are not approved for the voluntary use program for the City.

Respirator Use and Disposal
Filtering facepiece respirators are intended to be single use. When the task with associated exposures is completed, the respirator should be discarded, and not saved for re-use. It does not matter if it visually appears to be intact and in good shape. It is appropriate if short breaks in use are taken to remove the mask and then return to using it **within a single shift**. In such instances, the mask should be stored in a location and way that prevents the mask interior surfaces from exposure to hazardous particulates. Respirators are never to be shared or used by multiple individuals sequentially.

If voluntary use of a respirator leads to skin irritation or other physical symptoms, use should be ceased immediately. If any condition requires first aid or medical treatment an injury report shall be made within 24 hours to the supervisor/manager.

Voluntary use of respirators is not allowed when it interferes with employees’ ability to work safely by restricting vision, communication, or other vital functionality.

Training
Employees who are eligible for voluntary use of respirators and not already covered under the full respiratory protection measures (medical evaluations and fit testing) should be trained on proper use and disposal of provided PPE. Eligible employees will be provided the information from Table 2 in WAC 296-842-11005 (see appendix for text). Initial training should be done prior to first use of PPE under the voluntary use program. Retraining will be provided at an interval of at least every two years. Training records will be kept by the City, identifying who presented the training, the training material, and who attended the training.

Wildfire Smoke Safety

The City has evaluated the risk to wildfire smoke exposure for our outdoor workers and has determined that an exposure to potentially hazardous levels of wildfire smoke exists. The evaluation included reviewing recent historic data on $PM_{2.5}$ pollution levels for the areas where our employees work outdoors. We have determined it is likely that our employees working outdoors may be exposed to hazardous levels of wildfire smoke pollution while fulfilling their job duties. Due to this exposure, the City is implementing a wildfire smoke safety program.

Affected Employees and Workgroups
The City has reviewed the job descriptions and work duties of all employees to determine which employees, work groups, and departments have potential exposure to wildfire smoke. The wildfire smoke program addresses outdoor exposures; therefore, employees who do not work outdoors will not be impacted by this program and are exempt from trainings and all other obligations presented here. Furthermore, the following workplaces and operations are exempt from this program:

- Employees working in enclosed buildings and structures where windows, doors, and bays remained shut except for entry/exit.
- Employees working in enclosed vehicles with air filters in the cabin and windows/doors closed.
- Employees exposed to a smokey environment above action level for less than one hour per shift.

Based on the City's review, and considering the exemptions noted above, the following workgroups will be covered by this wildfire smoke safety program.

- All Public Works Field Personnel
- Other personnel required to work for extended periods of time exposed to outdoor weather conditions.

$PM_{2.5}$ Pollution Level Monitoring
The City's safety controls are triggered when $PM_{2.5}$ pollution levels meet or exceed the action level as determined by state safety rules. Wildfire smoke pollution is a mixture of tiny solids or liquid droplets; these particles can include smoke, soot, and dust in the air. $PM_{2.5}$ pollution is particulate matter with particulate size less than 2.5 micrometers (μm).

In instances of elevated air pollution levels or potential wildfire smoke hazards, the City will monitor air quality for $PM_{2.5}$ ahead of every shift for affected employees. Air quality will be checked throughout shifts as well. The frequency of checks will depend on the stability of the weather; checks will be more frequent with quickly changing weather or smoke levels. Public Works Leads/Managers will be responsible for checking the air quality on this schedule. Any employee assigned to monitor air quality for this program will receive training before duties begin. When $PM_{2.5}$ levels reach the action level of an AQI 72 and above (20.5μg/m^3 to 35.4μg/m^3), the Public Works Leads/Managers will alert the Public Works Director, or their designee, who have affected employees to alert them of the need to initiate controls, including making provisions for prompt medical attention when necessary.

The City will use air quality reporting from the ***EPA AirNow*** **mobile app**.

Two-way Communication Plan
For the City to reliably implement controls in response to in-shift air quality changes, and for employees to be able to report changing weather in work locations, reliable two-way communication systems are necessary.

To ensure communication, all remote workers or work groups will be accessible for communication via assigned cellular devices.

Employee Training
On an annual basis, affected employees will receive training on wildfire smoke safety. If new employees begin work in-season, they will receive training before working outdoors on days where the $PM_{2.5}$ action level has been exceeded. Employee training will be the responsibility of the Human Resources Manager, or their designee. Those conducting trainings will take attendance and will maintain training records in the employee personnel files.

The following training elements will be provided to all affected employees:

- Potential health impacts of smoke exposure, and those who might be most sensitive to them.
- How air quality is monitored, and how you can watch it as well (websites, mobile apps).
- The controls will be implemented by the City when wildfire smoke becomes hazardous.
- How voluntary respiratory protection plans work, and where to access filtering facepiece respirators.
- Familiarize workers with the City's 2-way communication plan.
- Encourage employees to report any potential health symptom as they work in environments with hazardous wildfire smoke levels (above action level).

Supervisors must receive this training, as well as any additional training needed to know the following:

- Signs and symptoms of wildfire smoke exposure, and how to assist exposed workers and report exposures.
- Duties and obligations when enacting identified controls and voluntary respiratory protection.
- When and how to send workers to an emergency medical services facility provided, if necessary.

Training resources will be reviewed annually before employee and supervisor trainings to ensure that all identified controls and other information are up to date. The Human Resources Manager, or their designee will be responsible for this annual review. Additional brief trainings will be provided to affected employees if controls or other program elements change during a fire season.

Responding to Employee Exposure and Symptoms
The City's clear priority with this program is to keep workers with wildfire smoke pollution exposure safe. When employees who have been exposed to wildfire smoke exhibit signs or symptoms of excessive smoke exposure, supervisors and managers will act to ensure the worker receives appropriate medical care and the rest/break needed to recover from such exposure. The City will not retaliate against an employee for

reporting symptoms, seeking medical attention, following medical advice they have been given, or for filing a workers compensation claim due to wildfire smoke exposure.

Supervisors and affected employees will be trained on the signs and symptoms of wildfire smoke exposure. During times when the action level is exceeded, supervisors will be obligated to check in with workers at least every two hours to see if they are experiencing any health impacts from the smoke. If an employee does show health impacts, the supervisor and employees will discuss what the appropriate response will be. Supervisors will communicate with managers as needed when making such determinations. Some response options are as follows:

- Provide an additional or extended rest break for the employee indoors or in a controlled environment free of smoke.
- Offer a filtering facepiece respirator if not already wearing one.
- Seek medical attention for symptoms.

In cases where such response is required, the employee and supervisor will fill out an Employee Report of Accident form so the circumstances of the exposure and the program may be evaluation by department management, and the Safety Committee.

Exposure Controls

When the wildfire smoke pollution action level is met or exceeded (20.5µg/m^3 or 35.5µg/m^3), the City will initiate our identified exposure controls. When exposure controls are implemented, managers will determine what controls will be initiated. This information will be provided to leads/supervisors, who will inform their work groups via the established communication system noted in this program. Employees will be trained on any exposure control before it is implemented under this program, so they know how it works, and their associated duties, if any.

Engineering Controls:

Engineering controls are devices, equipment, or technology that provide physical barriers between a worker and a hazard. The following engineering controls have been identified for use when wildfire smoke pollution reaches or exceeds action levels:

- Providing enclosed buildings, structures, and vehicles for employees to work in.
- Installing or replacing HEPA grade filters in vehicles and buildings to increase filtration.
- Providing N95 or higher respirators to employees at any point in time.

Administrative Controls:

Administrative controls are rules or guidelines the entity can issue to direct how work is done, and how exposed employees are. The following administrative controls have been identified for use when wildfire smoke pollution reaches or exceeds action levels:

- Adjusting work schedules to cancel or delay strenuous outdoor work during high AQI levels,

Respiratory Protection
When $PM_{2.5}$ concentrations exceed 20.5µg/m^3 or 35.5µg/m^3 (AQI of 72 or 101), the entity will make filtering facepiece respirators (FFR) available to affected employees on a voluntary basis for use at their discretion. Proper use, fit, and disposal of respirators will be covered in employee training under this program.

Employees will not be permitted to use other face coverings such as surgical masks, gaiters, and bandanas. These face coverings are not acceptable substitutes for respirators in smokey situations because we do not know the expected protection that such devices can deliver, and we cannot assume they are providing proper respiratory protection to the wearer.

Employees will be able to access an N95 FFR at the Public Works Shop or Wastewater Treatment Plant Office Building.

When $PM_{2.5}$ concentrations exceed 250.5µg/m^3 (AQI of 351), the City will ***directly distribute*** filtering facepiece respirators (FFR) available to affected employees for voluntary use at their discretion. Proper use, fit, and disposal of respirators will be covered in employee training under this program.

In instances when $PM_{2.5}$ concentrations exceed 500.4µg/m^3 (AQI 849), the entity will implement a complete requirement of the respiratory protection program, including fit-testing, medical evaluations, requiring employees to be clean-shaven and requiring the use to particulate respirators.

When the PM2.5 concentrations reach a level of 555 or higher (AQI 957 or more), the City will require respirators with an assigned protection factor (APF) of 25 or more.

Voluntary Use of Respirators
Voluntary respiratory protection program rules established in WAC 296-842 will be followed here for those employees not already covered due to other exposures at work. For voluntary protection programs, the City will make N95 respirators available to employees when the action level air quality is reached. Employees will not be mandated to wear the masks until the smoke reaches or exceeds 500.4 µg/m^3 (AQI 849+); the City's duty is to provide the masks and train employees on how to properly use them. The City will not allow employees to use higher-level respirators as such use triggers medical evaluation and fit-testing requirements not in the voluntary program. When respirator use is required, our employees cannot have facial hair that interferes with the seal of the respirator.

Respirator Fit Testing
Respirators come in different sizes, makes, and models. Most respirators, including an N95 respirator, must form a tight seal to the face to work properly. A successful respirator fit test makes sure a specific size and type of respirator fits an employee's face and provides a specific level of protection. Unfitted respirators may not properly

seal, which can allow air contaminants like wildfire smoke particles to enter the respirator.

