City of Stanwood

COMPREHENSIVE SEWER SYSTEM PLAN

Prepared By

RH2
ENGINEERS
PLANNERS
SCIENTISTS

February 2015

City of Stanwood Comprehensive Sewer System Plan

Updated February 2015

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June 29, 2015

Mr. Kevin Hushagen
Public Works Director
City of Stanwood
10220 270th Street NW
Stanwood, WA 98292

Re: City of Stanwood General Sewer Plan (February 2015)

Dear Mr. Hushagen:

Pursuant to RCW 90.48.110 and WAC 173-240-030, the above-referenced general sewer plan has been reviewed and, is hereby approved.

Sewage collection facilities within the planning area boundary shall be constructed according to the approved general sewer plan or amendments thereto. Prior to construction, the City is required to submit a written description of the project and written assurance that the extension is in conformance with the general sewer plan. Engineering reports and plans and specifications for planned collection facilities including sewer line extensions and pump stations, need not be submitted for approval, unless:

a) The proposed sewers or pump stations involve installation of overflows or bypasses; or

b) The proposed sewers or pump stations discharge to an overloaded treatment, collection, or disposal facility.

If you have any questions concerning this approval, please contact Lazaro Eleuterio at 425-649-7027 or lazaro.eleuterio@ecy.wa.gov.

Sincerely,

Kevin C. Fitzpatrick

Kevin C. Fitzpatrick
Section Manager
NWRO Water Quality Section

Enclosure

cc: Karla Kasick, PE; RH2 Engineers, Planners, Scientists

Certification

This Comprehensive Sewer System Plan for the City of Stanwood was prepared under the direction of the following registered professional engineers.

2/26/15

Karla Kasick, P.E.

2/26/15

Tony V. Pardi, P.E.

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Executive Summary

ES-1. 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 Comprehensive Sewer System Plan (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.

ES-2. SUMMARY OF KEY ELEMENTS

Sewer Service Area

The City limit boundary encompasses approximately 2.8 square miles. The City's sewer service area boundary is the same as the City limits. Approximately 59 percent of the lands within the current City limits are designated for residential use, approximately 10 percent are designated for commercial, approximately 7 percent are designated for industrial, and approximately 17 percent are designated for public facilities. The remaining 6 percent of the land within the City limits is non-designated right-of-way or other City property. The City's 2013 population was 6,340 and is expected to grow to 10,116 in 2035 under a moderate growth rate of 2.2 percent. The City's Urban Growth Area (UGA) population is expected to grow to 11,085 in 2035 under a moderate growth rate of 2.4 percent.

The sewer system is made up of a treatment plant, 7 pump stations, approximately 27 miles of sewer piping, and approximately 7,089 feet of force main. A summary of the sewer system characteristics are provided in **Table ES-1**.

Table ES-1
2013 Sewer System Summary

Description	Data
Population (City, 2013)	6,340
Sewer Planning Area (acre)	2,187
Total Connections	2,143
Number of Persons Per Household	2.9
Average Gallons Per Capita Per Day	83 gpcd
Average Daily Flow	0.52 MGD
Number of Pump Stations	7
Total Length of Sewer Main	~ 27.2 miles

The City's existing sewer service area is comprised of five major drainage basins. More than 27 miles of sewer piping ranging in size from 6 to 36 inches serves the sewer system customers. As shown in **Table ES-2**, most of the sewer pipe (approximately 78 percent) within the sewer service area is 8-inch-diameter pipe.

Table ES-2
Sewer Piping Inventory

Diameter (in)	Total Length (ft)	Total Length (mi)	% of Entire System
6	2,349	0.44	1.6%
8	112,658	21.34	78.4%
10	6,262	1.19	4.4%
12	7,629	1.44	5.3%
14	3,356	0.64	2.3%
15	6,814	1.29	4.7%
18	809	0.15	0.6%
20	245	0.05	0.2%
24	179	0.03	0.1%
27	3,180	0.60	2.2%
30	113	0.02	0.1%
36	74	0.01	0.1%

Existing Facilities

The City currently owns and maintains seven wastewater lift stations. The characteristics of each lift station are presented in **Table ES-3**.

Table ES-3
Lift Station Characteristics

Lift Station	Pump Station					Pumps					Wet Well			Year Designed
	Manufacturer	No. of Pumps	Model	Serial No.	Force Main Dia. (in)	HP	TDH (ft)	Design Capacity (gpm)	2010 City Tested Capacity (gpm)	Firm Capacity (gpm)	Diameter (ft)	Depth (ft)	Length (ft)	
1-Church Creek	Hydromatic	2	Submersible	-	4	7.5	55	150 150	238	150	5.9	14.3	NA	1990
2-Cedarhome	Gorman-Rupp	2	Self-priming	1120394 1120395	6	20	76	345 345	333	333	12.1	7.7	17	1997
3-Pioneer Hills	Gorman-Rupp	2	Self-priming	1170041 1170042	6	20	72	500 500	470	470	14.5	8	20	1999
4-Main	ITT-Flygt	3	Self-priming	9860070 9860071 9860072	14	20	50	950 950 950	NA	1900	6.1	18.3	NA	1999
5-Taylor's Landing	Gorman-Rupp	2	Self-priming	1251514 1251515	4	7.5	52	150 150	91	150	5	20.8	NA	2001
6-Copper Station	Wemco	2	Submersible	06DW05896-01 06DW05896-02	6	20	137	300 300	NA	300	5.8	16.5	NA	2005
7-Lindstrom Development	Gorman-Rupp	2	Self-priming	1133852 1133853	4	7.5	45	160 160	198	198	8.5	13.3	NA	2007

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.

Existing Wastewater Characteristics and Flows

The 2012 average day flows for the lift stations are shown in **Table ES-4**, along with the 2007/2008 average day flows for the lift stations, which were extracted from the City's previous Plan. Main Lift Station receives flow from the other six lift stations and the wastewater is pumped to the City's wastewater treatment plant. **Table ES-5** provides the 2008 through 2013 average day flow rates at the City's wastewater treatment plant.

Table ES-4
Existing Average Day Flow Rates at Lift Stations

Lift Station	2007/2008 Average Day Flow (GPD)	2012 Existing Average Day Flow (GPD)
LS 4 (Main)	545,833	596,801
LS 2 (Cedarhome)	58,296	91,471
LS 1 (Church Creek)	33,879	20,650
LS 3 (Pioneer Hills)	9,872	10,438
LS 6 (Copper)	469	7,362
LS 5 (Taylor's Landing)	5,128	5,731
LS 7 (Lindstrom)	6,434	4,951

Table ES-5
Existing Average Day Flow Rates at the Wastewater Treatment Plant

Year	Average Day Flow (GPD)	Average Day Flow per Capita (GPCD)
2008	545,833	93
2009	553,161	91
2010	545,709	88
2011	559,983	90
2012	596,801	95
2013	523,495	83

Inflow and Infiltration

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 inflow and infiltration (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 days in the last several years of recorded data for the City were 1.92, 1.65, 1.58 million gallons per day (MGD). This peak inflow events equate to 293, 250, and 248 gpcd. Only one of the peak inflow events exceeds the EPA maximum of 275 gpcd. Conducting an inflow 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 inflow should be considered by the City.

Infiltration is considered to be non-excessive if the average daily flow during periods of dry weather does not exceed 120 gpcd. A review of the City's flow data during periods of zero to a small amount of precipitation indicate peaks of 107, 104, and 101 gpcd, which is below the EPA maximum of 120 gpcd.

Peaking Factors

Projected flows are used to further 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-6** demonstrates the flow rates and peaking factors as measured at the City's wastewater treatment plant.

Table ES-6
Existing Flow and Peaking Factors for the Wastewater Treatment Plant

Flow Scenario	Flow (MGD)	Peaking Factor (in terms of AAF)
2009 Average Annual Flow	0.55	1.00
2009 Max Month Flow	0.79	1.44
2009 Max Day Flow	1.58	2.86
2010 Average Annual Flow	0.55	1.00
2010 Max Month Flow	0.66	1.21
2010 Max Day Flow	1.28	2.35
2011 Average Annual Flow	0.56	1.00
2011 Max Month Flow	0.81	1.44
2011 Max Day Flow	1.61	2.88
2012 Average Annual Flow	0.60	1.00
2012 Max Month Flow	0.78	1.30
2012 Max Day Flow	1.92	3.22
2013 Average Annual Flow	0.52	1.00
2013 Max Month Flow	0.75	1.44
2013 Max Day Flow	1.45	2.77

Population projections for the 2021 and 2035 planning horizons were used to calculate the projected flow rates. **Table ES-7** contains the projected flow rates for the sewer drainage basins and the wastewater treatment plant for the City's expanded UGA population. The table demonstrates that the design flow capacity of 1.5 MGD will be exceeded by 2035 if growth occurs at the expected rate.

Table ES-7
Projected Average Day and Peak Hour Flow Rates

Sewer Drainage Basin	2013 Existing ADF (GPD)	2013 Existing PHF (GPM)	Projected 2021 ADF (GPD)	Projected 2021 PHF (GPM)	Projected 2035 ADF (GPD)	Projected 2035 PHF (GPM)
1	189,150	520	233,090	640	257,440	710
2	9,160	30	17,870	50	55,400	150
3	112,230	310	204,930	570	286,720	800
4[1]	137,200	380	56,410	160	92,430	260
5[1]	75,860	210	324,500	900	454,490	1,260
Treatment Plant (ADF)	**0.52 MGD**		**0.84 MGD**		**1.15 MGD**	
Treatment Plant (MMF)	**0.75 MGD**		**1.20 MGD**		**1.65 MGD**	

NOTES:
-Average day flows and peak hour flows shown in this table are rounded and approximate.
-Highlighted flow exceeds current wastewater treatment plant capacity.
1. These projections reflect projects to install gravity main so the Cedarhome Lift Station, Church Creek Lift Station, Taylor's Landing Lift Station, and Lindstrom Lift Station can be eliminated and abandoned by 2021. These improvements are discussed further in **Chapter 7**.

Current lift station pumping capacity and flow rate projections are provided in **Table ES-8**. As shown in the table below, the Main Lift Station is estimated to reach capacity prior to 2021.

Table ES-8
Projected Lift Station Average Day and Peak Hour Flow Rates

Name	Existing "Firm" Capacity (GPM)	2012 Existing ADF (GPD)	2012 Existing PHF (GPM)	Projected 2021 ADF (GPD)	Projected 2021 PHF (GPM)	Projected 2035 ADF (GPD)	Projected 2035 PHF (GPM)
LS 1 (Cedarhome)[1]	333	91,470	250	N/A	N/A	N/A	N/A
LS 2 (Church Creek)[1]	238	20,650	60	N/A	N/A	N/A	N/A
LS 3 (Pioneer Hills)	470	10,440	30	17,870	50	55,400	150
LS 4 (Main)	1,900	596,800	1,660	836,800	**2,320**	1,146,480	**3,180**
LS 5 (Taylor's Landing)[1]	150	5,730	20	N/A	N/A	N/A	N/A
LS 6 (Copper Station)	300	7,360	20	19,720	50	25,900	70
LS 7 (Lindstrom)[1]	198	4,950	10	N/A	N/A	N/A	N/A
Sewer Drainage Basin 1A	N/A	N/A	N/A	N/A	N/A	10,290	30
Sewer Drainage Basin 5C	N/A	N/A	N/A	15,790	40	36,960	100
Sewer Drainage Basin 5D	N/A	N/A	N/A	6,900	20	17,630	50
Sewer Drainage Basin 5E	N/A	N/A	N/A	24,190	70	24,530	70
Sewer Drainage Basin 5F	N/A	N/A	N/A	10,000	30	20,380	60
Sewer Drainage Basin 5G	N/A	N/A	N/A	20,970	60	21,900	60

NOTES:
-Average day flows and peak hour flows shown in this table are rounded off and approximate.
-Highlighted flow exceeds current pump capacity.
1. These projections reflect projects to install gravity main so the Cedarhome Lift Station, Church Creek Lift Station, Taylor's Landing Lift Station, and Lindstrom Lift Station can be eliminated and abandoned by 2021. These improvements are discussed further in **Chapter 7**.

Wastewater Treatment Evaluation

The City's current National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit allows the flow and loading parameters shown in **Table ES-9**.

Table ES-9
NPDES Flow and Loading

Criteria	Value
Flow (MGD)	1.5
BOD_5 (ppd)	4,100
TSS (ppd)	4,100

It is important to note that the permit requires a plan to be submitted by the City if the flow or waste loading reaches 85 percent for three consecutive months or if the facility will reach its design capacity in 5 years.

Based on the projected average annual flow, the wastewater treatment plant will reach capacity in the 20-year planning period, as shown in **Table ES-7**. The numbers presented in **Table ES-7** are projected estimates based on an average annual flow rate per capita of 100 gpcd, as per the guidelines presented in the Washington State Department of Ecology's *Criteria for Sewage Works Design*. However, the City's average annual influent flow rate per capita has been below 100 gpcd since 2007. The City should closely monitor influent flow for the wastewater treatment plant on a yearly basis to see if the average influent flow rate per capita continues to remain lower than the guidelines presented in Ecology's *Criteria for Sewage Works Design*.

Future wastewater treatment plant average annual and maximum month Biological Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) loadings, shown in **Table ES-10**, were estimated using data obtained from the City for 2013 and the population projections for the City's sewer service area. The City's 2013 maximum average month per capita BOD_5 loading was 0.28 pounds per capita per day, and the ratio of the maximum average month BOD_5 loading to the annual average BOD_5 loading was 1,786:1,578 or 1.13:1. The City's 2013 maximum average month per capita TSS loading was 0.27 pounds per capita per day, and the ratio of the maximum average month TSS loading to the annual average TSS loading was 1,683:1,468 or 1.15:1. These per capita loading rates and loading ratios were used to develop the future loadings to the wastewater treatment plant.