Regulations require a respirator fit test with required use. They do not require a fit test when respirators are worn voluntarily. Respirators will be provided for *voluntary* employee use when the current PM2.5 is 35.5 to 500.3 µg/m^3 (AQI 849 to 957). Required use of respirators by employers requires a fit test (no matter the smoke level).

Take steps to improve the respirator seal and reduce exposure to wildfire smoke, by:

- Using the appropriate procedures for putting on a respirator,
- Doing a seal check, and
- Maintaining the respirator per the manufacture's instruction manual.

Respirator Medical Evaluations

Respirators provide protection from wildfire smoke. However, they also increase breathing resistance and cause the wearer to work harder to breathe. Some people cannot use a respirator due to certain medical conditions. A respirator medical evaluation conducted by a medical provider determines an employee's ability to wear a particular respirator. Respirator medical evaluations are done to prevent injuries and illnesses that can come from wearing a respirator. Respirator medical evaluations are not required to be provided by the City when respirators are voluntarily worn. When respirators are required to be worn in the workplace then respirator medical evaluations must be provided to employees when the current PM2.5 is 500.4 µg/m^3 (AQI 849).

Directions for putting on a filtering facepiece respirator (including an N95)

1. With clean, dry hands, inspect the respirator and straps for any damage or defect.
2. Hold the respirator with the straps facing you, and the metal or foam nose bridge facing up.
3. Place the mask with the top over your nose and the bottom under your chin. Hold the mask in place with one hand.
4. While holding the mask to your face with one hand, grab the top strap with the other hand.
5. Pull the top strap over your head and place it so the strap goes above your ears.
6. While continuing to hold the mask to your face, pull the bottom strap over your head and place it so the strap goes below your ears.
7. Bend the nosepiece of the respirator over the top of the nose, so it fits securely.
8. Perform a seal check:
    - Ensure the respirator is sitting snuggly on your face, with the top strap above your ears, the bottom strap below.
    - Cover the respirator with both hands and exhale. If you feel air leaking where the respirator seals against your face, adjust the respirator and nosepiece, and try again. The respirator should bulge from the face and not leak around the seal.
    - Next, cover the respirator with both hands and inhale. If you feel air leaking where the respirator seals against the face, adjust the respirator and

nosepiece, and try again. The respirator should collapse slightly and not leak around the seal.

Fall Protection Program

When City of Stanwood employees are exposed to a hazard of falling while working and performing duties on elevated surfaces and ladders from a location 10 feet or more in height, the City shall ensure that fall restraint systems, fall arrest systems, or positioning device systems are provided. Employees will not perform any duties which require the employee to get within 6 feet of an unprotected edge, platform, walkway, or utilize elevated equipment unless the employee is properly secured from falling.

Additionally, this program shall apply to all employees in order to minimize slips, trips and falls on the same elevation. All employees shall control fall hazards in their work area by maintaining good housekeeping and shall report conditions that may lead to slips, trips and falls to the appropriate maintenance unit.

Subcontractors/Contractors working on City projects are required to comply with all applicable WISHA workplace safety regulations and shall provide their own fall protection program and plan.

Responsibilities
Department managers and supervisors are responsible for:

- ensuring that all requirements listed in the written program for fall protection are met
- ensuring new and existing employees receive fall protection training as applicable to their job duties
- for identifying elevated work areas

City of Stanwood supervisors are responsible for:

- conducting periodic visits to elevated work locations to inspect equipment and to observe employees' procedures while working at elevated levels
- arranging for required training of employees in fall protection and in the safe use of elevating personal platforms
- evaluating other elevated work locations identified by managers and supervisors for fall protection requirements
- general oversight of the program

Employees whose duties involve work activities at elevated locations are required to comply with the rules established in this program and accepted safety practices outlined herein.

Fall Protection Coverage
The following work situations are covered by the City’s fall protection program:

- **Ladders** – fixed, free standing, temporary, or roll away type
- **Elevating personal platforms** – aerial platforms, scissors lifts, forklift-mounted platforms, cherry pickers, etc.

- Elevated surfaces – roofs (closer than 6 feet to the edge), catwalks, skylights, boilers, chillers, etc.
- **Vertical opening** – ground level entry into excavations, trenches, holes, pits, vessels, and other confined spaces.

Fall protection is required whenever work is performed in an area 10 feet or above its surroundings and can generally be provided through the use of fall protection systems including:

- **Guardrails** – Standard guardrails consist of a top rail, located 42 inches above the floor, and a mid-rail. Screens and mesh may be used to replace the mid-rail, so long as they extend from the top rail to the floor.
- **Personal fall arresting systems** – Components of a personal fall arresting system include a body harness, lanyard, lifeline, connector, and an anchorage point capable of supporting at least 5000 pounds.
- **Positioning device systems** – Positioning device systems consist of a body belt or harness rigged to allow work on a vertical surface, such as a wall, with both hands free.
- **Warning line systems** – Warning line systems are made up of lines or ropes installed around a work area on a roof. These act as a barrier to prevent those working on the roof from approaching it edges.
- **Covers** – Covers are fastened over holes in the working surface to prevent falls. Where it can be clearly demonstrated that the use of these systems is infeasible or creates a greater hazard, alternative fall protection measures may be implemented.

Guidelines for Employees using Specific Equipment

This section should be used extensively when determining the scope of training for exposed employees. Training should provide employees who work at heights with information regarding the protection systems available to them and preferred for any job they are assigned.

Ladders

Employees who work on ladders with a working height of 10 feet or more shall be knowledgeable of the following:

- How to inspect ladders for visible defects
- How to use ladders properly

Fall Arrest Systems

Employees who use personal fall arresting systems to control fall hazards in their work area shall be knowledgeable of the following:

- The application limits of the equipment.
- The proper hook-up, anchoring and tie-off techniques including determination of elongation and deceleration distance.
- Methods of use, inspection, and storage of equipment.

Personal fall arrest components including harnesses and lanyards shall be inspected prior to each use for mildew, wear, damage and other deterioration. Defective components shall be removed from service.

Fall arrest systems including harnesses shall be inspected at least twice each year or according to manufacturer's recommendations. The date of the most current semi-annual inspection shall be recorded on an inspection tag which shall be attached to the harness. In addition, records shall be kept and maintained showing date of purchase, dates when attachments were renewed, and dates when the entire harness assembly was inspected and by whom. Public Works Supervisors are to ensure inspections occur and are documented as required.

Arial lifts

Employees who use aerial lifts shall be knowledgeable of the following:

- The manufacturer's operating instructions.
- Pre-start inspection of the lift Inspection of the work area for dangerous conditions such as uneven surfaces, overhead obstructions such as power lines, or other hazards.
- Load capacities of the equipment.
- How to safely move the equipment.
- How to prevent falls and use appropriate fall protection personal protective equipment.
- Minimum safe approach distances to energized power lines.

Walking and working surfaces

All employees should be aware of the following guidelines to minimize slips, trips and falls on the same elevation of walking/working surfaces:

- To prevent slipping, tripping and falling, all work environments including passageways, storerooms, and service areas must be kept clean, orderly and in a sanitary condition.
- The floor of every work area will be maintained in a clean and, so far as possible, dry condition.
- Where wet processes are used, drainage will be maintained and false floors, platforms, mats, or other dry standing places are provided.

Reporting requirements

Constant awareness of and respect for fall protection procedures and compliance with all applicable safety rules is mandatory.

Supervisors may issue warnings and implement disciplinary actions, up to and including termination for failure to follow the guidelines of this program.

Employees shall report any safety concerns to their supervisor or manager immediately.

Training
Under no circumstances will any employee work in areas of high fall hazards, perform work requiring fall protection devices, or use fall protection devices until they have attended training in fall protection. This includes all new employees regardless of previous experience.

The training program provided by the City includes classroom instruction and operational training on specific fall hazards on-site.

Employees will require retraining under any of the following conditions:
- Changes in the workplace.
- Changes in the types of fall protection systems or equipment to be used.
- Inadequacies in an employee's knowledge of use of fall protection systems or equipment or observed behavior indicate that the employee has not retained the required training.

Fall Protection Work Plan
Whenever City employees must work at heights 10 feet or higher, they are required to work under a Fall Protection Work Plan. This document identifies all hazards associated with the particular work being done at height and prescribes the appropriate controls to protect the employee.

Supervisors are required to ensure that all work done by their employees is done under a fall protection work plan. It is the department manager's responsibility to review work plans and determine if they are being completed and followed appropriately.

All fall protection work plans will be kept in accordance with records retentions rules and then disposed of appropriately.

Bloodborne Pathogens Exposure Control Program

The City is committed to providing a safe and healthful work environment for our entire staff. This is our plan to eliminate or minimize occupational exposure to blood-borne pathogens.

Employees who have occupational exposure to blood or other potentially infectious material (OPIM) must follow the procedures and work practices in this plan.

Employees can review this plan at any time during their work shifts. The City will provide a copy to an employee within 15 days of a request.

Program Management
The City will oversee the exposure control plan generally, specifically focused on medical records and vaccination verifications, exposure reports, trainings records. The City expects individual department supervisors to ensure compliance of employees with the standards in this program.

The exposure control officer for the blood-borne pathogen exposure control plan is the Human Resources Manager. The HR Manager will work will all department managers with bloodborne pathogen exposures to ensure workers receive necessary training, vaccination opportunities, medical treatment, and safety equipment necessary to do their jobs while being protected from BBPs.

Exposure Determinations
The City is required to make coverage determinations regarding who will be included in the exposure control plan. This determination will be made by reviewing job duties for all potentially exposed employees and determining whose job duties place them in reasonable anticipation of exposure to BBPs.

Public Works
In the public works department, the following job classifications or positions are deemed to have reasonably anticipated exposure to BBPs and will be covered under this program:

Parks and Wastewater Public Works Technician
Wastewater Treatment Plant Operator

Hepatitis B Vaccination
HBV vaccinations shall be offered to all employees identified as high risk free of charge by the City. The City will allow the use of City time and pay all fees associated with that service. The vaccination will be provided after the employee has received the training outlined in these policies, but within 10 (ten) days of assignment to duties. This policy shall exempt employees who have previously received the complete vaccination series, whose antibody testing indicates they are immune, or those employees for whom the vaccine is contraindicated. Employee vaccinations shall be documented and maintained in the employee's medical record files in the Human Resources Department and shall be for the duration of employment plus thirty (30) years in accordance with records retention rules.

Routine booster dose(s) of the HBV vaccine shall be provided in accordance with US Public Health Service recommendations at no cost to the employees.

If an employee refuses to obtain the required HBV vaccination, the employee will be required to document that refusal on the HBV Declination Form (See Appendix) which will be maintained in the employee's medical record for the duration of employment plus thirty (30) years. If, however, an employee subsequently decides to have an HBV vaccination, it will be made available under the same terms and conditions as stated above, upon employer's receipt of a written request to the Human Resources Manager.

Medical Evaluations and Follow-up after Exposure Incidents
All employees are required to report all exposure incidents to their immediate supervisor. All exposure incidents shall be recorded on the OSHA300 form and

investigated. All needlestick injuries will be recorded on the Sharps Injury Log to protect personally identifiable information. All exposures must document the route(s) of exposure and the circumstances under which the exposure occurred.

Exposure incidents include percutaneous needle sticks or cuts, mucous membrane exposure to blood or body fluids meeting OPIM criteria, or contact with blood or body fluids via chapped, abraded, or otherwise non-intact skin surfaces.

If an exposure incident occurs, take the following steps:

- The source individual shall be notified of the exposure incident and be requested to consent to and obtain testing for HIV/HBV. A refusal of the source individual to consent for testing shall be documented
- The results of the source individual's test shall be made known to the exposed employee
- The exposed employee shall also be reminded of the laws and regulations concerning the disclosure of the identity and infectious status of the source individual
- If the source individual refuses to consent to HIV/HBV testing, or if the source individual tests positive, the exposed employee shall have a clinical evaluation which will include HIV and HBV antibody testing as soon as possible
- If the exposed employee refuses to submit to clinical evaluation and HIV and HBV testing, such refusal will be documented and maintained in the employee's medical record
- If the employee consents to baseline blood collection, but does not consent to testing, the employee's blood sample shall be preserved for ninety (90) days. If within ninety (90) days of exposure, the employee elects to have the baseline sample tested such testing will be conducted as soon as possible
- Exposed employees shall have access to post-exposure prophylaxis as recommended by the US Public Health Service when medically indicated, as well as counseling
- Exposed employees shall also be advised to report and seek medical evaluation of any acute febrile illness within twelve (12) weeks following exposure
- All tests shall be conducted by an accredited laboratory at no cost to the employee

The following information will be provided to the physician performing the post-exposure evaluation:

- A copy of the blood borne pathogens rule section addressing post-exposure requirements (WAC 296-823-160)
- A description of the employee's duties
- Documentation of the route(s) of exposure and circumstances under which the exposure occurred
- Results of the source individual's blood testing, if available
- All relevant medical records of the employee, including vaccination status

The Human Resources Department will obtain a written report and opinion from the physician performing the post-exposure evaluation within15 days of the evaluation’s completion. The report shall be limited to:

- That the employee has been informed of the results of the evaluation
- That the employee has been told about any medical conditions resulting from exposure to blood or other infectious materials which warrant further evaluation or treatment

The City will ensure that all other findings or diagnoses remain confidential and are NOT included in the written report.

If the health care professional provides the written opinion directly to the employee, the City does not need to do so. If the employee's personal health care professional completes the evaluation, the City is not required to obtain the health care professional's written opinion.

Sharps Containment and Disposals
Handling of sharps, specifically used syringes, pose the greatest threat of BBP exposure for City staff. This being the case, the City has implemented handling and disposal procedures with the intention of minimizing the potential for exposure coming from these interactions.

Subsequent to recovery or use, potentially contaminated sharp instruments and/or disposable sharps shall be disposed of in the following manner:
- All such sharp items shall be placed in a leak proof, rigid, puncture-resistant, break-resistant container which is conspicuously labeled and which is located in all public works maintenance vehicles and first aid stations.
- The person recovering/receiving a sharps instrument or item shall be responsible for its proper disposal as soon as feasible. In no instance will any employee leave any such sharp instrument at any work station, or in any vehicle beyond the end of the employee's shift without notifying their supervisor.
- Needles shall not be recapped, purposely bent or broken, or removed from disposable syringes.
- Scalpel blades shall be removed from the handle using clamped forceps and placed in the appropriate sharps container by the person using that item.
- Knives and other sharps necessary for evidence will, at all times, remain in an approved, properly labeled sharps container.
- Appropriate protective gloves will be worn at all times when handling any sharps or knives possibly contaminated by blood or OPIM.
- At no time will any employee reach into a sharps container to retrieve any item. All such removal will be accomplished with tongs, pliers, or other mechanical tool. Such actions require prior approval by management before attempted retrieval.

Contaminated sharps shall be discarded immediately after they are located or used, or as soon as feasible, in appropriate containers. This presumes that there is no compelling need to retain the item for evidentiary purposes.

Sharps containers should be emptied or replaced whenever two-thirds full, except evidence containers.

When moving containers containing contaminated sharps, care should be taken to assure the container is closed to prevent spillage or protrusion of contents.

In the event of leakage or protrusion, the container is to be placed in a secondary container which must also be closable, puncture resistant, and leak-proof.

Handling Contaminated Clothing and Laundry
Employees whose clothing or equipment becomes contaminated during the course of duties should remove the clothing or equipment at the earliest possible convenience.

Contaminated linen shall be handled as little as possible with a minimum of agitation. When handling contaminated laundry, PPE shall be used. Contaminated linen shall be bagged at the location where it is recovered/received and shall not be sorted or rinsed on location.

Contaminated linen shall be placed in a red, leak proof bag which shall be marked "Bio-Hazard" to indicate the potential infectious status of its contents. Should outside contamination of the bag occur, double bagging shall be required.
All bagged items will be secured in a location where accidental exposure is unlikely. Each department shall designate an area where bagged laundry can be secured while waiting pickup for specialized cleaning.

Public Works: Bags/receptacles located in the WWTP Operations Building, 26729 98th Avenue NW

Durable Equipment
Some equipment that will come into contact with blood and OPIM will be durable and should not be disposed, but rather cleaned.

For all departments, when personal durable equipment is found to be exposed to blood or OPIM, it is the responsibility of the owner to appropriately clean the equipment and ensure it is safe for continued use.

If there is not time or resources to appropriately clean equipment ahead of next anticipated use, the equipment should be removed from service until it can be cleaned and verified to be safe

Cleaning Instructions
Use a 10% diluted bleach spray or other as-effective cleaning agent to disinfect the durable equipment. Let the spray stand for at least 5 minutes before cleaning the equipment. If any rags used in cleaning have blood or OPIM on them at the conclusion of cleaning, they must be disposed of properly.

Cleaning supplies for the sterilization of equipment can be found in the following locations across departments:

- WWTP Operations Building, 26729 98th Avenue NW

Personal Protective Equipment
The City will provide and maintain, in a sanitary and reliable condition, necessary personal protective equipment (PPE) which is relevant to the procedures and job functions of the various employees. Employees are required to use appropriate PPE for the task they are performing, except in those extraordinary circumstances when such use would, in the employee's professional judgment, prevent the service from being provided. In such cases the incident shall be investigated and documented in order to determine if changes can be instituted to prevent such occurrences.

The use of gloves is indicated and must be worn:
- For all emergency response care which involves potential exposure to blood or body fluids, particularly if the employee has cuts, abraded skin, chapped hands, dermatitis, or other non-intact skin.
- During all decontamination procedures involving clean-up of blood or body fluids.
- When scrubbing equipment contaminated with blood or body fluids prior to sterilization.
- Gloves shall be of appropriate quality and material and shall comply with the standards of safety for the procedure performed. A sufficient quantity and appropriate size for each employee will be supplied by the City.
- Hypo-allergenic gloves, glove liners, powder less gloves or similar alternatives will be made available to those employees who are allergic to the gloves normally provided.
- Gloves shall be single-use and shall be disposed of immediately following each contaminant contact or procedure.

Masks and Eye Protectors are to be available and are required to be used:
- When contamination of mucosal membranes (eye, nose, or mouth) with body fluids is likely to occur.
- Resuscitation equipment is provided to minimize the need for mouth-to-mouth resuscitation and shall be easily accessible in the event resuscitation is necessary. Mouth suctioning of blood or other potentially infectious material is prohibited.

New or cleaned personal protective equipment will be installed to replace contaminated or used equipment. This will be the responsibility of the employee who used the equipment. Failure to replace/restock used materials will expose the employee(s) to disciplinary action.

Housekeeping and Clean-Up
All equipment and work surfaces shall be cleaned as soon as practical after any contamination by blood or other potentially infectious material. In no circumstances will this be left for other employees to do. It is the responsibility of the employee who contaminated the area.

Protective coverings used to cover equipment are to be removed, cleaned or replaced as soon as feasible after being contaminated.

All bins, cans, or other receptacles which will be reused and which may be contaminated are to be emptied, cleaned and decontaminated at the end of each work shift.
Broken glass which may be contaminated is not to be picked up by hand but cleaned up or picked up by using a broom and dust pan, tongs, or forceps.

Reusable sharps are, after use, to be placed in the appropriate labeled container. Employees shall not reach into such containers with their hands, but must place and retrieve used, and presumably contaminated, sharps with tongs or forceps.

Regulated Waste Handling and Disposal
Regulated waste related to BBP exposures may include:

- Liquid or semi-liquid blood or other infectious materials.
- Contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed.
- Items caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling.
- Contaminated sharps.
- Pathological and microbiological wastes containing blood or other potentially infectious materials.