Table ES-10
Projected Wastewater Treatment Plant BOD_5 and TSS Loadings

Year	STA Service Area Population	Annual Average BOD_5 (ppd)	Maximum Average Month BOD_5 (ppd)	Annual Average TSS (ppd)	Maximum Average Month TSS (ppd)
2005	4,858	1,052	1,703	1,252	1,642
2006	5,287	1,354	2,028	1,259	1,763
2007	5,593	1,567	1,820	1,244	1,442
2008	5,885	1,559	1,828	1,232	1,401
2009	6,073	1,450	1,851	1,489	1,813
2010	6,231	1,468	1,796	1,403	1,769
2011	6,220	1,514	2,330	1,311	1,792
2012	6,300	1,456	1,722	1,305	1,497
2013	**6,340**	**1,578**	**1,786**	**1,468**	**1,683**
2014	6,530	1,625	1,839	1,512	1,733
2015	6,770	1,685	1,907	1,568	1,797
2016	7,010	1,744	1,975	1,623	1,860
2017	7,250	1,804	2,042	1,679	1,924
2018	7,490	1,864	2,110	1,734	1,988
2019	7,730	1,923	2,177	1,790	2,051
2020	7,970	1,983	2,245	1,845	2,115
2021 (+6 years)	**8,210**	**2,043**	**2,313**	**1,901**	**2,179**
2022	8,416	2,094	2,371	1,949	2,233
2023	8,622	2,145	2,429	1,996	2,288
2024	8,828	2,197	2,487	2,044	2,343
2025	9,034	2,248	2,545	2,092	2,397
2026	9,240	2,299	2,603	2,140	2,452
2027	9,446	2,350	2,661	2,187	2,507
2028	9,652	2,402	2,719	2,235	2,561
2029	9,858	2,453	2,777	2,283	2,616
2030	10,064	2,504	2,835	2,330	2,671
2031	10,269	2,555	2,893	2,378	2,725
2032	10,475	2,606	2,951	2,425	2,780
2033	10,681	2,658	3,009	2,473	2,835
2034	10,887	2,709	3,067	2,521	2,889
2035 (+20 years)	**11,085**	**2,758**	**3,122**	**2,567**	**2,942**

NOTE:
-The 2013 maximum average month BOD_5 loading per capita (0.28 lb/person/day), ratio of maximum average month BOD_5 loading to annual average BOD_5 loading (1.13:1), maximum average month TSS loading per capita (0.27 lb/person/day), and ratio of maximum average month TSS loading to annual average TSS loading (1.15:1) were used for the loading projections.

Table ES-10 demonstrates the City's wastewater treatment plant may not reach its capacity for BOD_5 and TSS loadings in the 20-year planning period. The maximum month loading is the limiting criterion in the wastewater treatment plant reaching capacity. The numbers presented in **Table ES-10** are projected estimates based on current loading information. The City should closely monitor BOD_5 and TSS loadings on a yearly basis to see if these trends continue.

Summary of Improvements

A general description of improvements and an overview of the deficiencies they will resolve are presented in **Chapter 7**. Capital Improvement Plan (CIP) numbers with an "EX" prefix indicate improvements that are necessary to resolve existing system deficiencies. Some of the improvements will be necessary when development occurs in the currently undeveloped areas in the UGA. The CIP numbers for developer-funded improvements have a "DF" prefix.

Project 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 2014 dollars. The cost estimates include construction costs and indirect costs. The existing system improvements were prioritized by the City based on a perceived need for the improvement. The schedule for the developer funded projects will be dependent on the timing and design of the specific development areas. A general schedule has been established for planning purposes; the estimated schedule will be modified as development occurs. In addition, the City retains the flexibility to reschedule, expand or reduce CIP projects when new information becomes available for review and analysis.

Table ES-11
Proposed Improvements Implementation Schedule

No.	Description	Estimated Cost (2014 $$)	Schedule of Improvements Planned Year of Project and Estimated Cost in 2014 $$ 2014	2015	2016	2017	2018	2019	2020	2021	2022-2028	2029-2035
Pipeline Improvements												
EX1	Sewer Drainage Basin 1 Pipe Replacement Program	$5,763K		$274K	$274K	$274K	$274K	$274K	$274K	$274K	$1,921K	$1,921K
EX2	Collector/Interceptor System Flow Monitoring and Video	$353K		$40K		$40K		$40K		$40K	$193K	
EX3	270th Street NW Pipe Construction	$100K		$100K								
EX4	272nd Street NW and 76th Drive NW Gravity Main Replacement	$643K					$96K	$547K				
EX5A	Church Creek Collection System Construction	$1,025K									$1,025K	
EX5B	Cedarhome Collection System Construction	$175K										$175K
EX13	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	$236K					$47K	$189K				
EX14	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	$1,690K		$169K	$761K	$761K						
EX15	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	$271K							$41K	$230K		
EX16	Upper Pioneer Highway Interceptor Existing Deficiencies	$572K					$86K	$486K				
EX17	Pioneer Highway Interceptor Existing Deficiencies	$559K									$559K	
EX18	Lower Pioneer Highway Interceptor Existing Deficiencies	$569K									$85K	$484K
EX19	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	$717K								$108K	$609K	
EX20	265th Street NW Gravity Main Existing Deficiencies	$145K									$145K	
Facility Improvements												
EX6	Miscellaneous Improvements	$665K		$35K	$35K	$35K	$35K	$35K	$35K	$35K	$210K	$210K
EX7	Telemetry System Upgrades	$275K	$40K	$10K	$50K	$15K					$80K	$80K
EX8A	Long-term Biosolids Utilization Study	$110K		$110K								
EX8B	Long-term Biosolids Utilization Modifications	$1,925K			$289K	$545K	$545K	$545K				
EX8C	Biosolids Removal and Utilization	$500K							$500K			
EX9	Grit Removal Unit Installation	$203K					$51K	$76K	$76K			
EX10	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	$48K				$48K						
EX11	Sheet Pile Installation	$4,900K					$200K		$250K	$250K	$4,200K	
EX12	Main Lift Station (Lift Station 4) Force Main Upgrades	$486K		$73K	$413K							
Planning and Wastewater Treatment Plant Improvements												
M1	Inflow and Infiltration Study	$100K			$50K					$50K		
M2	Comprehensive Sewer System Plan Update	$232K	$101K	$15K								$116K
M3	Sewer Rate Study	$50K				$50K						
M4	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates[1]	$200K								$67K	$133K	
M5	Wastewater Treatment Plant Update and Expansion[2,3]	$11,498K										$11,498K
Total Estimated Project Costs of City Funded Improvements		**$34,010,000**	**$141K**	**$826K**	**$1,872K**	**$1,768K**	**$1,335K**	**$2,193K**	**$1,176K**	**$1,054K**	**$9,161K**	**$14,484K**
Developer Funded Improvements - Prior to 2021												
DF1A	Main Lift Station (Lift Station 4) Alternatives Analysis	$54K	Timing of Project Based on Timing of Future Developments									
DF1B	Main Lift Station (Lift Station 4) Rehabilitation	$1,544K	Timing of Project Based on Timing of Future Developments									
DF2	72nd Avenue NW Gravity Main Replacement	$193K	Timing of Project Based on Timing of Future Developments									
DF3	Church Creek Loop NW Main Replacement	$423K	Timing of Project Based on Timing of Future Developments									
DF4	68th Avenue NW Gravity Main Replacement	$321K	Timing of Project Based on Timing of Future Developments									
DF5	90th Avenue NW and Viking Way Pipe Construction	$514K	Timing of Project Based on Timing of Future Developments									
DF6	Lift Station 8 Construction	$1,842K	Timing of Project Based on Timing of Future Developments									
DF7	Lift Station 9 Construction	$1,769K	Timing of Project Based on Timing of Future Developments									
DF8A	Lift Station 10 Construction	$1,927K	Timing of Project Based on Timing of Future Developments									
DF8B	Taylor's Landing Lift Station (Lift Station 5) Pipe Construction	$481K	Timing of Project Based on Timing of Future Developments									
DF9	Lift Station 11 Construction	$1,875K	Timing of Project Based on Timing of Future Developments									
DF10A	Lift Station 12 Construction	$2,099K	Timing of Project Based on Timing of Future Developments									
DF10B	Lindstrom Lift Station (Lift Station 7) Pipe Construction	$420K	Timing of Project Based on Timing of Future Developments									
Developer Funded Improvements - Prior to 2035												
DF11	271st Street NW Monitoring and Potential Pipe Replacement	$1,397K	Timing of Project Based on Timing of Future Developments									
DF12	274th Street NW Gravity Main Replacement	$130K	Timing of Project Based on Timing of Future Developments									
DF13	Lift Station 13 Construction	$2,099K	Timing of Project Based on Timing of Future Developments									
Total Estimated Project Costs of Developer Funded Improvements		**$17,088,000**										

NOTES:
1 - Time scheduled is based on projected maximum month average flow reaching 85 percent of the capacity of the wastewater treatment plant.
2 - Price is dependent on wastewater treatment system requirements in the future. Time scheduled is based on projected maximum month average flow reaching the capacity of the wastewater treatment plant.
3 - Price is dependent on plan update conducted in M4.

Operation and Maintenance

Chapter 8 addresses the operation and maintenance staff for the City's wastewater treatment plant and collection system. Currently, there are four full-time employees for the wastewater treatment plant and collection system.

For future operation and maintenance needs, the City will need to add one more person to staff the wastewater treatment plant. In addition, the collection system will continue to expand with population growth and the City will need to add additional staff to maintain the gravity sewers, force mains, and pump stations. One additional employee may be added as required to the staff for future collection system maintenance needs.

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 operating and construction funds for the previous 6 years are summarized in **Tables ES-12** and **ES-13**.

Table ES-12
Summary of Historical Fund Resources and Uses Arising from Cash Transactions
Sewer Fund 401

Sewer Fund 401		2008	2009	2010	2011	2012	2013
Beginning Net Cash and Investments							
	Unspecified	$1,032,378	$1,166,454	-	-	-	-
308.1	Reserved	-	-	$ 67,933	$ 68,430	$ 604,442	$ 592,996
308.8	Unreserved	-	-	$4,253,043	$4,054,619	$3,641,483	$3,356,846
	Total Beginning Cash Balance	$1,032,378	$1,166,454	$4,320,976	$4,123,049	$4,245,925	$3,949,842
Revenues:							
340	Charges for Services	$1,473,253	$1,539,960	$1,579,935	$1,541,882	$1,574,702	$1,603,401
360	Miscellaneous	$ 65,141	$ 23,263	$ 108,324	$ 102,116	$ 290,230	$ 426,163
390	Other Financing Sources	$ 112,000	$ 120,000	-	-	$ 2,987	-
	Total Revenues and Other Sources	**$1,650,394**	**$1,683,223**	**$1,688,259**	**$1,643,998**	**$1,867,919**	**$2,029,564**
	Total Resources	**$2,682,772**	**$2,849,677**	**$6,009,235**	**$5,767,047**	**$6,113,844**	**$5,979,406**
Operating Expenditures							
510	General Government						
530	Physical Environment	$ 715,562	$ 937,264	$ 900,948	$ 717,202	$ 775,755	$ 733,416
	Total Operating Expenditures	$ 715,562	$ 937,264	$ 900,948	$ 717,202	$ 775,755	$ 733,416
591-593	Debt Service	$ 27,424	$ 21,756	$ 19,797	$ 17,838	$ 686,737	$1,129,200
594-596	Capital Outlay	$ 579	-	$ 294,583	$ 115,222	$ 701,511	$ 85,924
	Total Expenditures	$ 743,565	$ 959,020	$1,215,328	$ 850,262	$2,164,003	$1,948,540
597	Other Financing Uses	$ 128,000	$ 40,000	-	-	-	-
	Total Uses	$ 871,565	$ 999,020	$1,215,328	$ 850,262	$2,164,003	$1,948,540
Excess (Deficit) of Resources Over Uses		$1,811,207	$1,850,657	$4,793,907	$4,916,785	$3,949,841	$4,030,866
380	Non-revenues	$ 50,000	$ 50,000	-	-	-	-
580	Non-expenditures	$ 694,753	$ 670,858	$ 670,858	$ 670,858	-	-
Ending Net Cash and Investments							
	Unspecified	$1,166,454	$1,229,800	-	-	-	-
508.1	Reserved	-	-	$ 68,430	$ 604,442	$ 592,996	$ 591,569
508.8	Unreserved	-	-	$4,054,619	$3,641,485	$3,356,846	$3,439,297
	Total	$1,166,454	$1,229,799	$4,123,049	$4,245,927	$3,949,841	$4,030,866

Table ES-13
Summary of Historical Fund Resources and Uses Arising from Cash Transactions
Sewer Construction Funds 403-407

Sewer Construction Funds (403-407)		2008	2009	2010-2013*
Beginning Net Cash and Investments		2,914,850	3,063,003	
Revenues:				
390	Other Financing Sources	290,683	1,002,337	
	Total Revenues and Other Sources	**290,683**	**1,002,337**	
	Total Resources	**3,205,533**	**4,065,340**	
Operating Expenditures				
591-593	Debt Service	-	-	
594-596	Capital Outlay	-	-	
	Total Expenditures	-	-	
597	Other Financing Uses	244,105	1,070,053	
	Total Uses	244,105	1,070,053	
Excess (Deficit) of Resources Over Uses		2,961,428	2,995,287	
380	Non-revenues	101,575	-	
580	Non-expenditures	-	-	
	Ending Net Cash and Investments	**3,063,003**	**2,995,287**	

*The City maintained about $3 million in the Capital Funds in 2008 and 2009 before reporting of these fund levels was grouped with the Sewer Fund 401.

Tables ES-12 and **ES-13** show the following findings and trends.

- The City's sewer charges for services increased steadily from about $1.5 million in 2008 to $1.6 million in 2013, with the exception of a 2.4 percent drop in 2011. Expenses stay between $715,000 and $775,000 with the exception of 2 years at over $900,000 in 2009 and 2010, due to a higher indirect cost allocation and resulting transfer to the General Fund in those 2 years.
- The O&M Coverage Ratio (total operating revenue divided by total operating expenses) began 2008 at 167 percent, and grew to 277 percent by 2013, due to a rapidly increasing miscellaneous revenue category.
- Net Operating Income as a percent of Operating Revenue in 2008 was 40 percent and climbed to 64 percent by 2013.
- The sewer utility has no outstanding bond debt. 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 changes from 1.65 in 2008 to 1.09 in 2013, indicating the City's capacity for new debt is eroding over the 6-year period.

The CIP identifies $11.9 million inflated to year of construction in capital projects over the 6-year period and $53.1 million inflated to year of construction over the 20-year period. Costs are stated in

2014 dollars and escalated to the year of planned spending at an annual inflation rate of 3.62 percent annually to the year of planned spending. A summary is shown in **Table ES-14**.

Table ES-14
6-and 20-Year CIP

Year	2014 dollars	Inflated
Study Year 2014/2015	$ 967,329	$ 997,232
2016	$ 1,821,779	$ 1,956,017
2017	$ 1,718,345	$ 1,911,727
2018	$ 1,335,045	$ 1,539,040
2019	$ 2,192,520	$ 2,619,003
2020	$ 1,176,204	$ 1,455,839
2021	$ 1,003,995	$ 1,287,659
6-Year Capital Total	**$ 10,215,217**	**$ 11,766,515**
Expensed Outlay	$ 100,000	$ 109,311
6-Year CIP Total	**$ 10,315,217**	**$ 11,875,826**
2022-2035	$ 23,644,783	$ 41,112,932
Expensed Outlay	$ 50,000	$ 64,127
20-Year CIP Total	**$ 34,010,000**	**$ 53,052,885**

Table ES-15 summarizes the forecasted financial performance and annual revenue requirements for the 6-year planning period based on the forecast of revenues, expenditures, fund balances, financial policies, and assumptions presented in **Chapter 9** of the Plan.

Table ES-15
6-Year Financial Forecast

	Study Years		6 Year Forecast					
Revenue Requirement	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Revenues								
Rate Revenues Under Existing Rates	$1,625,618	$1,625,618	$1,647,273	$1,668,929	$1,690,585	$1,712,240	$1,733,896	$1,808,536
Non-Rate Revenues	$ 3,236	$ 4,109	$ 6,188	$ 8,448	$ 10,274	$ 12,505	$ 14,651	$ 14,144
Total Revenues	**$1,628,854**	**$1,629,727**	**$1,653,462**	**$1,677,377**	**$1,700,859**	**$1,724,745**	**$1,748,547**	**$1,822,680**
Expenses								
Cash Operating Expenses	$ 961,087	$ 938,692	$1,015,445	$1,037,687	$1,002,804	$1,024,002	$1,045,666	$1,142,548
Existing Debt Service	$ 578,900	$ 578,365	$ 577,831	$ 577,296	$ 576,761	$ 576,227	$ 575,692	$ 575,158
New Debt Service	-	-	-	$ 96,464	$ 207,172	$ 414,583	$ 520,775	$ 597,719
Rate Funded System Reinvestment	-	$ 13,281	$ 52,401	$ 54,280	$ 41,518	$ 11,732	-	-
Total Expenses	**$1,539,987**	**$1,530,338**	**$1,645,677**	**$1,765,726**	**$1,828,255**	**$2,026,544**	**$2,142,133**	**$2,315,425**
Net Surplus (Deficiency)	**$ 88,867**	**$ 99,389**	**$ 7,784**	**$ (88,349)**	**$ (127,396)**	**$ (301,799)**	**$ (393,586)**	**$ (492,745)**
Additions to Meet Coverage	-	-	-	-	-	-	-	-
Total Surplus (Deficiency)	**$ 88,867**	**$ 99,389**	**$ 7,784**	**$ (88,349)**	**$ (127,396)**	**$ (301,799)**	**$ (393,586)**	**$ (492,745)**
% of Rate Revenue	0.00%	0.00%	0.00%	5.29%	7.54%	17.63%	22.70%	27.25%
Annual Rate Adjustment	**0.00%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**4.50%**	**7.50%**
Cumulative Annual Rate Adjustment	**0.00%**	**3.50%**	**7.12%**	**10.87%**	**14.75%**	**18.77%**	**24.11%**	**33.42%**
Rate Revenues After Rate Increase	$1,625,618	$1,682,514	$1,764,600	$1,850,372	$1,939,985	$2,033,604	$2,151,994	$2,412,979
Additional Taxes from Rate Increase	$ -	$ 2,191	$ 4,517	$ 6,986	$ 9,602	$ 12,373	$ 16,097	$ 23,271
Net Cash Flow After Rate Increase	**$ 88,867**	**$ 154,095**	**$ 120,594**	**$ 86,108**	**$ 112,402**	**$ 7,192**	**$ 8,415**	**$ 88,428**
Coverage After Rate Increases	**n/a**	**n/a**	**n/a**	**11.22**	**5.86**	**3.12**	**2.81**	**3.68**

The existing sewer rate structure consists of a fixed monthly charge and a variable monthly charge per hundred cubic feet of winter average water use. The City's existing sewer rate structure is shown in **Table ES-16**.

Table ES-16
Existing Schedule of Rates

2014 Sewer Rates	
Residential	**Current**
Individually Metered	$ 37.15
Master Metered	$ 37.15
Residential Volume Charge	$ 5.19
Commercial	
Light Commercial	$ 37.15
Light Commercial Volume Charge	$ 5.19
Heavy Commercial	$ 42.23
Heavy Commercial Volume Charge	$ 6.03
General Industrial	$ 47.31
General Industrial Charge	$ 6.88

Sewer rates with forecasted rate increases for the 6-year planning period are shown in **Table ES-17**.

Table ES-17
6-Year Proposed Rates

Across the Board Projected Rate Increases								
Residential	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Individually Metered	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
Master Metered	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
Residential Volume Charge	$ 5.19	$ 5.37	$ 5.56	$ 5.75	$ 5.96	$ 6.16	$ 6.44	$ 6.92
Commercial								
Light Commercial	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
Light Commercial Volume Charge	$ 5.19	$ 5.37	$ 5.56	$ 5.75	$ 5.96	$ 6.16	$ 6.44	$ 6.92
Heavy Commercial	$ 42.23	$ 43.71	$ 45.24	$ 46.82	$ 48.46	$ 50.16	$ 52.41	$ 56.34
Heavy Commercial Volume Charge	$ 6.03	$ 6.24	$ 6.46	$ 6.69	$ 6.92	$ 7.16	$ 7.48	$ 8.05
General Industrial	$ 47.31	$ 48.97	$ 50.68	$ 52.45	$ 54.29	$ 56.19	$ 58.72	$ 63.12
General Industrial Charge	$ 6.88	$ 7.12	$ 7.37	$ 7.63	$ 7.89	$ 8.17	$ 8.54	$ 9.18

CHAPTER 1

Introduction

1-1. 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, a treatment facility including ultraviolet disinfection, sludge stabilization ponds, and river discharge.

1-2. OVERVIEW OF EXISTING SYSTEM

The City limits encompass approximately 2.8 square miles, while the planned sewer service area is the same as the City's Urban Growth Boundary (UGA), which encompasses 3.4 square miles. The City experienced a steady increase in growth from a population of 3,755 in 1999 to a population of 6,073 in 2009 (6.2% per year). The City has experienced a slower rate of growth in population since 2009 to a 2013 population of 6,340 (1.1% per year), which is the base year for this plan. As of December 2013, the City provided service to approximately 2,143 customer connections within the City's sewer service area. The City's sewer system is comprised of 1 treatment plant, 7 pump stations, and approximately 27 miles of gravity collection and force main pipes. A summary of sewer system data is provided in **Table 1-1**.

Table 1-1
2013 Sewer System Data

Description	Data
Population (City, 2013)	6,340
Sewer Planning Area (acre)	2,187
Total Connections	2,143
Number of Persons Per Household	2.9
Average Gallons Per Capita Per Day	83 gpcd
Average Daily Flow	0.52 MGD
Number of Pump Stations	7
Total Length of Sewer Main	~ 27.2 miles

1-3. AUTHORIZATION AND PURPOSE

In November 2013, the City authorized RH2 Engineering, Inc., (RH2) to prepare a Comprehensive Sewer System Plan (Plan) in accordance with Washington Administrative Code (WAC) 173-240-050. The previous Plan was prepared for the City in 2010. The purpose of this updated Plan is as follows.

- Snohomish County (County) is updating its Comprehensive Plan and the associated population allocation to the individual cities within the County. The City is also updating its planning documents as information becomes available for consistency with the County Comprehensive Plan. The process impacts the City's UGA boundary as well as its population projections, which are revised for this Plan update.

- To evaluate existing sewer flow data and project future flows.
- To analyze the existing sewer system to determine if it meets minimum requirements mandated by the Washington State Department of Ecology (Ecology), and the City's own policies and design criteria.
- To determine the overall reliability and vulnerability of existing wastewater lift stations.
- To identify sewer system improvements that will resolve existing system deficiencies and accommodate future system needs.
- To prepare a schedule of improvements that meets the goals of the City's financial program.

1-4. RELATED PLANS AND STUDIES

As part of preparing this Plan, several plans and studies were examined, including the following.

- City of Stanwood *Wastewater Facilities Plan* (May 2000)
- City of Stanwood Public Works Department Technical Memorandum Wastewater Characterization Survey (1999)
- City of Stanwood *General Sewer Plan* (March 2010)
- City of Stanwood *Comprehensive Plan* (December 2012)

1-5. PROJECTS COMPLETED SINCE THE 2010 PLAN

The Plan was last updated in March 2010. The City has undergone several projects since the previous Plan was first prepared in 2008 and has implemented a majority of the recommended projects in the 2010 Plan, including electrical improvements at Church Creek Lift Station, sewer main replacement along Pioneer Highway, and removal of biosolids at the City's sludge stabilization ponds. **Table 1-2** provides a list of the projects that have been completed since the City's previous Plan.

Table 1-2
Projects Completed Since 2008

Project Description	Year	Engineering Cost	Construction Cost	Project Cost
Church Creek Lift Station Electrical Improvements	2009	$31,000	$66,000	$97,000
Biosolids Removal and Hauling	2009	$41,000	$379,000	$420,000
80th Alley Sewer Repair	2010	$0	$100,000	$100,000
CCTV Sewer Line Inspection and Cleaning	2011	$0	$21,000	$21,000
CCTV Sewer Line Inspection and Cleaning	2012	$0	$21,000	$21,000
94th Drive Force Main Emergency Repair	2012	$0	$16,000	$16,000
94th Drive Force Main Slip Line	2012	$0	$122,000	$122,000
Pioneer Highway Sewer Main Replacement	2012	$35,000	$404,000	$439,000
Sodium Hypochlorite Injection System	2013	$0	$8,000	$8,000

1-6. SUMMARY OF PLAN CONTENTS

A brief summary of the content of the chapters in this Plan is as follows.

- **Chapter 1** introduces the reader to the City's sewer system, the objectives of the Plan, and the Plan organization.
- **Chapter 2** presents the sewer service area and describes the existing sewer system.
- **Chapter 3** presents related plans, land use, and population characteristics.
- **Chapter 4** identifies existing wastewater flow rates and projects future 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** presents the proposed sewer system improvements, their estimated costs, and an implementation schedule.
- **Chapter 8** discusses the City's operations and maintenance program.
- **Chapter 9** summarizes the financial status of the sewer utility and presents a plan for funding the sewer improvements.

1-7. LIST OF ABBREVIATIONS

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

Table 1-3
Abbreviations

Abbreviation	Description
AAF	Average Annual Flow
BOD	Biochemical Oxygen Demand
CIP	Capital Improvement Plan
City	City of Stanwood
DOH	Department of Health
Ecology	Department of Ecology
EPA	Environmental Protection Agency
fps	feet per second
GMA	Growth Management Act
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
HDPE	High Density Polyethylene
HMI	human interface
hp	horsepower
I/I	Infiltration and Inflow
L&I	Labor and Industries
LF	linear feet
MGD	million gallons per day
mg/L	milligrams per liter
mL	millilieters
MUTCD	Manual on Uniform Traffic Control Devices
NH3-N	Ammonia as Nitrate
NPDES	National Pollutant Discharge Elimination System
OFM	Office of Financial Management
OSHA	Occupational Safety and Health Administration
Plan	Comprehensive Sewer System Plan
ppd	pounds per day
PVC	Polyvinyl Chloride
RAS	Return Activated Sludge
RCW	Revised Code of Washington
SCADA	Supervisory control & data acquisition
SEPA	State Environmental Policy Act
SMC	Stanwood Municipal Code
TDH	Total Dynamic Head
TSS	Total Suspended Solids
UGA	Urban Growth Area
UV	Ultraviolet
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Act

CHAPTER 2

Sewer System Description

2-1. INTRODUCTION

This chapter describes the City of Stanwood's (City) sewer service area and the sewer system and its individual components. The results of the evaluation and analyses of the existing sewer system are presented in **Chapter 6.**

2-2. 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 pump 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 service area and **Figure 2-2** is a map of the existing sewer system.

The City's primary 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. In 1973, the plant was upgraded with the addition of effluent chlorination facilities and a propeller-type flow meter. The City constructed a new wastewater treatment plant in 2004 to increase the system's total capacity to 1.5 million gallons per day. 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. For more information on the treatment facility and facility upgrades, refer to the City of Stanwood *Wastewater Facilities Plan* by Tetra Tech/KCM, Inc., dated May 2000. 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.

Geology

The City is located in the Puget Sound Lowland in an area with a complex geological history. Geologic conditions in the area are the result of at least two glaciations separated by nonglacial and interglacial periods followed by post-glacial erosion and recent alluvial deposition by the Stillaguamish River. Vashon glacial till, a dense mixture of sand, gravel, silt, and clay, exists to a depth of 50 to 70 feet below the ground surface on upland areas above downtown Stanwood. Below the glacial till is a layer of Vashon advance outwash, approximately 60 to 80 feet thick, composed of sandy and silty gravel.

The lowland area of the Stillaguamish River channel consists of active or abandoned channel and flood overbank deposits. Channel deposits consist of thin to thick layers of loose, dark brown to olive to black, fine to medium-grained sand with sub-rounded gravel up to several inches in diameter. Finer-grained brown to olive gray overbank deposits consist primarily of thin layers of fine sand, sandy silt, silt, and occasional peat. Channel and overbank deposits are interlayered to depths of several tens to hundreds of feet. The channel and overbank deposits are typically groundwater-saturated below depths of 5 to 10 feet, but seasonal fluctuations may bring groundwater to the surface. Subsurface construction in the river channel deposits of the downtown Stanwood area typically require management of unstable sidewalls, running sands, and groundwater seepage into excavations.

Topography

The topography of the area served by the City varies greatly in elevation. The lowest areas served are located in the downtown Stanwood area with an approximate elevation of 10 feet. The areas to the east are located on a hill. The highest areas served are located in the northeast portion and have an elevation of approximately 225 feet. The contours of the Urban Growth Area (UGA) and surrounding sewer service area are shown in **Figure 2-1**.

Climate

The climate in the City is typical of Snohomish County. There is a weather station in Stanwood and the average summer temperature is 62 degrees Fahrenheit with an average daily maximum temperature of 74 degrees Fahrenheit. The average winter temperature in Stanwood is 42 degrees Fahrenheit with an average daily minimum temperature of 35 degrees Fahrenheit. Precipitation most often occurs during the months of September to April, with the heaviest rains generally occurring during the month of November. The average total annual precipitation for Stanwood is 22 inches.

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 the Irvine Slough, Douglas Creek, and Douglas Slough, as shown in **Figures 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 2.8 square miles, as shown in **Figure 2-1**. 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 **Figure 2-1** and **2-2**.

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

The northern, southeastern, and southwestern portions of the 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 the Washington State Growth Management Act guidelines. The UGA and a larger sewer service planning area were documented in the City's *Wastewater Facilities Plan,* completed in May 2000. The Washington State Department of Ecology (Ecology) has indicated that Chapter 36.70A of the Revised Code of Washington (RCW) prohibits the extension of the sewer service outside the UGA unless public health and safety and the environment will be adversely affected. The proposed sewer service area from the City's *Wastewater Facilities Plan* was revised to comply with the RCW and City codes.

The City has proposed an amendment to the UGA, which is currently under review by the County. The County is not expected to complete its analysis of the UGA amendment until June 2015. If the County Council approves the UGA amendment in 2015, this Plan will be amended accordingly. The proposed UGA addition and removal areas are also shown in **Figure 3-1**.

2-3. EXISTING SEWER FACILITIES

The City owns, operates and maintains the wastewater system, which includes the collection system, sewage pump stations, a wastewater treatment facility and an effluent outfall.