Such regulated waste must be placed in the appropriate, labeled containers. Containers must meet the following specifications:

- Closable
- Able to prevent leakage during handling, storage, or transport
- Appropriately labeled

Containers must be closed prior to removal to prevent leaks. If outside contamination of a container occurs, the container is to be placed in a secondary container which is also closable, able to prevent leakage, and appropriately labeled.

Disposal of Regulated Waste
At the end of each day, remove waste from vehicles and other work areas and placed in an appropriate waste receptacle lined with a red, leak-proof plastic bag, and stored in the appropriate location for pick-up and disposal by an outside contractor. Such independent contractors will be responsible for the training of their employees regarding the identification, segregation, and disposal of infectious waste.

It is management’s duty to contract regulated waste disposal and pickups, and ensure they are occurring as expected.

Procedures in the Event of Personal Exposure
All employees are required to use the following procedures in the event of exposure to possibly infectious blood or body fluids:

Needle Stick/Cut: Milk the exposure to express blood and clean the wound vigorously with soap and water for at least 10-15 seconds using friction.

Mucosal Splash: For a mucosal splash to eyes, nose, or mouth, flush or rinse with saline or water. For a mucosal splash to the skin or contamination of open wound, wash with soap and water. Shower and change clothes if necessary.

Blood Splash/Contact: For blood splash to mucosal tissues follow mucosal splash guideline above. For blood splash or contact to chapped, abraded, cut or broken skin, wash with soap and water and again remove contaminated clothing as soon as possible.

For any other contact with blood or body fluids to skin surfaces, wash with soap and water immediately or antiseptic wipes when wash facilities are not available. Remove contaminated clothing, shower and if continued contamination is anticipated, put on appropriate personal protective equipment.

Reporting: Report all needle sticks, mucosal splashes, and contamination of open wounds with blood and/or body fluids to your immediate senior supervisor.

Employee Training
All employees whose job functions involve the risk of exposure to blood or body fluids shall receive appropriate education and training prior to the commencement of their duties and annually thereafter. Such education and training shall, at a minimum, include:

- A copy of the regulation and an explanation of its contents.
- A general explanation of the epidemiology and symptoms of blood-borne diseases.
- An explanation of the modes of transmission of blood borne pathogens.
- An explanation of each department's exposure control plan and means by which the employee can obtain a copy of the written plan.
- An explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood or other potentially infectious materials.
- An explanation of the use and limitations of methods that will prevent or reduce exposure, including work practices and personal protective equipment.
- Information on the types, proper use, location, removal, handling, decontamination and disposal of personal protective equipment.
- An explanation of the basis for selecting personal protective equipment.
- Information on the Hepatitis B vaccine including information on its efficacy, safety, method of administration, benefits of being vaccinated, and that the vaccine will be offered free of charge.
- Information on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials.
- An explanation of the procedures to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available.

- Information on the post-exposure evaluation and follow-up that the employer is required to provide.
- An explanation of the signs and labels and/or color-coding used by the employer.
- An opportunity for interactive questions and answers with the persons conducting the training sessions.

Additional training will be provided when new tasks or procedures involving potential exposure are instituted.

Medical Records
A medical record for each employee whose duties include potential occupational exposure will be maintained by the City. These records will include:

- The name and social security number of the employee.
- A copy of the employee's HBV vaccination status including the dates of vaccination and any medical records regarding the employee's ability to receive the vaccination.
- A copy of all opinions, examinations, testing, and follow-up involving post-exposure incidents.
- A copy of any information provided to any other healthcare professional regarding possible exposure.

Such records will be kept confidential and will not be disclosed to any person, except as required by law, without the express written consent of the employee. Such records will be maintained for thirty (30) years beyond the duration of the employment.

Ergonomics Program

What is Ergonomics?
Ergonomics is the scientific study of human work. It considers the physical, behavioral and mental capabilities and the limitations of the worker as they interact with tools, equipment, work methods, tasks, and work environment.

Purpose
- Reduce the physical stress associated with a given job.
- Increase the comfort, health, and safety of the work environment.
- Increase productivity.
- Reduce human errors associated with a task.
- Improve quality of work life.

Goal
- Ergonomics is a way to work smarter—not harder
- Fits the job to the worker – Not the worker to the job!

Musculoskeletal Disorders caused by Cumulative Trauma
- Carpal Tunnel Syndrome

- Tendonitis-forearm to hand
- Epicondylitis-elbow
- Rotator Cuff Syndrome-shoulder

In order to prevent Cumulative Trauma Disorders (CTDs) to the musculoskeletal system, we must first understand their causal factors. Identifying the causes of CTDs is challenging because no one single causative factor will lead to a CTD by itself. It is the interaction of several risk factors over time that may lead to a CTD. These risk factors include:

1. **Awkward Posture**: postures that are not our normal standing and sitting posture. Examples include: bending, twisting, turning, long-arm reaching, cradling the neck with the telephone.

2. **Force**: gripping, grasping, and pinching activities such as picking up large file folders or stapling.

3. **High Repetition**: movements over and over again with hand, arm, or shoulder. Frequency and duration are risk factors.

4. **Contact/Mechanical Stress**: direct pressure on nerves – soft tissues of our body coming in contact with something that is hard, sharp or rough. Example, no padding with the keyboard and mouse.

5. **Static Load**: keeping muscles in one place for long periods of time. Examples: sitting or using the mouse for long periods of time without moving.

6. **Vibration**: using tools such as jackhammers.

7. **Temperature Extremes**: heat and cold

Symptoms to look for and report to your supervisor:

- Pain, numbness and tingling in the thumb and first 3 fingers or last 2 fingers.
- Shaking your hand to get the feeling back
- Weakness in the hand
- Pain and discomfort in wrist
- Pain going up to elbow or shoulder
- Clumsy feeling in affected hand

Workstation Design

Use the following guidelines to assist in setting up your workstation to reduce CTD risk factors:

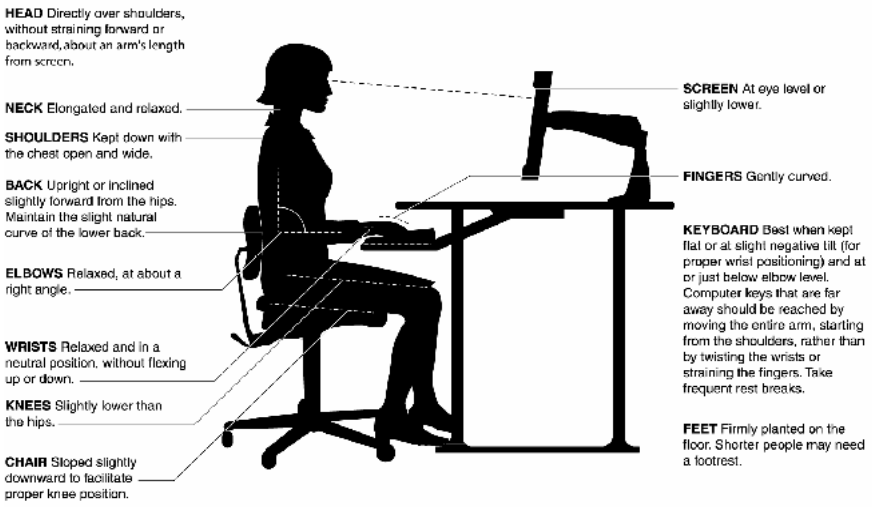
Keyboard

- Shoulders should be relaxed with arms hanging comfortably by sides.
- Bend at the elbows so that the arm is in a 90-degree angle and elbows are at waist.

- Forearms come straight out with palms hovering over thighs. Wrists are flat. Position keyboard and or tray under palms.
- Use padded articulating tray large enough to accommodate both keyboard and mouse.

Figure 1

Optimum Neutral Posture for Seated Computer Operators



Mouse

- Should be located next to and at the same level as the keyboard.
- Use padded foam wrist supports for mouse and keyboard to elevate wrists to neutral and eliminate contact with hard surfaces.

Chair

- Sit all the way back in the chair to allow weight distribution on buttocks, not thighs.
- Hips and knees should be level and positioned in a 90-degree angle.
- Feet flat on the floor or footrest.
- Backrest is upright with lumbar support at small of back, head aligned over shoulders.

Monitor

- Monitor should sit “straight on” to employee – not at an angle.
- Top of monitor screen should be at eye level or just below (except if wearing bifocals, the monitor can be lower).
- Optimum viewing distance is 20 to 30 inches.
- Minimize glare by placing screen at right angles to light source, use anti-glare screen, or adjusting the screen angle.

Telephone

- Use a headset if telephone usage is two or more hours per day.

- Telephone 'neck holder' devices that encourage awkward neck and shoulder posture while on the phone should be removed and eliminated.
- Place telephone within easy reach to eliminate long arm reaching.

Document Holders
- Recommended for copy intensive work.
- The holder should be placed at the same level as the monitor screen.

Shelves
- Frequently used items located in shelving above shoulder height should be moved down below shoulder height.
- Use a “two-handed” lift when lifting large 3-ring binders.

Stretch Breaks and Micro-Pauses
- Incorporate preventative stretch and exercise breaks from constant keying every hour.
- Change from static positions every 30 minutes to help reduce neck and lower back strain.

Outdoor Heat Exposure – Heat Stress

The City of Stanwood has evaluated the risk to outdoor ambient heat exposure and has determined that exposure to potentially hazardous heat exists. The evaluation included reviewing recent historic data on temperatures rising and increasing medical issues due to heat stress and illnesses. We have found that it is likely that our employees working outdoors may be exposed to heat stress and heat-related illnesses if proper precautions are not taken. Due to this exposure, the City of Stanwood is implementing an outdoor ambient heat exposure program.

Affected Employees and Workgroups
The City has reviewed the job descriptions and work duties of all employees to determine which employees, work groups, and departments have potential exposure to outdoor ambient heat. The outdoor ambient heat program addresses outdoor exposures; therefore, employees who do not work outdoors will not be affected by this program and are exempt from mandatory training and all other obligations presented here. Furthermore, the following workplaces and operations are exempt from this program:

- Employees working in enclosed buildings and structures where windows, doors, and bays stay shut except for entry/exit.
- Employees working in enclosed vehicles with air conditioning.