Collection Piping

The City has approximately 27 miles of sewer piping, including collection sewers and interceptors. There are approximately 7,089 feet of force main throughout the system. Approximately 78% of the system is 8-inch-diameter gravity main, totaling approximately 21 miles. **Table 2-1** summarizes the pipe by diameter. **Figure 2-2** illustrates pipe size and location.

Table 2-1
Sewer Piping Inventory

Diameter (in)	Total Length (ft)	Total Length (mi)	% of Entire System
6	2,349	0.44	1.6%
8	112,658	21.34	78.4%
10	6,262	1.19	4.4%
12	7,629	1.44	5.3%
14	3,356	0.64	2.3%
15	6,814	1.29	4.7%
18	809	0.15	0.6%
20	245	0.05	0.2%
24	179	0.03	0.1%
27	3,180	0.60	2.2%
30	113	0.02	0.1%
36	74	0.01	0.1%

Lift Stations

The City currently owns, operates, and maintains seven wastewater lift stations. The operation of the pumps in the lifts stations are dictated by the water level in the wet wells. None of the City's lift stations has a bypass to a water of the State. The characteristics of each lift station are summarized in **Table 2-2**, and a description of each lift station follows. The firm capacities presented in **Table 2-2** 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 2-2
Lift Station Characteristics

Lift Station	Pump Station					Pumps					Wet Well			Year Designed
	Manufacturer	No. of Pumps	Model	Serial No.	Force Main Dia. (in)	HP	TDH (ft)	Design Capacity (gpm)	2010 City Tested Capacity (gpm)	Firm Capacity (gpm)	Diameter (ft)	Depth (ft)	Length (ft)	
1-Church Creek	Hydromatic	2	Submersible	-	4	7.5	55	150 150	238	150	5.9	14.3	NA	1990
2-Cedarhome	Gorman-Rupp	2	Self-priming	1120394 1120395	6	20	76	345 345	333	333	12.1	7.7	17	1997
3-Pioneer Hills	Gorman-Rupp	2	Self-priming	1170041 1170042	6	20	72	500 500	470	470	14.5	8	20	1999
4-Main	ITT-Flygt	3	Wet Pit/ Dry Pit	9860070 9860071 9860072	14	20	50	950 950 950	NA	1900	6.1	18.3	NA	1999
5-Taylor's Landing	Gorman-Rupp	2	Self-priming	1251514 1251515	4	7.5	52	150 150	91	150*	5	20.8	NA	2001
6-Copper Station	Wemco	2	Submersible	06DW05896-01 06DW05896-02	6	20	137	300 300	NA	300	5.8	16.5	NA	2005
7-Lindstrom Development	Gorman-Rupp	2	Self-priming	1133852 1133853	4	7.5	45	160 160	198	198	8.5	13.3	NA	2007

* The firm capacity of this lift station is listed as the design capacity due to known priming issues that affected the testing

Church Creek Lift Station

Church Creek Lift Station, located at 272nd Street NW, was constructed in 1990, upgraded in 2009, and serves the Church Creek Estates development. This small submersible-type lift station is located at the east end of the collection system. The lift station has two pumps, each with a design capacity of 150 gallons per minute (gpm) at 55 feet of discharge head. This station has a 4-inch force main. Standby power is provided via a trailer-mounted engine generator. The City conducted pump testing on the installed pumps in 2008 as part of the previous Plan and the result is presented in **Table 2-2**. The results of the pump testing can be found in **Appendix A**. 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. This is a self-priming lift station located at the east end of the collection system. The lift station has two pumps, each with a design capacity of 345 gpm at 76 feet of discharge head. 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 the previous Plan and the result is presented in **Table 2-2**. The results of the testing can be found in **Appendix A**. The water level in the wet well is measured by a bubbler.

Pioneer Hills Lift Station

Pioneer Hills Lift Station is located along Pioneer Highway and was constructed in 1999 to serve the Pioneer Hills development. This is a self-priming lift station located at the north end of the collection system. The lift station has two pumps, each with a design capacity of 500 gpm at 72 feet of discharge head. 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 the previous Plan and the result is presented in **Table 2-2**. The results of the testing can be found in **Appendix A**.

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

Main Lift Station

Main Lift Station is located on 94th Drive NW and was rebuilt in 1999 to transport all of the wastewater from the City's collection system to the wastewater treatment plant. The wetwell/drywell type lift station is located on the western end of the collection system. The lift station has three pumps, each with a design capacity of 950 gpm at 50 feet of total discharge head that are controlled by a variable frequency drive. This station has a 16-inch steel force main that was slip lined with 14-inch high-density polyethylene (HDPE) pipe in 2012. An engine generator for standby power was also added in 2012. Pump testing at this lift station was not completed to confirm actual capacity. The water level in the wet well is measured by a bubbler and the lift station also has floats for backup.

Taylor's Landing Lift Station

Taylor's Landing Lift Station, located at the intersection of Pioneer Highway and 78th Avenue NW, was constructed in 2001 to serve a small housing development in the area. This is a self-priming lift station located at the south end of the collection system. The lift station has two pumps, each with a design capacity of 150 gpm at 52 feet of discharge head. This station has a 4-inch force main and standby power is provided via a portable engine generator. The City conducted pump testing on the installed pumps in 2008 as part of the previous Plan and the result is presented in **Table 2-2**. The City has indicated that this pump has prime/reprime issues; therefore, the results of the tests are not under optimal conditions. The results of the testing can be found in **Appendix A**. The water level in the wet well is measured by a bubbler.

Copper Station Lift Station

Copper Station Lift Station is located north of 288th Street NW and was constructed in 2005 to serve the Copper Station housing development. This submersible type lift station is located at the northernmost end of the collection system. The lift station has two pumps, each with a design capacity of 300 gpm at 137 feet of total discharge head. This station has a 6-inch force main and an engine generator on site for standby power. Copper Station Lift Station is a newer lift station that was capacity tested when construction was completed. The City did not conduct pump testing since the station is relatively new. 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 was formerly a privately-owned lift station that served the commercial area south of State Route 532. The City took ownership of this lift station in 2007. This is a self-priming lift station located at the southeastern end of the collection system. The lift station has two pumps, each with a design capacity of 160 gpm at 45 feet of discharge head. This station has a 4-inch force main and an engine generator on site for standby power. The City conducted pump testing on the installed pumps in 2008 as part of the previous Plan and the results are presented in **Table 2-2**. The results of the testing can be found in **Appendix A**. The water level in the wet well is measured by a transducer and the lift station also has floats for backup.

Wastewater Treatment and Disposal Facilities

The City's existing 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 biological oxygen demand (BOD) loads from the industrial source, Twin City Foods. In 1991 and 1992, the dikes around the treatment facility were raised to a nominal elevation of 11.0 feet due to the flooding during the end of 1990.

The City upgraded the treatment plant in 1996 to include conversion of the 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 a 0.25 million gallons per day (MGD) to a 1.5 MGD treatment plant. These upgrades included construction of headworks, oxidation ditches and secondary clarifiers, an ultraviolet disinfection system, a scum system, a plant water system, a yard pump station, sludge stabilization ponds, and a decant pump station. 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 plant was upgraded with a sodium hypochlorite injection system that feeds into the washdown water line and the RAS piping.

The City's current National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit allows an average influent flow for the maximum month of 1.5 MGD, a maximum month influent 5-day biological oxygen demand (BOD_5) of 4,100 pounds per day (ppd), and a maximum month influent total suspended solids (TSS) of 4,100 ppd. The 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. The permit allows the following average monthly maximum effluent limitations: BOD_5 of 376 ppd; TSS of 376 ppd; fecal coliform of 200/100 milliliters (mL); and total ammonia as NH3-N of 10 milligrams per liter (mg/L). A copy of the current NPDES permit is located in **Appendix B**.

Telemetry and Supervisory Control

Successful operation of any municipal sewer system requires gathering and using accurate sewer system information. A telemetry and supervisory control system gathers information and can efficiently control a system by automatically optimizing facility operations. A telemetry and supervisory control system also provides instant alarm notification to operations personnel in the event of equipment failure, operation problem, flood, fire or other emergency situations.

The City's telemetry and supervisory control system consists of an older autodialer system and a new supervisory control and data acquisition (SCADA) system that was installed with the upgraded wastewater treatment plant in 2004. The older autodialer units are located at each of the City's lift stations with the exception of the Lindstrom, Copper, and Church Creek Stations. These autodialer units still operate sufficiently, and the telemetry is still functional at these lift stations. The new SCADA system includes Lindstrom and Copper Station Lift Stations, the wastewater treatment plant, and the recently upgraded Church Creek Lift Station. These four facilities are monitored through programmable logic controllers connected to a Human Machine Interface (HMI) computer. Alarms generated by the autodialer units and the new SCADA system are transmitted to the staff by phone using dedicated alarm systems. Daily report data from the older autodialers is sent via fax every morning to the treatment plant. Data from the new SCADA system is continuously collected on the wastewater treatment plant HMI computer system. Operators can view the HMI data in real time or historical information. The HMI computer also automatically creates wastewater treatment plant reports required by Washington State.

Industrial Wastewater Characterization

As part of the City's wastewater treatment facility upgrades, the City completed an industrial wastewater characterization study in 1999 to determine strength and flow. The report that characterizes the City's industrial users is the *City of Stanwood Public Works Department Technical Memorandum Wastewater Characterization Survey*, August 1999 by TetraTech/KCM, Inc. In general, the City's industrial wastewater characterization has not changed. In addition, there are no known new industrial users coming into the City in the near future.

The City's wastewater treatment facility receives wastewater from two major industrial sources, North Star Cold Storage, Inc., and Roy N. Carlson, Inc.

North Star Cold Storage, Inc., has a seafood processing plant located at 27100 Pioneer Highway, which operates for 8 to 9 hours a day, 5 to 6 days per week, according to the facility's discharge permit fact sheet. The characteristics of the wastewater from the North Star Cold Storage, Inc., facility reported in the facility's discharge permit fact sheet are presented in **Table 2-3**.

Table 2-3
North Star Cold Storage, Inc., Facility Wastewater Characteristics

Parameter	Minimum	Average	Maximum
Flow (gpd)	8,900	34,703	49,900
BOD_5 (mg/L)	4	636	4,470
TSS (mg/L)	6	139	776
Oil and Grease (mg/L)	5	13.3	79
pH	5.5	7.13	8.0

Roy N. Carlson, Inc., has a trucking center located at 8506 Cedar Home Drive. According to the facility's discharge permit fact sheet, the main source of wastewater from this facility is from the tanker truck cleaning operations. The characteristics of the wastewater from the Roy N. Carlson, Inc., facility reported in the facility's discharge permit fact sheet are presented in **Table 2-4**.

Table 2-4
Roy N. Carlson, Inc., Wastewater Characteristics

Parameter	Minimum	Average	Maximum
Flow (gpd)	547	935	1,269
BOD_5 (ppd)	1.2	8.6	36
COD (ppd)	0.74	4.75	11.1
TSS (ppd)	0.14	0.45	2.09
Oil and Grease (mg/L)	2.7	15.6	97
pH (Minimum)	6.04	6.17	6.68
pH (Maximum)	6.12	6.54	7.16

2-4. ADJACENT SEWER SYSTEMS

There are no other nearby municipal sewer service systems. There are private industrial wastewater generators that are located in the City. This includes Twin City Foods and the Schenk Meat Packing Plant. Twin City Foods is a vegetable processing and cold storage facility. The Twin City Foods NPDES permit allows the facility to apply treated wastewater at an agronomic rate through spray irrigation between the months of March through October. No spray irrigation is permitted between November 1st and March 1st. The facility ceased discharging its waste to the City's wastewater treatment plant in 2000. The Schenk Meat Packing Plant is located in the northeast portion of the City and has its own lagoon and effluent disposal system.

2-5. THE CITY OF STANWOOD WATER SYSTEM

The City of Stanwood

This section provides a brief description of the existing water system and the current operation of the facilities. The water service area and system facilities are shown in **Figure 2-4**.

Pressure Zones

The City serves customers within an elevation range of approximately sea level, near the shores of Skagit Bay and the Stillaguamish River, to approximately 250 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 flow requirements of the system. The City achieves this by dividing the water system into seven distinct pressure zones.

Supply Facilities

Introduction

All water supply to the City's water system is provided by a few groundwater wells in the East Stanwood Aquifer and one groundwater spring source. 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 is currently offline due to a November 2011 landslide restricting access to the site. Bryant Well No. 1 is the City's largest single source of supply located near SR 532 and 268th Street NW. Bryant Well No. 2, which is located adjacent to Bryant Well No. 1, is offline due to a decline in capacity and is considered an emergency source of supply. An emergency source is a source of supply that DOH has approved for use, but is not utilized for routine or seasonal demands. A replacement, Bryant Well No. 3, was drilled in 2013 and is planned for connection 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 Fure Well, which is located on the eastern edge of the City limits, is out of service and is considered an emergency source.

Water Treatment

The City transitioned to system-wide chlorination in 2008. The Cedarhome Well and Bryant Well No. 1 are chorinated. Hatt Slough Springs was chlorinated as a precautionary measure when it was in use, even though harmful bacteria have never been detected. The spring source has been tested and determined not to be under the direct influence of surface water. Historically, the water quality at all of the sources has been excellent, aside from slightly higher than allowable manganese levels at Bryant Well No. 1 and Fure Well, and slightly higher than allowable 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 No. 1 for arsenic, manganese, and hydrogen sulfide using an oxidation and filtration process. This facility will also treat the future Bryant Well No. 3, the replacement for Bryant Well No. 2. 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 on-site 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.

When Hatt Slough Springs is in service, chlorination is achieved by continuous injection of sodium hypochlorite (liquid chlorine) into the system during operation of the pumps at the facility. The 12.5 percent concentrated sodium hypochlorite solution is created with 1 gallon of sodium hypochlorite per 8 gallons of water. The chlorination equipment at the Hatt Slough Springs site consists of a 50-gallon dilution tank and metering pump for the disinfection process.

The Fure Well is considered an emergency source and it is not currently chlorinated.

Water Conservation

The City has a Water Use Efficiency (WUE) program that meets the requirements of Chapter 246-290 of the Washington Administrative Code (WAC). Based on the successful implementation of the current WUE program, the City has achieved one of the goals adopted in 2010 ahead of schedule. The 2010 goal was to reduce the 4-year rolling average demand per equivalent residential unit (ERU) to 201 gallons per day (gpd) by 2019 and 195 gpd by 2029. The 4-year rolling average demand per ERU in 2013 was 192 gpd, which is well below the 2029 goal. The City continues to strive to meet the other goal, which is to achieve 10 percent or less DSL. New goals have been proposed based on the demand analysis and projections presented in the City's updated 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 185 gpd by 2035; and
- Improve distribution system leakage to 10 percent or less by 2035.

The City will achieve these goals and objectives through the implementation of the WUE program that follows. 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.