Based on the City’s review, and considering the established exemptions, the following work groups will be covered by this outdoor ambient heat exposure program:

- All Public Works Field Personnel

- Other personnel required to work for extended periods of time in outdoor weather conditions.

Outdoor Working Conditions
Any employee identified above may be subject to working conditions outdoors for more than 15 minutes in any 60-minute period. The outdoor heat exposure will be in effect when:

- Employees are wearing non-breathable clothing, or clothing that provides a vapor barrier (such as rain gear or chemical resistant suits) in a temperature range as low as 52° Fahrenheit and above.
- Employees wearing any type of clothing when temperatures reach 80° Fahrenheit and above.

Shade or Alternatives
The purpose of shade is to cool down the employee's body and prevent or recover from heat-related illnesses. The City will provide enough shade to fully cover everyone taking a break at the same time when room to sit comfortably in a normal position. The City will also encourage and allow preventative cool-down rest periods unless the employee is on a meal break.

For the work sites, we will ensure that you have access to shade or alternative cooling during all affected work shifts. For example,

- When possible, we will provide air-conditioned vehicles.
- When vehicles equipped with air conditioning is not available, we will provide portable canopies.

The following requirements for shade will be provided by the City:

- Assess the need for shade at the jobsite based on the number of workers, the available means for shade or other cooling methods, the proximity of work areas, and other factors that affect the provision of shade or alternatives.
- Ensure shade or other alternatives are set up properly.
- Encourage employees to use shade to prevent heat-related illness or to recover if the employee begins to feel sick.

This will be provided onsite by the Public Works Lead(s)/Supervisors.

Hydration
Employees are encouraged to drink water before the workday starts so that they do not get dehydrated.

The City will ensure that employees have access to water in portable bottles and coolers.

The Public Works Lead(s)/Supervisors are responsible to ensure there is enough suitably cool water to allow each employee to drink at least a quart per hour.

Acclimatization to Heat
The City recognizes that it can take 7-14 days to fully adjust to hot working conditions. This can also be lost if an employee is away from hot conditions for a week or more.

Employees that are newly assigned to work in the heat should adjust/acclimatize as follows:

- Day One: Build a tolerance to heat by working at 20% the normal time
- Day Two: Work at 30% of the normal time
- Day Three: Work at 40% of the time

In addition, the Public Works Lead/Supervisor, will ensure that acclimatizing employees are closely observed for signs and symptoms of heat illness over a 14-day period. This will happen by:

- Ensure that workers use a two-way communication system or cell phones to check on each other regularly (every hour) on the jobsite.

In addition to newly assigned workers, employees who have been away from the heat for a week or more, or employees working during a heat wave should also follow the acclimatization practices above.

Cool Down Rest Periods
When temperatures reach 80° Fahrenheit or above, every worker is required to take at least a 10-minute cool down rest period every 2 hours. This will be maintained by the Public Works Lead/Supervisor who is also responsible for ensuring that everyone is being observed for signs and symptoms of heat related illnesses. When the Lead is offsite, workers shall take their required rest periods and will regularly observe each other for signs and symptoms of heat related illnesses under the “buddy system”.

All cool down rest periods are paid time unless it is taken during a meal break.

Any employee who starts to experience heat-related illnesses will be relieved of their duty, allowed to safely cool down, and will be closely monitored to verify they are okay or need to seek medical attention.

Training
Each year, the City will provide our affected employees with safety training on the dangers of outdoor heat exposure as well as the actions that must be taken to prevent heat-related illnesses. Additional training will be scheduled for new hires and any employee who needs a refresher.

The following training elements will be provided to all affected employees:

- Recognize the common signs and symptoms of heat-related illnesses for themselves and their co-workers.
- Understand that environmental factors increase the risk for heat-related illnesses such as higher temperatures, humidity, working under direct sunlight, lack of

wind, level of physical activity, and wearing of Personal Protective Equipment (PPE).

- Acknowledge that removing heat-retaining PPE such as non-breathable chemical resistant clothing during all breaks is necessary to allow employees bodies to cool down.
- Comprehend that staying hydrated by drinking small quantities of water or other acceptable beverages throughout the day is a top priority to prevent heat illnesses.
- Know that an acclimatization period of 14 days for workers newly assigned to work in the heat is mandatory for their safety and that they need to re-acclimatize when they spend a week or more away from heat.
- Understand that cool down rest periods are taken to prevent/recover from heat illnesses, and that they are mandatory when temperatures reach 80° Fahrenheit or higher. Paid breaks are to be taken unless it is during a meal period. Employees must be closely monitored for signs and symptoms of heat illness, and how the City will ensure observation and communication for crews and individual workers.
- Know that heat illness can progress quickly and how to report signs/symptoms of heat-related illness they experience or observe in coworkers, and how to **immediately** respond to prevent the situation from becoming a medical emergency. Employees also need to know how to identify and what to do during a heat-related medical emergency (e.g., potential heat stroke).

Supervisors need to know the following (in addition to what is detailed for employees above):

- The procedures to follow to implement the heat-related illness prevention plan including the acclimatization schedule, how to keep track of environmental conditions throughout the day, when to increase the number of breaks or stop work early, to check that workers are accessing shade and water (especially for mobile operations), encourage them to stay hydrated, and communicate with lone workers to ensure they are safe.
- The type of shade or cooling method that will be provided for all employees and where it's located. For example: when to provide alternative cooling methods like cooling vests and gel-filled bandanas or effective means.
- Close observation procedures at or above 80° F.
- What the supervisor needs to do if an employee shows signs and symptoms of possible heat-related illness including appropriate emergency response procedures including how to transport any affected employees to a medical service provider.

Responding to Heat-Related Illness

Let a supervisor or someone nearby know if you or a co-worker are experiencing any signs or symptoms of heat-related illness and take immediate action to ensure circumstances don't get dangerously worse.

- Time is critical. Quick action increases the chances of a full recovery. Get the employee away from the hot area and into the cool shaded area provided.

- Let the employee rest and drink cool water
- Never leave an employee who is experiencing heat-related problems alone, things could get worse. (For lone workers, keep your supervisor on the line to monitor your recovery and the need to contact emergency services.
- If the employee does not respond quickly, call emergency medical services.
- If the employee is in a remote or non-developed area with unidentified roads, have another employee arrange to meet emergency services at the closest point to guide them to the victim's location, or transport the victim to a place where they can be reached by emergency medical services.

If the employee receives medical attention, obtain a written authorization from the provider so that the worker can get back to work and to note whether there are any restrictions or limitations.

Material Handling and Lifting

Material handling is defined as using any part of the body to lift, move, push, pull, retrieve, carry, or climb with any materials such as people, inventory, merchandise, tools, raw materials, or supplies found in the work environment. Overexertion can cause sprains/strains injuries to our musculoskeletal system causing pain and discomfort.

Other factors to consider that can contribute in causing these injuries are:

- Poor physical fitness
- Lack of flexibility
- Participation in certain recreational activities
- Emotional stress
- Lack of rest
- Poor back support when sleeping
- Poor posture when sitting and standing for long periods

The City of Stanwood will focus on factors that can be controlled in the workplace and implement engineering, administrative or training controls to eliminate or reduce hazards on the job that can contribute to musculoskeletal injuries.

Priorities for Risk Control

1. Eliminate need for manual materials handling by using mechanical aids such as:
    - Lift tables
    - Lift trucks
    - Hoists and cranes
    - Drum and barrel dumpers
    - Conveyors

2. Change work area layout by:
    - Changing height of work level
    - Changing worker level
    - Providing all material at work level
    - Minimizing horizontal distance between operator and load
    - Decreasing vertical distance load travels
    - Limiting stacking heights to shoulder height
    - Keeping heavy objects at knuckle height

3. Decrease job demands by decreasing object weight by:
    - Assigning the job to 2 or more persons
    - Distributing the load into 2 or more containers
    - Reducing container weight
    - Reducing hand force.

4. Change type of manual materials handling activity by:

- Changing from lifting to lowering
- Changing from carrying to pulling
- Changing from pulling to pushing

5. Maximize time to perform job by:
   - Reducing frequency of activities
   - Incorporating work/rest schedules
   - Utilizing job rotation

Rules of Thumb

- Weights greater than 30 pounds for men and women are usually excessive.
- Pushing is preferable to pulling.
- Do not set something on the floor, which has to be picked up again later. Keep objects at work level.
- Mid-range height (area between knuckles and shoulders) is the best height for manual handling.

Lifting

Lifting is one of the most dangerous activities for the spine. The neutral position MUST be used to reduce the risk of injury. Lifting in a neutral position allows the larger and more powerful leg muscles to do the lifting.

1. Avoid manual lifting whenever possible. Manual lifting is one of the most common causes of workplace injury. If you are doing manual lifting, you are at risk for injury. Use mechanical means when possible.
2. The closer the object, the easier it is to lift.
3. Avoid twisting as you lift to help keep your back strong and free from injury.
4. Use lifting handles whenever possible.
5. Good firm footing is a must.

How to lift properly

1. Squat down close to the object; maintain a natural curve of back.
2. Test the weight of the object by lifting or tilting a corner.
3. If the object is too heavy:
   - Divide into smaller loads.
   - Get someone to help.
   - Use a mechanical device.
   - Grasp object firmly.
   - Keeping the object close in, lift it while straightening the legs and tightening the stomach and buttock muscles.
   - Never twist or jerk the body.
   - Avoid lifting to the side.
   - Avoid overextending and reaching too far.

How to carry an object

1. Select a clear route of travel and maintain an awareness of surface conditions.

2. Keep a firm grip on the object and carry it close to the body.
3. Do not allow the load to obstruct your view.
4. Do not twist the body; change direction by moving the feet.

How to set an object down:
1. Face the spot where the object is to be placed.
2. Squat down, maintain a natural curve of back.
3. Lower object, first on to one corner or onto a support to avoid finger injuries.
4. Lower the object into final position keeping fingers out of the way.

Housekeeping

Close attention to good housekeeping and office safety encourages teamwork, prevents accidents and creates a wholesome and productive work environment.

Good housekeeping is one of the most important factors in maintaining a safe job. Numerous workers in the industry are injured each year because they trip, stumble or step on objects that are in their way. These accidents are often blamed on the worker's carelessness in not looking where they are going. Actually, these accidents are the direct result of poor housekeeping. When you see something lying around, stop and take the time to put it in its proper place. Don't wait for someone else to do it, even though they may be the one who left it there.

- Report all injuries, regardless of severity to your supervisor.
- Walk cautiously up and down stairs; Use the handrail whenever possible.
- Use caution when opening a door onto a stairwell and walking past doors in stairwells.
- Keep floors, landings, and stairs free of debris.
- Close drawers of desks and file cabinets when not in use.
- Boxes, chairs, etc., shall not be used in place of ladders.
- Keep the floor free of tripping hazards such as telephone cords, electric extension cords, and paper cartons.
- Store material on shelves in a manner to prevent falling; heavy objects should be placed on lower shelves.
- Report unsafe electrical cords, faulty electrical or other equipment, or any other hazardous condition promptly to your supervisor.

Slips, Trips and Falls

Slips, trips and falls are a leading cause of accidents in the workplace. Injuries can occur anywhere at any time. Surfaces such as asphalt, sidewalks, wooden, tiled, or carpet-covered floors, special surfaces on stairs and conveyances (moving sidewalks, escalators, and elevators) can present serious tripping, slipping, or falling hazards.

Walking surfaces can change substantially when people track in mud, snow, dirt and moisture. Outside weather conditions can often produce wet and slick surfaces. Holes in asphalt or unexpected obstructions in sidewalks can be a potential cause for injury. Torn or curled-up carpet or floor coverings are other areas of concern. Liquid spills in bathrooms, lunch rooms etc. can be unseen or undetected.

Guidelines

- Be aware of floor surfaces. Look at path of travel for obstacles.
- Clean up spills-even if you didn't do it.
- Wear appropriate shoes in adverse weather conditions. (no heels on ice or slick surfaces).
- Report any hazards.

Poor housekeeping is another cause for slips, trips and falls. Open drawers, boxes in aisles, extension/computer cords, debris or objects, or cramped and crowed space are some examples of this.

- Keep drawers closed when not in use. Open one at a time.
- Pick up after yourself. Everything should be put away after it is used.
- Do not use extension cords.
- Report hazards.

Inadequate illumination can contribute to slips, trips and falls. Light values at floor level should be uniform with no glare or shadows. There should be no violent contrasts in light levels between floor areas. Report areas where lighting has gone out and bulbs need replacing to your supervisor or maintenance.

Other factors causing slips, trips and falls include:

- Illness
- Emotional disturbances
- Fatigue
- Lack of familiarity with environment
    - Poor vision

Electrical Hazards

The easiest way to reduce the possibility of electrocution is to:

- Use Ground Fault Circuit Interrupter (GFCI)
- Make sure extension cords are not frayed.
- Make sure equipment is grounded.
- Receptacles are mounted and secured.
- Panel boxes are covered.
- Do not use extension cords to suspend lighting.
- Do not use extension cords as permanent wiring.

What is a GFCI?
GFCI is a fast-acting circuit breaker which senses small imbalances in the circuit caused by current leakage to ground and, in a fraction of a second, shuts of the electricity.
The GFCI continually matches the amount of current going to an electrical device against the amount of current returning from the device along the electrical path. Whenever the amount going differs from the amount returning by approximately 5 milliamps, the GFCI interrupts the electrical power within as little as 1/40 of a second. Why does the GFCI cut the flow at 5 milliamps? It only takes 100 milliamps to kill a person.

Ladders

Supervisors are responsible to ensure that all ladders used in their assigned area are regularly inspected and that defective ladders are replaced or repaired.

Purchasing department shall ensure that all ladders purchased meet the specifications of the ANSI codes for metal or fiberglass ladders.

Placement
1. All ladders must be fully secured before being climbed. Portable ladders shall be equipped with safety feet or with sharp spurs. When necessary, ladders will be securely lashed at the top and or bottom. When appropriate, safety hooks will be utilized to secure ladders at top.
2. Only ladders of proper length shall be used. Any alteration to a ladder is strictly prohibited.
3. Step ladders shall be fully opened and locked in place during use.
4. Ladder placement shall be so positioned that for every 4 feet of height, the base will be located 1 foot away from the vertical plain. This ratio is 4 to 1or 25% of the total height.
5. Ladders shall not be placed in front of doors opening toward the ladder unless the door is blocked open, locked, or guarded.
6. When a ladder is being used in an open traffic area or where there is a danger of it being knocked over, a workman shall be stationed at the foot of the ladder.
7. Ladders shall not be used in a horizontal position as a platform, runway, scaffold, or any other purpose except that for which they were designed.
8. Rubber safety feet are recommended for hard surfaces such as wood or concrete. Safety spurs will be used on soft surfaces.
9. No ladder shall be used to gain access to a roof unless the top of the ladder extends at least 3 feet above the point of support.
10. Fixed ladders erected in areas in which a stairway cannot be constructed must be of steel. When fixed ladders exceed 20 feet in height, a cage or basket guard (beginning not more than 8 feet above grade) shall be provided. The ladder must have a minimum front clearance of 6 1/2-inches, and a minimum side clearance of 15-inches measured from the centerline. Side rails on permanent ladders should extend 3 ft. 6in. above landings.

Climbing Ladders

1. Examine ladders before each use. If broken, cracked, or defective in any way, the ladder shall be tagged for immediate repair or destruction and removed from work area.
2. Face ladder when climbing up or down.
3. Use rungs for climbing and descending, not side rails.
4. Keep body centered between side rails; move the ladder as needed. Don't reach.
5. Do not slide down, jump off, or run on a ladder.
6. Keep hands free while climbing ladders. Carry small objects in pockets or on belts; use hand lines for larger items.
7. Before climbing a ladder, make sure it is clean, free of grease, oil, mud, snow, or other slippery material. Keep your shoes clean.
8. When working from a stepladder over five feet high, workers shall not stand on a step higher than the third step from the top of the stepladder.
9. Do not climb higher than the third rung from the top on straight or extension ladders or the second tread from the top of stepladders.
10. Do not climb a ladder already occupied by another person.
11. Hook safety chains onto elevated platforms that have more than one access. Chains may be unhooked on unoccupied platforms having only one access.
12. No type of work shall be performed on a ladder over 25 feet from the ground that requires the use of both hands to perform the work, unless a safety harness is worn and the safety lanyard is secured to the ladder.
13. Any work that requires eye protection, respirators, or handling of pressure equipment, shall not be performed from a ladder more than twenty-five feet above the surrounding surface.

These are NOT ladders!

Hand Tools – Care and Use

Common types of Hand Tools; Use the right tool for the right job:
- Wrenches: open, pipe, socket
- Impact: drift pins, chisels, wedges
- Hammers
- Screw drivers
- Cutting: knives, axes, saws machetes
- Shovels
- Rakes
- Hoes

Inspection and Use Guidelines:
- Maintain in serviceable condition.
- Check handles for cracks, splinters, and taped repairs.
- Wear proper PPE.
- Do not carry sharp-edged tools in pockets.
- Keep sharp-edge tools sharp.
- Cut away from body.

Wrenches:
Must not be used if sprung or worn to the point that slippage occurs.

Impact:
Keep free of mushroomed heads.

Axes:
- Must be sharp.
- Check head for burrs or deep grooves.
- Head securely fastened to handle; when in doubt insert a wedge.
- Check handles for cracks, splinters, and taped repairs.

Saws:
- Make sure saw body is straight.
- Inspect for sharpness and missing teeth.
- Check handles for cracks and that the blade is securely attached.

Knives:
- Must be sharp.
- No burrs or nicks.
- Cut away from body.
- Never cut on items held between the knees or legs.

Power Tools

General
All rotating shafts, spindle, belts, fittings and other projections must be guarded. Machinery intended for stationary use must be secured from tipping over.

Common Types of Power Tools
Electric power operated tools, drills, saws, grinders
- Must be double insulated or grounded.
- Do not hoist or lower using the electric cords.
- Inspect cords and connections; if damaged, have them replaced.
- All power saws shall have guarding to protect the operator from contact with moving saw teeth.
- Use retractable guards when possible.

Pneumatic Power Tools
- Secure tool hose by whip check.
- Connections to be clipped.
- Do not exceed the manufacturer's safe operating pressure.
- All hoses exceeding ½" I.D. shall have a safety device at the source of supple or branch line to reduce pressure in case of hose failure.
- On nailers and staplers operating at over 100 psi, a safety device is required to prevent firing unless muzzle is in contact with work surface.
- When cleaning with compressed air, 30 psi is maximum pressure and then only with PPE and chip guarding.
- Inspect all hoses and fittings; if damaged, have them replaced.

Abrasive Wheels
- Guards must be in place.
- Ring test prior to use.
- Use safety glasses and face shield.
- Must have safety guards that expose only the proper amount of wheel surface.

Bench Grinders
- Tool rest with 1/8" of grinding wheel
- Tongue guard with ¼" of grinding wheel

Motor Vehicle Driving

Driving is the primary mode of travel for 90% of all licensed persons 16 years and older. It is an activity that most people enjoy and one that must be correctly learned and properly practiced if injury is to be prevented.

Each year, nearly one driver in eight is involved in a reportable crash. Only 10 percent of drivers recognize this statistic. Thirty percent believe their chances of a collision are

one in a thousand. As a result, most drivers let their guard down when they're behind the wheel and aren't aware of conditions that can lead to crashes.

As a City employee commuting to work, carpooling, driving a City owned vehicle or other work-related driving task, we want you to arrive to work and home safely. Lack of awareness is a major factor in traffic crashes and many drivers do not relate "risk" to driving. Managing risk when you drive involves controlling visibility, time, and space, and being aware of the amount of traction available.

The following are guidelines that can help you assess conditions more accurately, predict the actions of other roadway users, and make decisions with a more realistic concept of the consequences.