The City's current WUE program is contained in **Appendix F** of the *2015 Comprehensive Water System Plan*.

Pump Station Facilities

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

The Cedarhome Booster Pump Station was originally constructed in 1973 and replaced in 2006 with a larger capacity facility. The new above-grade Cedarhome Booster Pump Station is located on the northwest corner of 68th Avenue NW and 282nd Place NW. Three identical, horizontal split case centrifugal pumps powered by 20 horsepower motors provide the primary supply from the 297 Zone to the 365 Zone Cedarhome Reservoir. The pump station does not have a power receptacle to enable connection of a portable engine generator set for backup power supply.

The Knittle Booster Pump Station, 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 Booster Pump Station. The primary pump is rated at 15 gpm and powered by a 3 horsepower motor. The two lag pumps are rated at 85 gpm and powered by 5 horsepower motors. The fourth pump, which can provide fire flow to the 365 Zone, is rated at 1,175 gpm and powered by a 50 horsepower motor. The pump station has a power receptacle to enable connection of a portable engine generator set for backup power supply.

Storage Facilities

Knittle Reservoir No. 1 is located north of 276th Street NW and Stauffer Road on a dirt road and provides 200,000 gallons of water storage for the 297 Zone. Knittle Reservoir No. 2 is located on the same site as Knittle Reservoir No. 1 and also provides 1,000,000 gallons of water storage for the 297 Zone. Cedarhome Reservoir is also located on the same site as Knittle Reservoir No. 1 and provides 550,000 gallons of water storage for the 365 Zone. The two 200,000 gallon Bailey Reservoirs are located on 81st Drive NW on the same site as the Bailey Booster Pump Station.

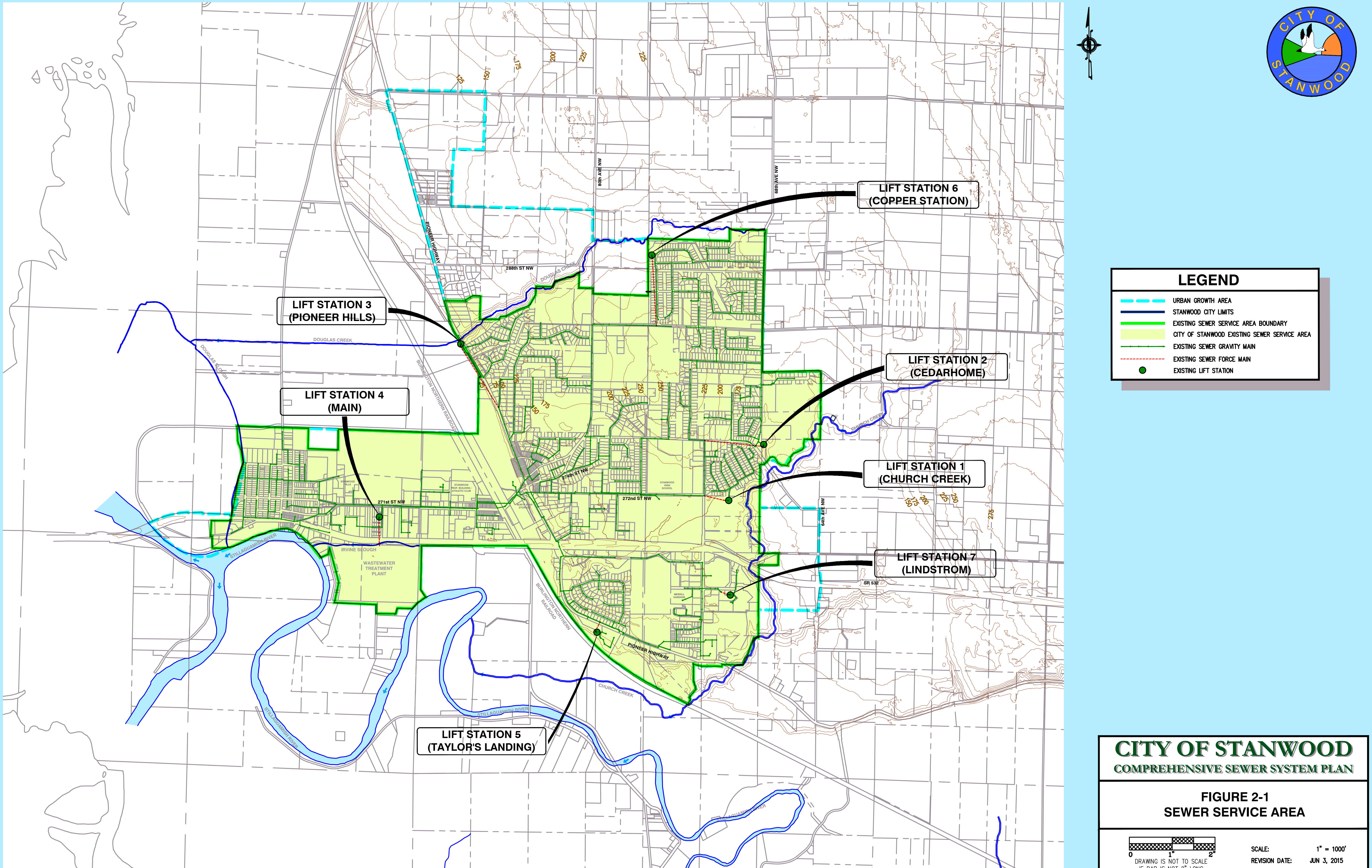
Distribution and Transmission System

The City's retail water service area contains more than 64 miles of water main ranging in size from less than 1 inch to 42 inches. Most of the water main (approximately one-third) within the existing retail water service area is 8-inch diameter, and nearly 80 percent of all water main is 8-inch diameter or smaller.

Water System Interties

Water system interties are physical connections between two adjacent water systems. Interties are normally separated by a closed isolation valve or control valve. Emergency supply interties provide water from one system to another during emergencies situations only. An emergency situation may occur when a water system loses its main source of supply or a major transmission main 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 are typically supplying 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 connecting 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) and Skagit County PUD. Potential interties are discussed in more detail in **Chapter 6** of the *2015 Comprehensive Water System Plan*. The City may also supply water to Camano Island due to aquifer limitations and salt-water intrusion on the island. The City does not have excess supply during the summer months, but could potentially serve as a link between Camano Island and other water districts in the area.



CITY OF STANWOOD

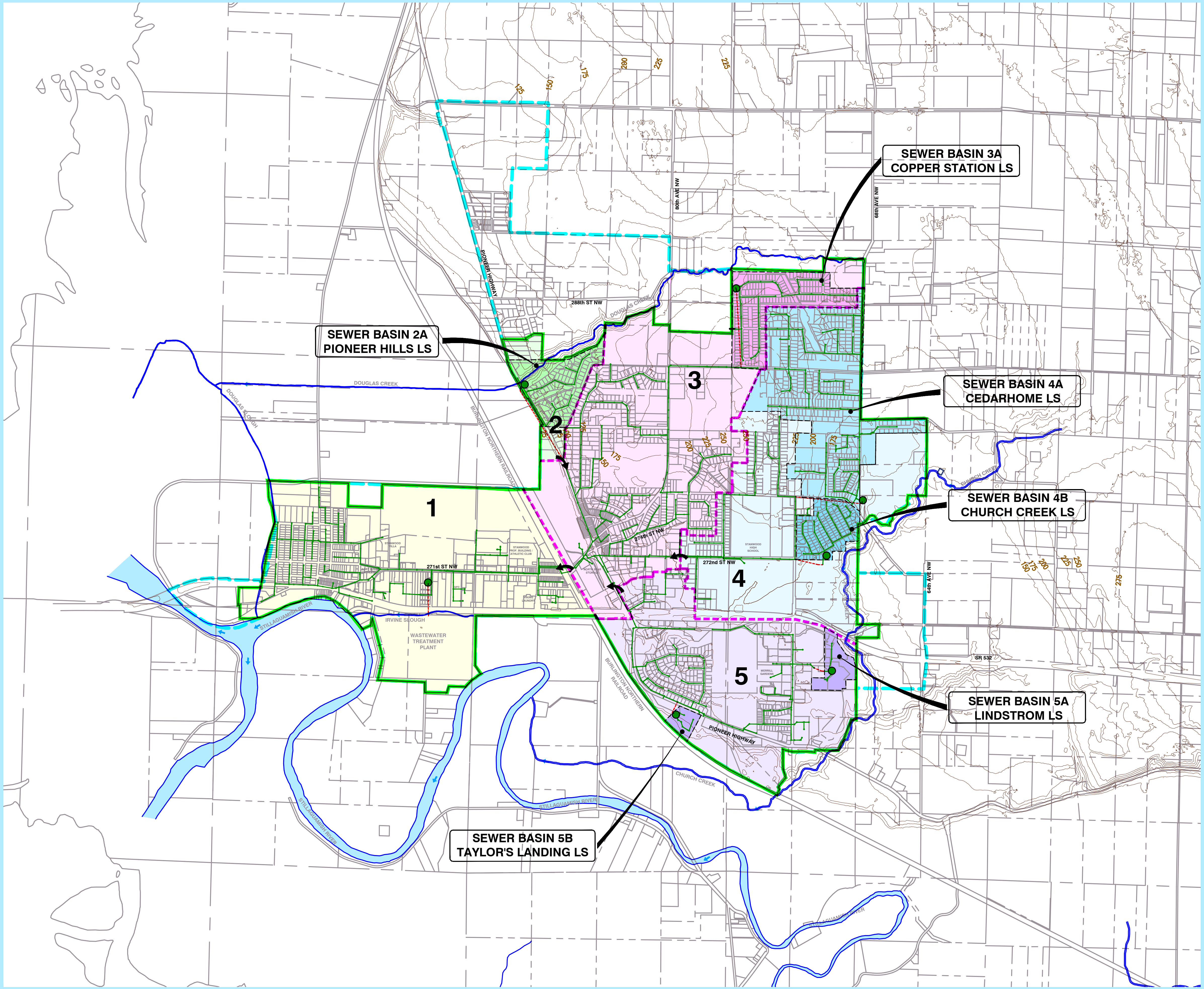
COMPREHENSIVE SEWER SYSTEM PLAN

FIGURE 2-1
SEWER SERVICE AREA

0 1" 2"
DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG

SCALE: 1" = 1000'
REVISION DATE: JUN 3, 2015

FIGURE 2-2
CITY OF STANWOOD
EXISTING SANITARY SEWER SYSTEM
1" = 500'



LEGEND

DRAINAGE BASINS

- DRAINAGE BASIN 1
- DRAINAGE BASIN 2
- DRAINAGE BASIN 3
- DRAINAGE BASIN 4
- DRAINAGE BASIN 5

BOUNDARIES / SYMBOLS

- URBAN GROWTH AREA
- STANWOOD CITY LIMITS
- EXISTING SEWER SERVICE AREA BOUNDARY
- SEWER DRAINAGE BASIN BOUNDARY
- LIFT STATION BASIN BOUNDARY
- SEWER DRAINAGE BASIN FLOW DIRECTION
- EXISTING SEWER GRAVITY MAIN
- EXISTING SEWER FORCE MAIN
- LIFT STATION

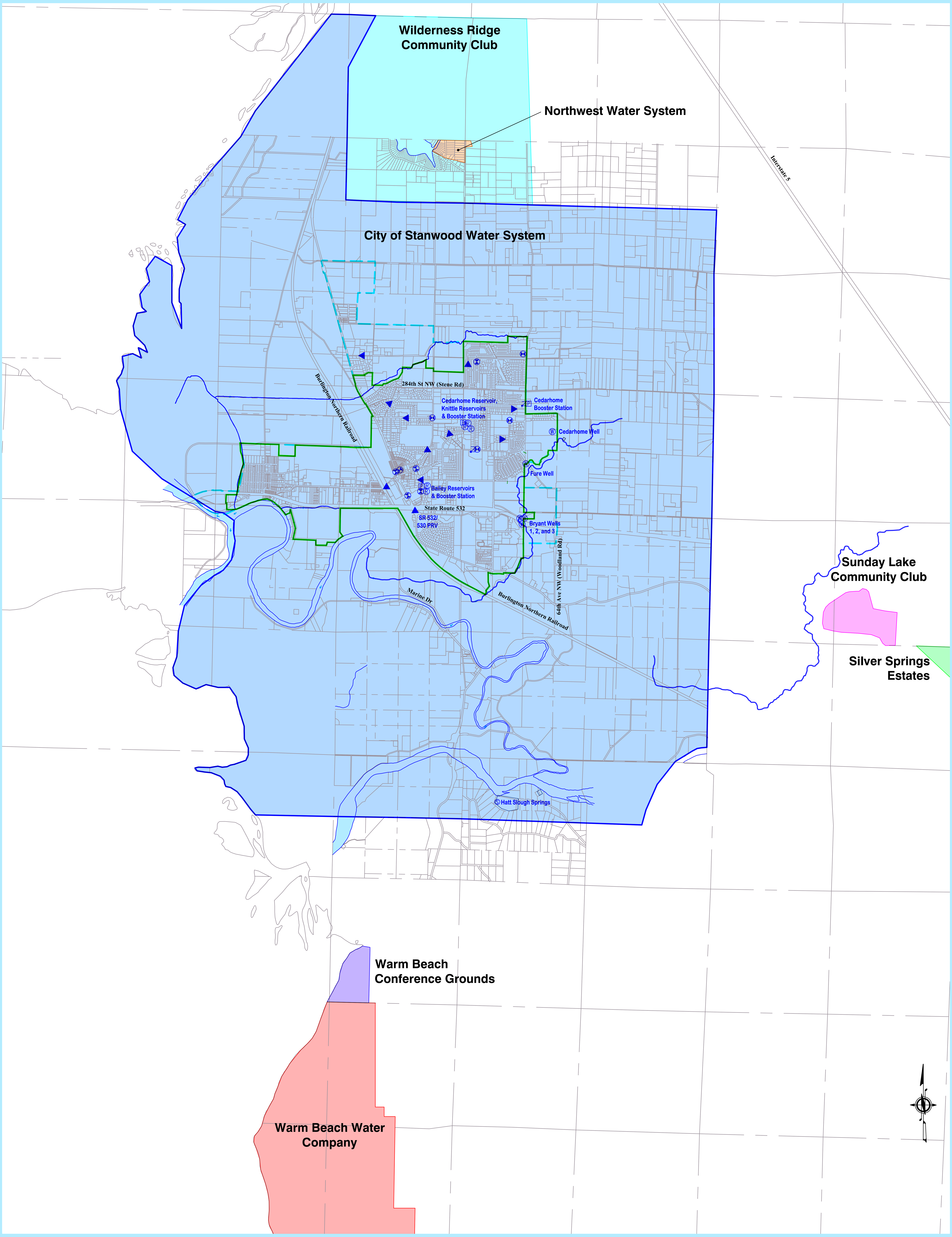
CITY OF STANWOOD

COMPREHENSIVE SEWER SYSTEM PLAN

FIGURE 2-3
SEWER DRAINAGE BASINS

0 1" 2"
DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG

SCALE: 1" = 1000'
REVISION DATE: JUN 3, 2015



LEGEND

BOUNDARIES

- URBAN GROWTH AREA
- STANWOOD CITY LIMITS
- EXISTING SEWER SERVICE AREA BOUNDARY
- FUTURE WATER SERVICE AREA

WATER FACILITIES

- Ⓡ RESERVOIR
- Ⓦ WELL
- Ⓢ SPRING
- ◄ PRESSURE REDUCING VALVE
- Ⓟ BOOSTER PUMP STATION
- N CHECK VALVE
- CLOSED VALVE

WATER SERVICE AREAS

- NORTHWEST WATER SYSTEM
- SILVER SPRINGS ESTATES
- CITY OF STANWOOD WATER SYSTEM
- SUNDAY LAKE COMMUNITY CLUB
- WARM BEACH WATER ASSOCIATION
- WARM BEACH CONFERENCE GROUNDS
- WILDERNESS RIDGE COMMUNITY CLUB

CITY OF STANWOOD

CITY OF STANWOOD
COMPREHENSIVE SEWER SYSTEM PLAN

FIGURE 2-4
WATER AND SEWER SERVICE AREAS

0 1" 2"
DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG

SCALE: 1" = 2000'
REVISION DATE: OCT 9, 2014

J:\DATA\STA\413-137\CAD\STA-SRVC-AREAS

CHAPTER 3

Land Use and Population

3-1. 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 last updated in December 2012. The City's *Comprehensive 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 *Comprehensive Sewer System Plan* (Plan) with other plans, identifies the designated land uses within the existing and future service area, and presents population projections within the City's planning area.