1. Inspect the Vehicle:
    - Walk around and inspect outside before entering.
    - Check tires for proper inflation.
    - Check oil/gas levels.
    - Check mirrors for proper alignment.
    - Make sure lights, signals, windshield wipers and instruments are working properly.

2. Develop Visual Habits:
    - Concentrate on path of travel.
    - Look well ahead.
    - Scan the scene constantly.
    - Look through rear window and turn head while backing up.
    - Be aware of signs, signals and roadway markings.
    - Look for pedestrians, bicycles, obstructions.

3. Time and Space Considerations:
    - Maintain 2-3 second following distance behind other vehicles.
    - Allow 2 seconds distance to the rear.
    - Allow at least one car width of space to one side.
    - Adjust speed for road, traffic, sight or weather conditions.

4. Communication with Other Drivers:
    - Use proper turn/hazard/brake signals.
    - Position car to be seen.
    - Turn lights on for safety.
    - Use the horn to warn.
    - Use appropriate body actions and gestures (eye-to-eye contact).

5. Adverse Driving Conditions and Emergencies:
    - Clear windshield, rear windows.
    - Slow for adverse weather conditions.
    - Pull off roadway and wait for rain or snow to ease if needed.
    - Use low beams and slow down for foggy conditions.
    - Adjust speed for glare and reduced visibility for night driving.
    - Pump brakes, shift to low gear or use emergency brake if brakes fail.
    - Avoid driving around bedtime or for long periods of time.
    - Firmly hold the steering wheel and steer straight if a blowout occurs.

6. Obey Laws/Safety Precautions:
    - Wear seatbelts (all passengers over 5 years old).
    - Use child restraint laws.
    - Lock doors.
    - Don't drink or abuse drugs and drive.
    - Don't drive while fatigued. Stop and rest.
    - Don't drive while emotionally, or mentally upset.
    - Pull over for emergency vehicles.
    - Obey construction site rules/signs.
    - Adhere to speed limits.
    - Do not use cell phones while driving.

Vehicle Accident Reporting Procedures

Stop immediately to investigate.

1. Protect the scene of the accident to prevent further injury or damage.
2. Call 911
3. Render assistance to injured parties within your training level.
4. Report the accident to your supervisor immediately.
5. Fill out the Accident Report Form (See Appendix) at the scene.
6. Return completed forms to your immediate supervisor within one business day following the accident.

Violence in the Workplace

Violence in the workplace causes a significant number of workplace fatalities and injuries throughout the United States. Every week, about 20 workers are murdered in the United States. Workplace fatality data shows that assaults and other violent acts are among the leading causes of work-related deaths in a number of states. For women, violence is the leading cause of workplace fatalities in the United States.

The following types of violence illustrate different characteristics of workplace violence and ways violence may present itself. Each involves different risk factors and means of preventing or responding to the potential violent incident.

1. Violence by strangers
2. Violence by customers or clients
3. Violence by co-workers
4. Violence by personal relations

The City of Stanwood is concerned and committed to our employees' safety and health. We refuse to tolerate violence in the workplace and will make every effort to prevent violent incidents from occurring by implementing a Workplace Violence Prevention Policy (WVPP), which is contained in the City's Personnel Policy Manual.

All managers, supervisors and employees are responsible for implementing and maintaining our WVPP. We require prompt and accurate reporting of all violent incidents whether or not physical injury has occurred.

Our program will ensure all employees adhere to work practices that are designed to make the workplace more secure, and do not engage in verbal threats or physical actions which create a security hazard for others in the workplace. It includes:

- Informing all employees about the WVPP.
- Evaluating workplace security measures.
- Recognition of workplace security hazards and risk factors associated with the four types of violence.
- Providing training and/or counseling to employees who need to improve work practices to ensure workplace security.
- Disciplining employees for failure to comply with established practices.
- Providing training designed to address specific aspects of workplace security
- unique to our establishment.
- Posting or distributing workplace security information.
- Providing a system for employees to inform management about hazards or threats of violence.
- Establishing procedures for protecting employees who report threats from retaliation.
- Complying with all Federal and State record keeping requirements.
- Conducting periodic inspections to identify and evaluate workplace security hazards and threats of workplace violence assessing all four types of violence listed above.
- Annual reviewing and evaluating program safety and security measures.

Safety Training

Safety training will be provided for all employees as an essential part of implementing the Accident Prevention Program. This training is conducted for new employees before they begin working at our establishment and on-going for staff as needed and appropriate.

These courses include:

- New Employee Orientation
- Safety and Health Responsibilities
- Reporting Accidents & Safety Hazards
- Accident Investigation
- Safety Committee
- First Aid/CPR
- Emergency Preparedness
- Safety Bulletin Board
- Personal Protective Equipment
- Hazardous Chemical Communication Program
- Silica/Silicosis Awareness Program
- Lock-Out/Tag-Out Program
- Confined Space Program
- Respiratory Protection Program
- Voluntary Respirator Use Program
- Wildfire Smoke
- Fall Protection Program
- Blood-Borne Pathogens-Exposure Control Plan
- Ergonomics Program
- Outdoor Heat Exposure
- Material Handling
- Lifting
- Housekeeping
- Slips, Trips and Falls
- Electrical Hazards
- Ladder Safety
- Hand Tools
- Portable Power Tools
- Motor Vehicle Driving
- Vehicle Accident Reporting

APPENDIX A

RELEASE FOR WORK AUTHORIZATION

Employee Name	**Claim Number**
Diagnosis	**Date of injury**

Return to Work Status

May return to regular work (date)	May not return to work until (estimated date)
May return to transitional work (date)	Estimated duration of transitional work

Physical Limitations: I certify the employee can perform duties within the capabilities defined as follows:
☐ Without any restrictions

Note: In terms of an 8-hour workday, "occasionally" equals 1-33%, "frequently" equals 34-66%, "continuously" equals 67-100%

Capabilities	**Never**	**Occas.**	**Freq.**	**Cont.**	**Lifting/Carrying**	**Never**	**Occas.**	**Freq.**	**Cont.**
Bend					0-5 lbs				
Squat					6-10 lbs				
Crawl					11-20 lbs				
Reach above shoulders					21-25 lbs				
Kneel					26-50 lbs				
Stoop					51-100 lbs				
Climb stairs/steps/step-stool					Repeated push/pull				
Climb ladders					Repeated simple grasp				
Walk on uneven ground					Repeated fine manipulation				
Other (specify)					Other (specify)				

Restriction of Activities	None	Mild	Moderate	Total	Comments
Unprotected heights					
Be around moving machinery					
Exposure to changes in temperature and humidity					
Driving automotive equipment					
Exposure to dust, fumes & gases					

In an 8-hour workday, worker can (check full capacity for each activity)

Total at one time (hours)

Hours	0	½	1	2	3	4	5	6	7	8
Sit										
Stand										
Walk										

Total during entire 8-hour day (hours)

Hours	0	½	1	2	3	4	5	6	7	8
Sit										
Stand										
Walk										

I have received a written list of job tasks □ Yes

I have **not** received a written list of job tasks, **but I agree that duties may be assigned and/or changed, so long as they match the limits defined by me above.** □ Yes □ No

Prognosis

Permanent restrictions likely? □ Yes □ No □ Unknown at this time

Medically stable? □ Yes □ No □ Date:

Physician Name (print)	Phone
Signature	Date

APPENDIX B

CITY OF STANWOOD

HAZARD REPORT AND NEAR MISS FORM

Desciption hazard or near miss:

Exact location of hazard or near miss: _____

Date on which hazard was noted or near miss occurred: _____

Time of Occurrence: _____

Reported by: _____

Date: _____

The following must be completed for all reports **Supervisor's Comments** (Include proposals or action taken to remedy the situation and prevent recurrence)

Supervisors Name: _____

Signature: _____

Date: _____

Safety Committee Comments

APPENDIX C

CITY OF STANWOOD
EMPLOYEE REPORT OF ACCIDENT

Distribution: (Initial for acknowledgement)	
Immediate Supervisor	_____
Department Head	_____
City Administrator	_____
Mayor	_____
Date Reviewed by Safety Committee	_____
Personnel File	_____

What type of accident *(check as many as apply)*

- ❑ Personal injury
- ❑ City vehicle
- ❑ Equipment or property damage (City or not)

Name of employee(s) involved: _____
Location of the Accident: _____
Date of Accident: _____ Time of Accident: _____
Reported to: _____
Witnesses:
Name _____ Address _____ Phone _____
Name _____ Address _____ Phone _____

Describe the injury and/or accident *(use reverse side of form, if necessary)*:

_____
_____
_____

Did this accident involve anyone not employed by the City? ❑ Yes ❑ No
If yes, give name and address: _____
If they were injured, describe: _____

_____

If personal injury accident: Was employee taken for medical treatment? ❑ Yes ❑ No
If yes, where? _____ Name of Doctor: _____
Do you anticipate loss of time from work? ❑ Yes ❑ No If yes, how long? _____ (hours)
Will a claim for industrial insurance be made? ❑ Yes ❑ No

How could this accident have been prevented? Include recommendation for changes in working conditions, equipment, or City policy *(attach additional information if necessary)*:

_____
_____

Note: All accidents, however minor, must be reported. The employee, when possible, will assist in the completion of this report, and will sign it when completed.

_____ _____
Signature of Employee Today's Date

Give this form and all attachments
to your immediate supervisor

Description of accident if vehicles involved. Use grid below to show location of streets, position of vehicles, direction of travel, and any other significant features *(attach picture if available and any additional comments, if necessary)*

CITY OF STANWOOD
EMPLOYEE ACCIDENT WITNESS STATEMENT

Date of Accident:
Name of employee(s) involved: _____
Name of Witness: _____
Location of the Accident: _____
Date of Accident: _____ Time of Accident: _____

Describe fully how accident occurred: (including events that occurred immediately before the accident):

_____
_____
_____
_____
_____
_____
_____

Describe bodily injured sustained (be specific about body part(s) affected):

_____
_____
_____

_____ _____
Signature of Witness Today's Date

CITY OF STANWOOD
SUPERVISOR'S ACCIDENT INVESTIGATION
(*To be completed by the employee's supervisor or department head)*

Location of the Accident: _____
Date of Accident: _____ Time of Accident: _____
Describe injury: _____
Describe damage to property/equipment: _____

What was the employee doing when injury/damage occurred? What machine or tool was being used? What type of operation?