3-2. COMPATIBILITY WITH OTHER PLANS

Introduction

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

- *Growth Management Act*
- *City of Stanwood Comprehensive Plan*
- *Snohomish County Comprehensive Plan*

Growth Management Act

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

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.
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. As part of the development of its 1995 *Comprehensive Plan*, the City designated an UGA that would accommodate the City's projected population growth and projected growth within the unincorporated portion of the UGA for a 20-year planning period. Since this time, the City has modified its UGA. The current UGA is shown in **Figure 3-1.**

The City has proposed an amendment to the UGA, which is currently under review by the County. The County is not expected to complete its analysis of the UGA amendment until June 2015. If the County Council approves the UGA amendment in 2015, this Plan will be amended accordingly. The proposed UGA addition and removal areas are also shown in **Figure 3-1**.

The City anticipates approval of the UGA amendment by the County in July 2015. The City expects to amend the Plan in 2016 with proposed improvements to provide sewer service to the proposed UGA additional areas.

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 (SEPA) checklist in **Appendix C** addresses other environmental concerns.

City of Stanwood Comprehensive Plan

The City's *Comprehensive Plan* is undergoing an update concurrently with this update of the City's Plan. 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 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 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 give 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 principal of concurrency as defined in the GMA. The City's Plan was reviewed and taken into consideration during the development of, and subsequent revisions to, the capital facilities element of its *Comprehensive Plan*.

The City's 2015 *Comprehensive Plan* will include information from the *2012 Buildable Land Report for Snohomish County* (Appendix D). A copy of the information relevant to the City of Stanwood from the *2012 Buildable Land Report for Snohomish County* is located in **Appendix D**. The analysis indicated that the existing City limits has the capacity for approximately 3,703 additional people and the unincorporated UGA has the capacity for approximately 1,392 additional people so the UGA has the capacity for approximately 5,095 additional people in total. The County allocated 3,586 people for the City limits and 731 people for the unincorporated UGA for a total of 4,317 people for the UGA through 2035. Based on this information, the City's *Comprehensive Plan* will show that the remaining capacity for the UGA is greater than the expected growth allocation in the UGA for 2014 to 2035 and the expected growth allocation for the existing City limits is greater than the remaining capacity in the City limits for 2014 to 2035. To accommodate for the expected growth allocation exceeding the remaining capacity in the existing City limits, the City is planning to rezone the future land use designations in parts of the City limits to allow for denser development in those areas of the City or to shift development to the unincorporated UGA, which has additional capacity available.

Snohomish County Comprehensive Plan

The County adopted the *Snohomish County Comprehensive Plan* on June 28, 1995, effective on July 10, 1995. Since this time, the *Snohomish County Comprehensive Plan* has been amended several times to incorporate UGA changes, capital facility plan changes, and land use changes. The most recent amendments took effect on December 21, 2013. The *Snohomish County Comprehensive Plan* consists of the following five sections.

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

The *Snohomish County 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 *Snohomish County Comprehensive Plan* contains the following land use goals that "form the basis of the County's land use strategy and:

- Provides for a supply and distribution of land use types to accommodate the majority of county population and employment growth within urban growth area;
- …reduces development pressures and patterns of sprawl within rural areas;
- Conserves agricultural, forest and mineral resource lands of long-term commercial significance; and
- Preserves and protects open space, scenic and cultural resources."

3-3. LAND USE

The City limits currently encompasses an area of approximately 1,775 acres, or 2.8 square miles. The City's UGA encompasses an additional 425 acres outside of the current City limits for a total area of

3.4 square miles. The sewer service planning area is the same as the City's UGA, with 2,200 total acres. The City's 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.

Approximately 59 percent of the area within the current City limits is designated for residential use, as indicated in **Table 3-1**. Approximately 10 percent is designated for commercial land, approximately 7 percent is designated for industrial land; and approximately 17 percent is designated for public facilities. The remaining land area within the City limits is non-designated right-of-way or other City property. The undesignated area includes various undesignated right-of-way in the City, including State Route 532.

Within the City's unincorporated UGA, a higher percentage of land use, approximately 69 percent, is designated for residential use as shown in **Table 3-1**. The remaining land within the unincorporated UGA is designated for commercial and industrial use, or is non-designated right-of-way.

The potential land use for the UGA addition areas, which includes residential and light industrial land uses, are also shown in **Figure 3-1**.

Table 3-1
Future Land Use Designation

Land Use Type	City Limits	Unincorporated UGA
Residential[1]	59.2%	68.8%
Commercial[2]	10.4%	4.8%
Industrial	6.9%	20.2%
Public Facility	17.2%	N/A
Farmland	N/A	N/A
Non-designated[3]	6.2%	6.2%
Total	100.0%	100.0%

NOTES:
1. Residential land use includes residential land use types and traditional neighborhood land use.
2. Commercial land use includes general commercial, mainstreet business I, mainstreet business II, and other commercial land uses.
3. Non-designated land uses include non-designated right-of-ways and City water facility property located outside of the UGA boundary.

3-4. POPULATION

Household Trends

Based on land use, the City is primarily a residential community comprised largely of single-family residences. In 2013, the Office of Financial Management (OFM) estimated that 1,889 housing units, or 72 percent, were single-family residential, approximately 727 housing units, or 28 percent, were multi-family residential, and approximately 4 housing units, or less than 1 percent, were "mobile homes and specials."

OFM data from the 2010 Census indicates an average household size of 2.55 persons per household within the City and an average household size of 2.62 persons per household within the County. The average household size reported in the Census is based on an average of the household size for owner occupied housing units and renter occupied housing units. For Stanwood, the average household size for owner occupied units in 2010 was 2.77 and the average household size for renter occupied units was 2.18. The *2012 Buildable Land Report for Snohomish County* utilizes average household sizes of 2.9 persons per household for single-family units and of 2.0 persons per household for multi-family units. The City has adopted an average household size of 2.9 for the *Comprehensive Plan* and this number is used in this plan.

Existing and Future City Population

The County has experienced rapid population growth and extensive physical developments over the last 10 years. The population of the County increased approximately 21 percent from 2000 to 2013 based on OFM estimates. The population of the City increased approximately 62 percent during the same period, which included several annexations. **Table 3-2** illustrates the historical population growth since 2000, with the years 1980, 1990, and 1995 included for reference.

Table 3-2
Population Trends within the City Limits

Year	Population
Historical	
1980	1,646
1990	1,961
1995	2,910
2000	3,923
2001	4,021
2002	4,172
2003	4,323
2004	4,530
2005	4,858
2006	5,287
2007	5,593
2008	5,885
2009	6,073
2010	6,231
2011	6,220
2012	6,300
2013	6,340

NOTE: The historical population represents the population within the City limits. The sources of the historical population numbers are the decennial census and Washington Office of Financial Management intercensal estimates.

Projected future growth for the City limits and the unincorporated UGA is shown in **Table 3-3**. The projected population data was prepared by the City's Community Development Department in conjunction with the update of the City's *Comprehensive Plan*. The 2014 OFM intercensal estimates are the baseline populations for the City and unincorporated UGA population projections.

The projections for the City and unincorporated UGA populations are based on 2035 growth targets in accordance with the *Countywide Planning Policies for Snohomish County* (Appendix B), adopted June 1, 2011 and amended June 12, 2013. The projections assume that the City will grow by approximately 171 people per year and the unincorporated UGA will grow by approximately 35 people per year. The total City and unincorporated UGA population is expected to experience an average annual growth rate of approximately 2.4 percent between the 2014 base year and 2035. Population projections for the City and unincorporated UGA are displayed in **Figure 3-2**.

Table 3-3
Population Projections within the City Limits

Year	City Population	Unincorporated UGA Population	Total City + UGA Population
Projected			
2014	6,530	238	6,768
2015	6,701	273	6,974
2016	6,872	308	7,180
2017	7,043	343	7,386
2018	7,214	378	7,592
2019	7,385	413	7,798
2020	7,556	448	8,004
2021 (+6 years)	**7,727**	**483**	**8,210**
2022	7,898	518	8,416
2023	8,069	553	8,622
2024	8,240	588	8,828
2025	8,411	623	9,034
2026	8,582	658	9,240
2027	8,753	693	9,446
2028	8,924	728	9,652
2029	9,095	763	9,858
2030	9,266	798	10,064
2031	9,437	832	10,269
2032	9,608	867	10,475
2033	9,779	902	10,681
2034	9,950	937	10,887
2035 (+20 years)	**10,116**	**969**	**11,085**

NOTES:
- Population projections were prepared by the City of Stanwood Community Development Department.
- The baseline 2014 population information is based on The Office of Financial Management intercensal estimates.
- The 2035 population estimates are based on the *Countywide Planning Policies for Snohomish County* (Appendix B).
- The projections assume that the City will grow by approximately 171 people per year and the unincorporated UGA will grow by approximately 35 people per year.

Figure 3-2
Population Projections within the City Limits

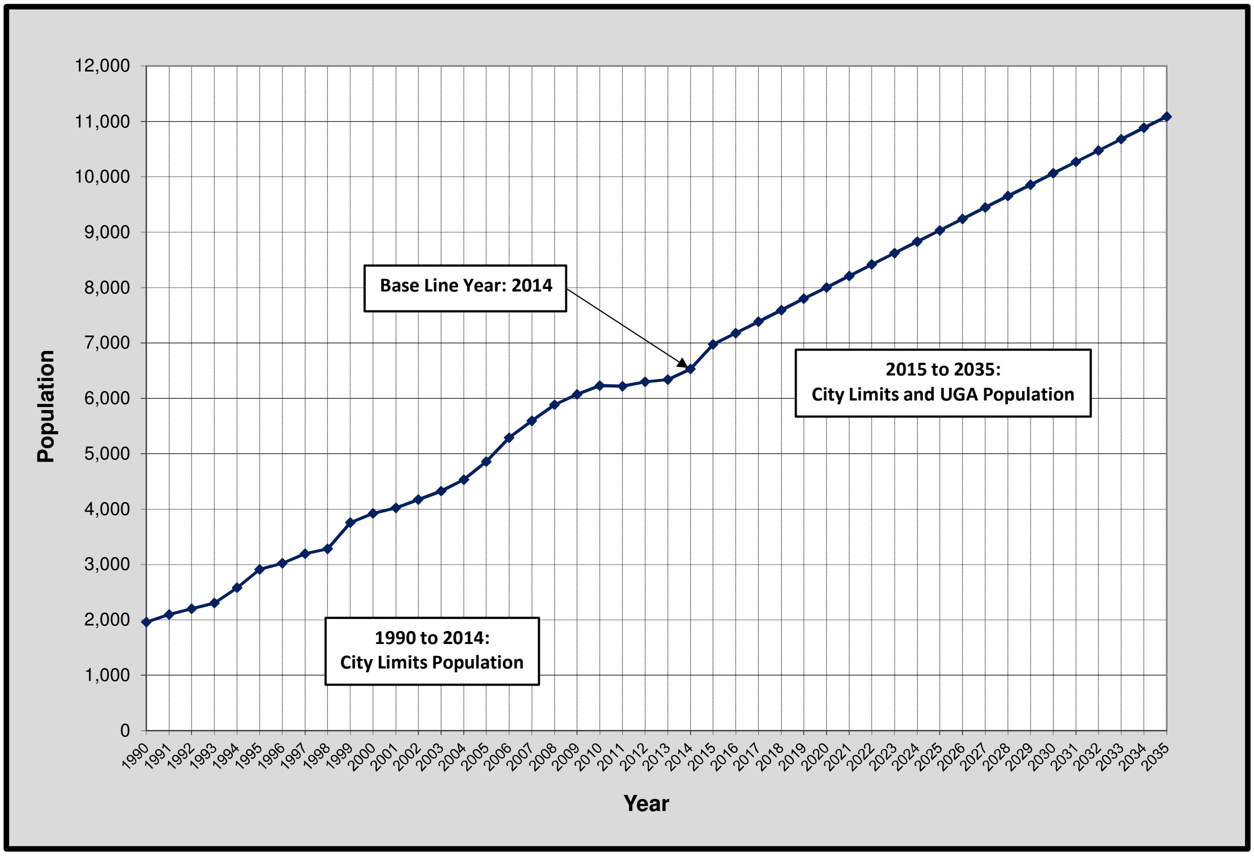
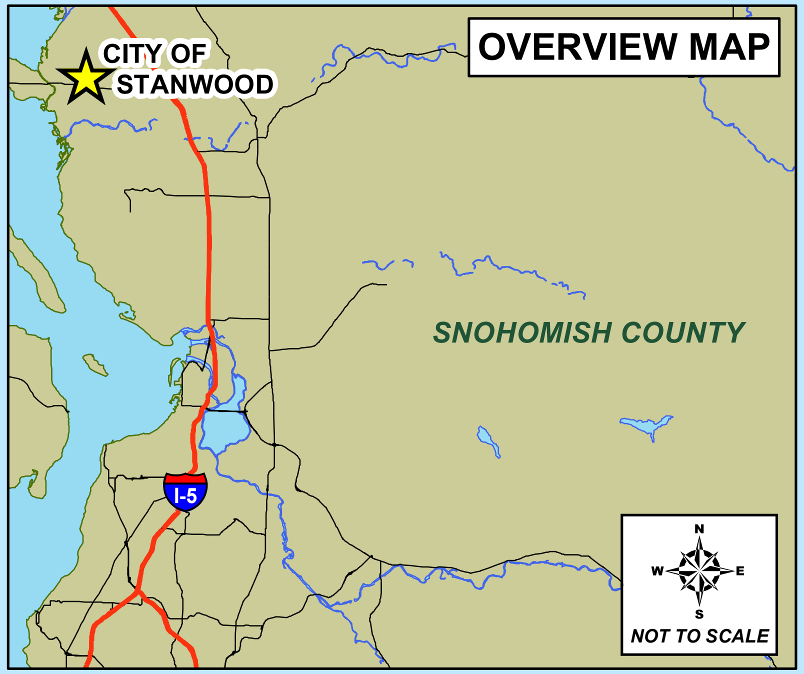


Figure 3-1
Land Use Map
City of Stanwood, Washington
Sewer System Plan



1 INCH = 2,000 FEET

0 2,000 4,000

Feet

DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG

N

LEGEND

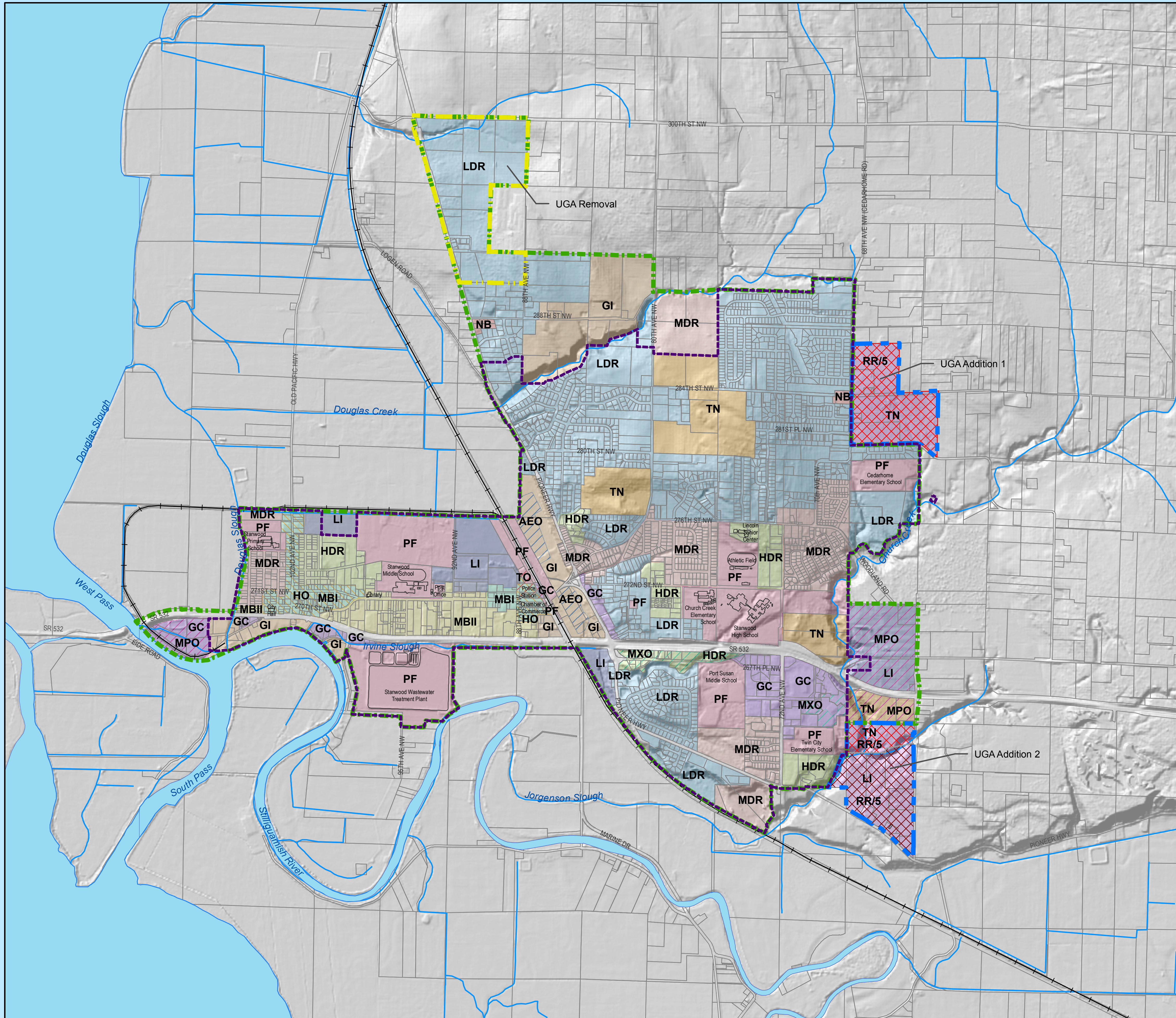
FUTURE LAND USE
- PF, EXISTING PUBLIC FACILITY
- NB, NEIGHBORHOOD BUSINESS
- LDR, LOW DENSITY RESIDENTIAL 3.5-4 DU/ACRE
- MDR, MEDIUM DENSITY RESIDENTIAL 6-10 DU/ACRE
- HDR, HIGH DENSITY RESIDENTIAL
- GC, GENERAL COMMERCIAL
- GI, GENERAL INDUSTRIAL
- LI, LIGHT INDUSTRIAL
- MBI, MAINSTREET BUSINESS I
- MBII, MAINSTREET BUSINESS II
- TN, TRADITIONAL NEIGHBORHOOD
- PARCELS

COUNTY FUTURE LAND USE
- RR/5, RURAL RESIDENTIAL-5

UGA ADDITION FUTURE LAND USE
- TN, TRADITIONAL NEIGHBORHOOD
- LI, LIGHT INDUSTRIAL

FUTURE LAND USE OVERLAY
- AEO, ADULT ENTERTAINMENT OVERLAY
- TO, TRANSIT OVERLAY
- MXO, MIXED USE OVERLAY
- MPO
- HISTORICAL OVERLAY (HO)
- CITY LIMITS
- STANWOOD UGA
- PROPOSED UGA REMOVAL
- PROPOSED UGA ADDITION
- BNSF RAILROAD
- WATERBODY
- WATER COURSE

DIGITAL DATA WERE OBTAINED FROM THE CITY OF STANWOOD, SNOHOMISH COUNTY, WASHINGTON DEPARTMENT OF NATURAL RESOURCES, US FISH AND WILDLIFE SERVICE, US GEOLOGICAL SURVEY AND THE US ENVIRONMENTAL PROTECTION AGENCY.



DATE REVISED: 1/27/2015 By:zschrempp Coordinate System:NAD 1983 StatePlane Washington North FIPS 4601 Feet J:\DATA\STA\413-137\GIS\MAPS\FIG3-1_LU_FUTURE.MXD

CHAPTER 4

Flow and Load Analysis

4-1. INTRODUCTION

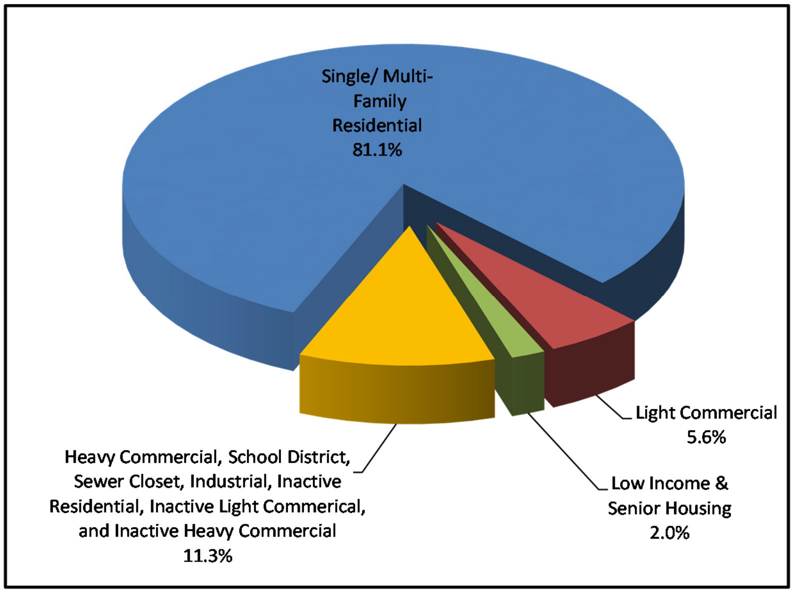
A detailed analysis of flow and loading in a sewer system is crucial to the planning efforts of a sewer service provider. When analyzing a sewer system, the first step is to identify current flow and load values to determine if the existing system can effectively provide adequate service to its customers 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 in order to satisfy future growth while continuing to meet federal and state laws.

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 is also used to develop the sewer service provider's National Pollutant Discharge Elimination System (NPDES) Permit required by the Washington State Department of Ecology (Ecology). Several different flow scenarios were analyzed and are addressed in this chapter, including average day flow, maximum day flow, peak hour flow, and projected future flows. Comprehensive wastewater treatment plant loading information and analysis is addressed in the City of Stanwood's (City) *Wastewater Facilities Plan* prepared by Tetra Tech/KCM Inc. in May 2000. This chapter presents a 2012/2013 planning-level evaluation of the wastewater treatment plant flow and loading.

4-2. CURRENT POPULATION AND SERVICE CONNECTIONS

The City's 2013 population is estimated at 6,340 people. As of December 2013, there were approximately 2,143 sewer service connections throughout the City's sewer system. Of those connections, 1,738 were single/multi-family residential services, 121 were light commercial, 42 were low income and senior housing, and 242 were other. **Chart 4-1** shows the 2013 system connections broken down by customer class.

Chart 4-1
2013 Sewer Service Connections by Customer Class



4-3. EXISTING WASTEWATER FLOW RATES

The City's existing collection system flow rates were estimated using 2012 lift station flow records and 2013 wastewater treatment plant flow data. The 2012 lift station flow rates are shown in **Table 4-1** along with the 2007/2008 lift station flow rates, which were extracted from the City's previous Comprehensive Sewer System Plan (Plan). The 2008 to 2013 wastewater treatment plant flow data is shown in **Table 4-2**.

Table 4-1
Existing Average Day Flow Rates at Lift Stations

Lift Station	2007/2008 Average Day Flow (GPD)	2012 Existing Average Day Flow (GPD)
LS 4 (Main)	545,833	596,801
LS 2 (Cedarhome)	58,296	91,471
LS 1 (Church Creek)	33,879	20,650
LS 3 (Pioneer Hills)	9,872	10,438
LS 6 (Copper)	469	7,362
LS 5 (Taylor's Landing)	5,128	5,731
LS 7 (Lindstrom)	6,434	4,951

It is important to note that Main Lift Station includes flow from the City's six lift stations which is conveyed to the City's wastewater treatment plant. Copper Lift Station has experienced an increase in flow due to development in that sewer drainage basin since the last Plan was completed.

Table 4-2
Existing Average Day Flow Rates at the Wastewater Treatment Plant

Year	Average Day Flow (GPD)	Average Day Flow per Capita (GPCD)
2008	545,833	93
2009	553,161	91
2010	545,709	88
2011	559,983	90
2012	596,801	95
2013	523,495	83

Using Flowlink 5 flow meters, the City collected flow data from January 2014 through May 2014 at several locations. These locations are marked on **Figure 7-1** in **Chapter 7** and the flow monitoring results are summarized in **Appendix E**. This information was reviewed and used to the extent possible in this evaluation to calibrate the sewer model. It is recommended that the City continue this flow monitoring to obtain additional flow data from these sewer system drainage basins in order to accurately evaluate future capacity issues. For the purposes of this Plan, total flow from these sewer drainage basins has been estimated through an evaluation of the recorded lift station flows, the recorded treatment plant flows, and the flow monitoring data collected by the City.

The daily influent flow of wastewater to the treatment plant and rainfall data collected are presented in **Figures 4-1** and **4-2** for January 2012 through December 2012 and January 2013 through December 2013, respectively. As can be seen from both of these figures, the influent wastewater flow rate to the treatment plant is influenced by rainfall. These figures demonstrate the effect of rainfall on the daily average influent flow to the wastewater treatment facility and confirm that some inflow and infiltration (I/I) may be occurring. Additional information regarding I/I in the City's sewer collection system can be found in **Section 4-4**.