_____
_____
_____
_____
_____
_____

How did injury/damage occur? List all objects and substances involved.

_____
_____
_____
_____
_____

PLEASE INDICATE ALL OF THE FOLLOWING WHICH CONTRIBUTED TO THE INJURY OR DAMAGE

___ Failure to lockout
___ Failure to secure
___ Horseplay
___ Improper dress
___ Improper guarding
___ Improper instruction
___ Improper maintenance
___ Improper protective equipment
___ Inoperative safety device
___ Lack of training or skill
___ Operating without authority
___ Physical or mental impairment
___ Poor housekeeping
___ Poor ventilation
___ Unsafe arrangement or process
___ Unsafe equipment
___ Unsafe position
___ Other _____

Supervisor's corrective action to ensure this type of accident does not recur:

_____
_____
_____

Was employee trained in the appropriate use of PPE/proper safety procedures?..... Yes ___ No ____
Was employee cautioned for failure to use PPE/proper safety procedures?..... Yes____ No____
Did employee promptly report the injury/damage?..... Yes____ No____
If applicable, is modified duty available..... Yes ____ No____

_____ _____ _____
Supervisor's name Supervisor's signature Date

APPENDIX D

EMPLOYEE SAFETY ORIENTATION

To be used for all new hires, or whenever a change in job assignment, location, or responsibility indicates that new hazards need to be addressed.

Employee name _____ Date Hired_____

Department_____ Job Assignment_____

I have provided this employee with the following information and scheduled any necessary training:

_____	_____	_____
Name of supervisor/manager	Signature	Date

- ❑ How and when to report injuries.
- ❑ The location of first aid kits and facilities, and who in the workgroup has received training in first aid and CPR.
- ❑ How to report unsafe conditions and practices.
- ❑ The use and care of required personal protective equipment (PPE).
- ❑ The proper actions to take in event of emergencies, including how to evacuate the work area, where fire extinguishers are located, and the employee's role in an emergency.
- ❑ How to identify any hazardous gases, chemicals, or materials stored at the worksite, how to use these materials safely, and the emergency actions to take following an accidental exposure.
- ❑ How the City's total safety program works.
- ❑ An on-the-job review of safe work practices and potential hazards on the job.
- ❑ Appropriate work-specific safety training scheduled below.

	Training Scheduled	**Training Received**
❑ Hazard Communication	_____	_____
❑ Safe Lifting	_____	_____
❑ CPR/First Aid	_____	_____
❑ Blood borne Pathogens	_____	_____
❑ Flagger Certification	_____	_____
❑ Other: (i.e., Asbestos, Lockout, Machine Guarding, Confined Space, Trenching and Shoring, Fall Protection)		
_____	_____	_____
_____	_____	_____

I have received the above information and will attend the above training.

_____	_____
Signature	Date

Note: Please return completed form to HR Department

APPENDIX E

CONFINED SPACE ENTRY PERMIT

PERMIT VALID FOR 8 HOURS ONLY.
ALL PERMIT COPIES MUST REMAIN AT THE SITE UNTIL JOB IS COMPLETED.

DATE: _____

LOCATION/DESCRIPTION OF CONFINED SPACE: _____ **TIME:** _____

PURPOSE OF ENTRY: _____ **EXPIRATION:** _____

EXPECTED HAZARDS: _____

COMMUNICATIONS: _____

ENTRY SUPERVISOR: _____

RESCUE PERSONNEL: _____

TEST INTERVAL: _____

SPECIAL REQUIREMENTS BEFORE ENTRY:	**YES**	**NO**		**YES**	**NO**
Lockout De-energize – Test and Verify			Escape Harness Required		
Lines Broken – Capped or Blanked			Tripod Emergency Escape Unit		
Purge – Flush and Vent			Lifelines		
Ventilation			Fire Extinguishers (Evaluate Need)		
Secure Area (Post and Flag)			Lighting (Explosion Proof)		
Breathing Apparatus			Protective Clothing		

TEST(S) TO BE TAKEN / ACCEPTABLE ENTRY CONDITIONS

DO NOT ENTER IF PERMISSIBLE ENTRY ARE EXCEEDED

	Permissible Entry Level	**DATE**										
		TESTER										
		TIME AM/PM	M	M	M	M	M	M	M	M	M	M
% of Oxygen	19.5% to 23.5%											
% of LFL* (Gas/Vapor/Mist)	Less than 10%											
Carbon Monoxide	35 ppm (8 hr.)											
Aromatic Hydrocarbon	1 ppm (8 hr.)											
Hydrogen Sulfide	10 ppm (8 hr.)											

GAS TESTER NAME: _____

NOTE: Continuous/periodic tests shall be established before beginning the job.
Any questions pertaining to test requirements should be directed to: _____

TESTING INSTRUMENTS USED	**NAME**	**TYPE**	**IDENTIFICATION NO.**

AUTHORIZED ENTRANTS:

_____

_____

_____

AUTHORIZED ATTENDANTS:

_____

_____

_____

PERMIT AUTHORIZATION:

I certify that all actions and conditions necessary for safe entry have been performed.

NAME (Print) _____ SIGNATURE _____

DATE _____ TIME _____

*L.F.L Lower Flammable Limit

APPENDIX F

Advisory Information for Persons Who Voluntarily Use Respirators

Respirators protect against airborne hazards when properly selected and used. Respirator usage that is required by WA DOSH or the City is not voluntary use. WISHA recommends voluntary use of respirators when exposure to substances is below WISHA permissible exposure limits (PELs) because respirators offer an additional level of comfort and protection.

If you choose to voluntarily use a respirator (whether it is provided by you or the City), be aware that **respirators can create hazards for you,** the user. You can avoid these hazards if you know how to use your respirator properly **and** how to keep it clean. Take these steps:

- Read and follow all instructions provided by the manufacturer about use, maintenance (cleaning and care), and warnings regarding the respirator's limitations.

- Choose respirators that have been certified for use to protect against the substance of concern. The National Institute for Occupational Safety and Health (NIOSH) certifies respirators. If a respirator is not certified by NIOSH, you have no guarantee that it meets minimum design and performance standards for workplace use.

    - A NIOSH approval label will appear on or in the respirator packaging. It will tell you what protection the respirator provides.

- Keep track of your respirator so you do not mistakenly use someone else's.

- Do not wear your respirator into:

    - Atmospheres containing hazards that your respirator is not designed to protect against.
      For example, a respirator designed to filter dust particles will not protect you against solvent vapor, smoke, or oxygen deficiency.

    - Situations where respirator use is required.

- Contact the Public Works Supervisor if you have any questions about respirator use.

I, hereby, as an employee of the City of Stanwood acknowledge the risks and benefits of voluntarily using a filtering facepiece respirator. Under no circumstances, am I being forced or coerced into the use of a respirator. A respirator is not required for any part of my job or task.

I am using a: _____ paper disposable type _____ ½ Face _____ Full Face _____ Other

Name:_____ **Date:**_____

Signature: _____

APPENDIX G

FALL PROTECTION WORK PLAN

WAC 296-155-246110-2 mandates the City develop and implement a written fall protection work plan including each area of the work place where employees are assigned and where fall hazards of 10 feet or more exist and that it the plan be available on the job site.

Name: City of Stanwood	**Date:**
Site Address:	

(If additional space is needed, use the back of the form)

Identify all fall hazards 10 feet or more above the ground level or lower level. Check all that apply:

- ❑ Open-sided floors
- ❑ Decks/Balconies
- ❑ Floor openings
- ❑ Skylight openings
- ❑ Wall Openings
- ❑ Window openings
- ❑ Door openings
- ❑ Roof openings
- ❑ Leading Edge Work
- ❑ Mobile lift work

Methods of fall protection to be used: (LSO = Low Slopes Only. Low slopes = 4 x12 or less)

- ❑ Guardrail system (LSO)
- ❑ Warning line system (LSO)
- ❑ Catch platform
- ❑ Safety Net
- ❑ Covers
- ❑ Personal fall arrest system
- ❑ Personal fall restraint system
- ❑ Positioning device system
- ❑ Horizontal life lines
- ❑ Vertical life lines and rope grab
- ❑ Safety watch system (LSO)
- ❑ Warning line w/safety monitor (LSO)

Name of safety watch or monitor if used: _____

Overhead Hazard Protection Methods

- ❑ Hard Hats
- ❑ Overhead hazard signs
- ❑ Debris nets
- ❑ Other: _____
- ❑ Toe boards on guardrails
- ❑ Screens on guardrails
- ❑ Barricade to control access to area
- ❑ Other:_____

Describe procedures for assembly, maintenance, inspection, disassembly of fall protection system to be used.

_____

_____

Describe procedures for handling, storage and securing tools, equipment and materials.

Describe methods of overhead protection for workers who may be in, or pass through work area.

Describe methods to be implemented for prompt, safe removal of injured worker(s).

Employees who received fall protection training on the above site specific fall protection work plan.

Name(s):	**Date:**

The competent person's signature verifies that the Fall Protection Work Plan has been completed, the employees informed of the plan, and employees have received training in the fall protection systems in use:

Name	**Title**	**Date**

APPENDIX H

VACCINATION DECLINATION FORM

Date: _____

Employee Name: _____

I understand that due to my occupational exposure to blood or other potentially infectious materials, I may be at risk of acquiring Hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with Hepatitis B vaccine, at no charge to myself. However, I decline Hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring Hepatitis B, a serious disease. If, in the future, I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with Hepatitis B vaccine, I can receive the vaccination series at no charge to me.

I have already received the Hepatitis B vaccination series.

_____ _____
Employee Signature Date

_____ _____
City Representative Signature Date