Figure 4-1
2012 Daily Influent Flow and Rainfall

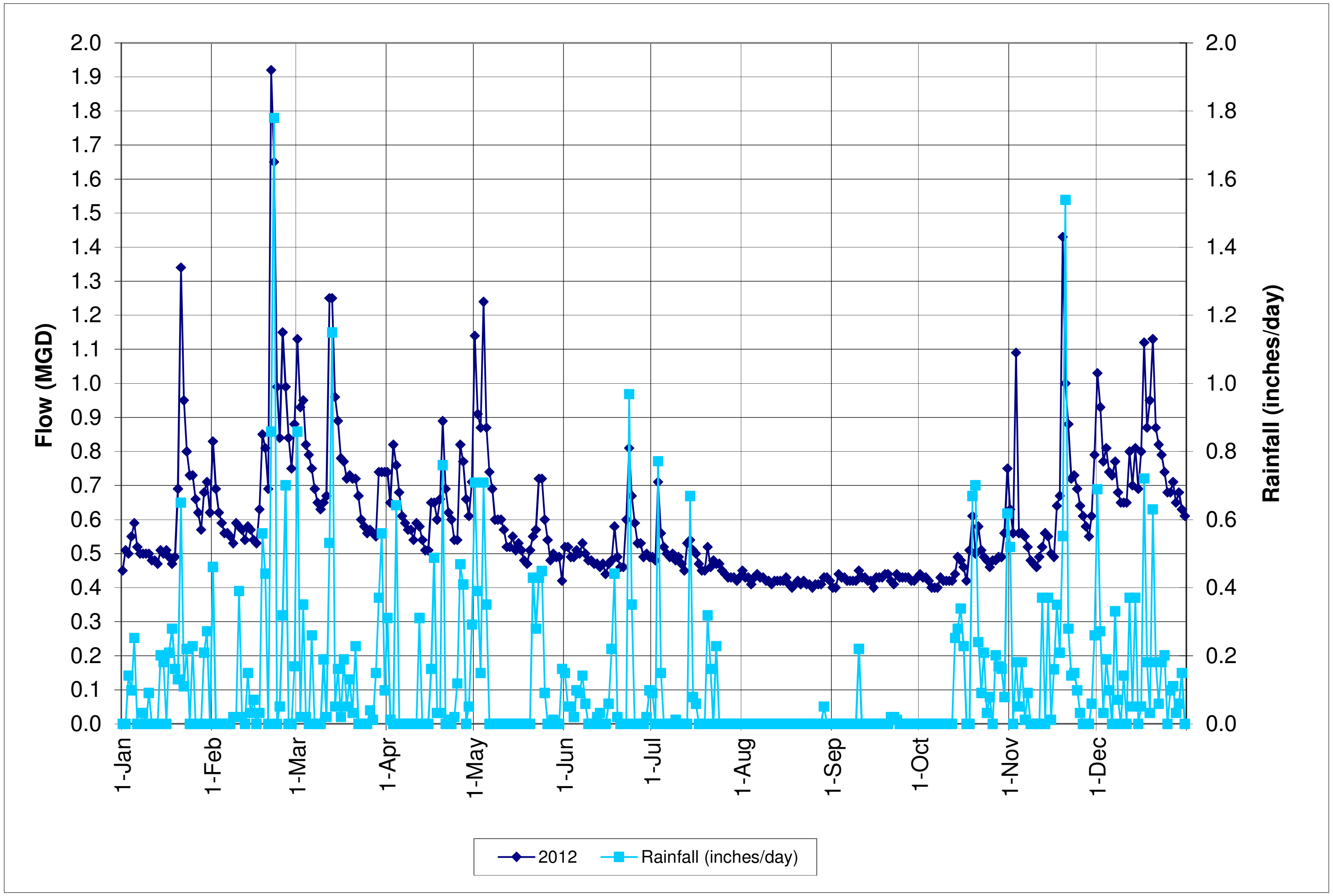
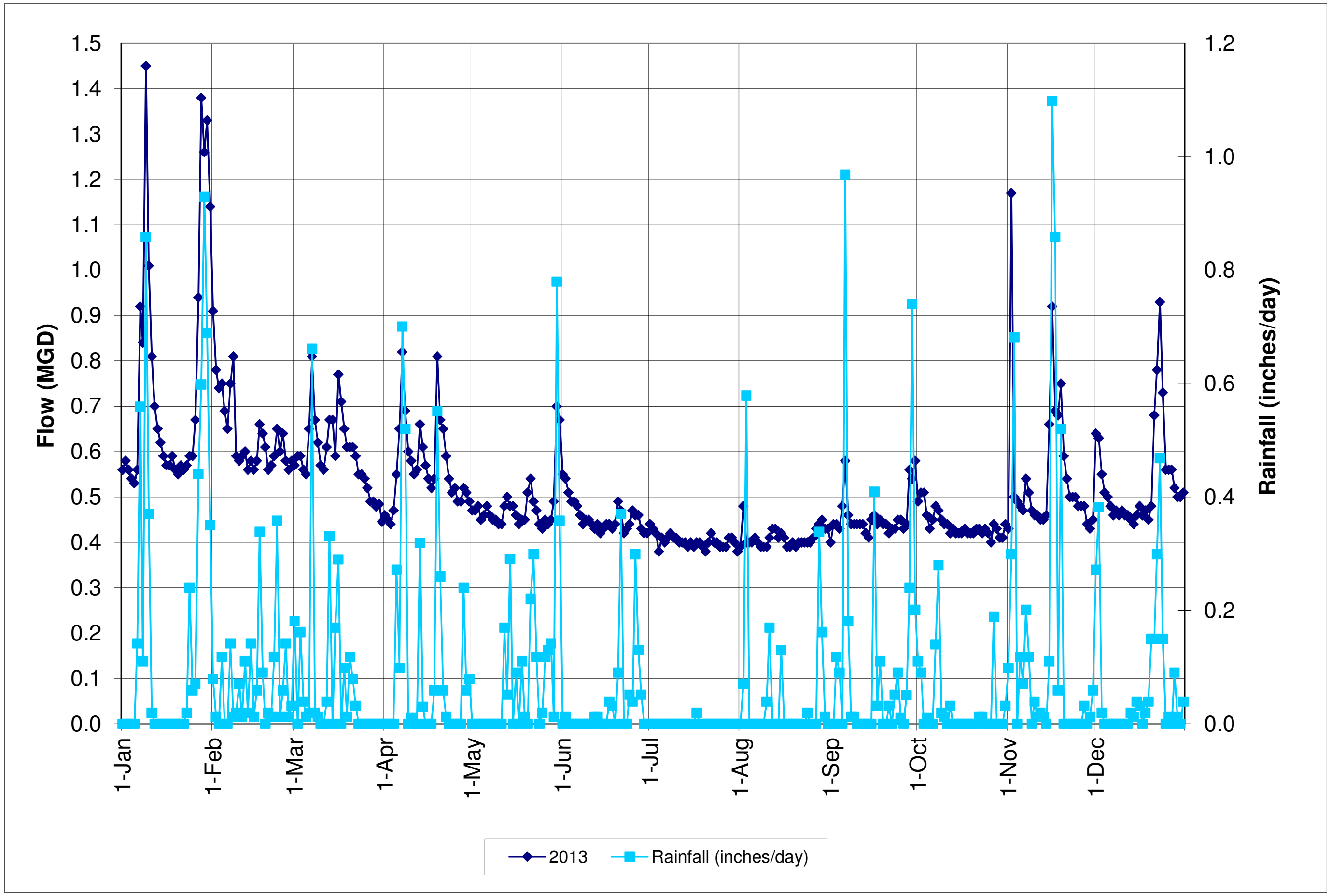


Figure 4-2
2013 Daily Influent Flow and Rainfall



4-4. 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.

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" and what amount can be cost-effectively removed. The report established I/I flow rates that were considered normal or acceptable, based on surveys and statistical evaluations of data from hundreds of cities across the nation.

Inflow

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 gallons per capita per day (gpcd). The peak recorded flow day in the last several years of record for the City was 1.92 million gallons per day (MGD), which occurred on February 21, 2012. This day was recorded as having 0.9 inches of precipitation. This peak inflow event equates to a 293 gpcd flow rate, which is above the EPA maximum of 275 gpcd. The second peak recorded flow day in the last several years of record for the City was 1.65 MGD which was on the following day, February 22, 2012. This day was recorded as a day of high precipitation in the amount of 1.8 inches. This peak inflow event equates to a 250 gpcd flow rate, which is below the EPA maximum of 275 gpcd. Although February 22, 2012, had nearly double the amount of precipitation, the wastewater influent decreased from the previous day. The third peak recorded flow day in the last several years of record for the City was 1.58 MGD on January 7, 2009. This day was recorded as a day of moderate precipitation in the amount of 1.0 inches. This peak inflow event equates to a 248 gpcd flow rate, which is below the EPA maximum of 275 gpcd.

February 21, 2012, had the highest influent flow (1.92 MGD) in the several years (2009 through 2013) reviewed for this Plan and suggests that this high influent flow is atypical. Additionally, since the following day, February 22, 2012, received nearly double the amount of precipitation and influent flow decreased, it is not likely a true representation of the inflow that would typically be present in the collection system. Conducting an inflow 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 inflow should be considered. This study is discussed further in **Chapter 7**.

Infiltration

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. The peak week in the last several years of record for the City, occurring after heavy rains, was the week of February 1, 2013. This yielded an average flow rate of 0.75 MGD, which equates to 107 gpcd. The second peak week in the last several years of record for the City, occurring after heavy rains, was the week of March 1, 2011, yielding an average flow rate of 0.72 MGD, which equates to 104 gpcd. The third peak week in the last several years of record for the City, occurring after heavy rains, was the week of May 9, 2011, yielding an average flow rate of 0.70 MGD, which equates to 101 gpcd.

All three events are below the EPA's maximum infiltration criterion; therefore, the amount of infiltration is considered non-excessive. Any I/I studies that are conducted in the future should follow the guidelines defined in Chapter C-1 of the Washington State Department of Ecology's (Ecology) *Criteria for Sewage Works Design* (commonly known as the "Orange Book"). The King County Department of Natural Resources has published a technical memorandum concerning I/I called *Regional Inflow and Infiltration Program*. This memorandum provides useful information which should be utilized to assist in future I/I studies conducted on the sewer collection system. The I/I evaluation data is included in **Appendix F**.

4-5. PEAKING FACTORS

Once existing flow rates are measured and defined, projected flow rates can be developed. Projected flows are used to further analyze how well the existing system will perform in the future, and to determine improvements required to maintain or improve system function. In order to establish projected flow scenarios for a sewer system, peaking factors need to be determined for the existing system, which can then be applied to future flow rates. Peaking factors are the ratio of higher flows, such as maximum day flow, to the average annual flow. **Table 4-3** shows the flow rates and peaking factors as measured at the City's wastewater treatment plant.

Table 4-3
Summary of Existing Flows and Peaking Factors for the Wastewater Treatment Plant

Flow Scenario	Flow (MGD)	Peaking Factor (in terms of AAF)
2009 Average Annual Flow	0.55	1.00
2009 Max Month Flow	0.79	1.44
2009 Max Day Flow	1.58	2.86
2010 Average Annual Flow	0.55	1.00
2010 Max Month Flow	0.66	1.21
2010 Max Day Flow	1.28	2.35
2011 Average Annual Flow	0.56	1.00
2011 Max Month Flow	0.81	1.44
2011 Max Day Flow	1.61	2.88
2012 Average Annual Flow	0.60	1.00
2012 Max Month Flow	0.78	1.30
2012 Max Day Flow	1.92	3.22
2013 Average Annual Flow	0.52	1.00
2013 Max Month Flow	0.75	1.44
2013 Max Day Flow	1.45	2.77

As previously indicated, the 2012 maximum day flow of 1.92 MGD appears to be atypical for the City's collection system. Also, the maximum month and maximum day peaking factors have remained consistent over the last 5 years.

The City is not able to retrieve direct measurements of peak hour flows into Main Lift Station so this value could not be obtained for comparison. Peaking factors for collection system pipes and lift stations are typically 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. For the purposes of this Plan, peak hour flow will be estimated using a peaking factor of four times Average Annual Flow (AAF).

4-6. PROJECTED WASTEWATER FLOW RATES

Future flow rates were calculated for the 2021 (6-year) and 2035 (20-year) planning horizons. Population projections, as shown in **Table 3-2** in **Chapter 3**, were used to calculate the projected flow rates. A population increase was established over the projected period, which was in turn applied to the estimated existing flow rate for each sewer drainage basin. Information regarding expected future development and areas where growth is projected was obtained from the City and used to develop population and flow distributions for the 2021 and 2035 planning horizons.

The projected flows at the treatment plant and the flow distribution to the various sewer drainage basins were developed using the following assumptions.

- The existing average flow rate per capita for 2013 is approximately 83 gpcd, as shown in **Table 4-2**. The existing average flow rate per capita for 2013 is lower than recent years and Ecology's sewer system design guidelines.
- For planning purposes, the future flow rate per capita will be 100 gpcd, which is in accordance with the Ecology's sewer system design guidelines.
- The future flow rate for sewer drainage subbasins where primarily commercial and industrial development is expected will be 35 gallons per day (gpd) per person per shift, which is in accordance with the Ecology's sewer system design guidelines.

Table 4-4 presents the existing and projected flow rates for the sewer drainage basins and wastewater treatment plant. **Chapter 3** should be referenced for more detail regarding both population and growth scenarios.

Table 4-4
Projected Sewer Drainage Basin Average Day and Peak Hour Flow Rates

Sewer Drainage Basin	2013 Existing		Projected 2021		Projected 2035	
	ADF (GPD)	PHF (GPM)	ADF (GPD)	PHF (GPM)	ADF (GPD)	PHF (GPM)
1	189,150	520	233,090	640	257,440	710
2	9,160	30	17,870	50	55,400	150
3	112,230	310	204,930	570	286,720	800
4[1]	137,200	380	56,410	160	92,430	260
5[1]	75,860	210	324,500	900	454,490	1,260
Treatment Plant (ADF)	**0.52 MGD**		**0.84 MGD**		**1.15 MGD**	
Treatment Plant (MMF)	**0.75 MGD**		**1.20 MGD**		**1.65 MGD**	

NOTES:
-Average day flows and peak hour flows shown in this table are rounded and approximate.
-Highlighted flow exceeds current wastewater treatment plant capacity.
1. These projections reflect projects to install gravity main so the Cedarhome Lift Station, Church Creek Lift Station, Taylor's Landing Lift Station, and Lindstrom Lift Station can be eliminated and abandoned by 2021. These improvements are discussed further in **Chapter 7**.

The City's current NPDES permit allows a maximum month average influent flow of 1.5 MGD at the wastewater treatment plant. As shown in **Table 4-4**, the flow capacity of the treatment facility 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. **Appendix G** also includes more information regarding future wastewater treatment plant projections and wastewater treatment plant capacity scheduling. Capacity upgrades to the wastewater treatment facility will be necessary to handle future flows. The numbers presented in **Table 4-4** are projected estimates based on current flow information. The City should closely monitor influent flow on a yearly basis to see if this trend continues.

Current lift station pumping capacity and flow rate projections are provided in **Table 4-5**. The projections in **Tables 4-4** and **4-5** reflect projects to install gravity main so Cedarhome Lift Station, Church Creek Lift Station, Taylor's Landing Lift Station, and Lindstrom Lift Station can be eliminated and abandoned by 2021. These improvements are discussed further in **Chapter 7**.

Table 4-5
Projected Lift Station and Sewer Drainage Basin
Average Day and Peak Hour Flow Rates

Name	Existing "Firm" Capacity (GPM)	2012 Existing ADF (GPD)	2012 Existing PHF (GPM)	Projected 2021 ADF (GPD)	Projected 2021 PHF (GPM)	Projected 2035 ADF (GPD)	Projected 2035 PHF (GPM)
LS 1 (Cedarhome)[1]	333	91,470	250	N/A	N/A	N/A	N/A
LS 2 (Church Creek)[1]	238	20,650	60	N/A	N/A	N/A	N/A
LS 3 (Pioneer Hills)	470	10,440	30	17,870	50	55,400	150
LS 4 (Main)	1,900	596,800	1,660	836,800	2,320	1,146,480	3,180
LS 5 (Taylor's Landing)[1]	150	5,730	20	N/A	N/A	N/A	N/A
LS 6 (Copper Station)	300	7,360	20	19,720	50	25,900	70
LS 7 (Lindstrom)[1]	198	4,950	10	N/A	N/A	N/A	N/A
Sewer Drainage Basin 1A	N/A	N/A	N/A	N/A	N/A	10,290	30
Sewer Drainage Basin 5C	N/A	N/A	N/A	15,790	40	36,960	100
Sewer Drainage Basin 5D	N/A	N/A	N/A	6,900	20	17,630	50
Sewer Drainage Basin 5E	N/A	N/A	N/A	24,190	70	24,530	70
Sewer Drainage Basin 5F	N/A	N/A	N/A	10,000	30	20,380	60
Sewer Drainage Basin 5G	N/A	N/A	N/A	20,970	60	21,900	60

NOTES:
-Average day flows and peak hour flows shown in this table are rounded off and approximate.
-Highlighted flow exceeds current pump capacity.
1. These projections reflect projects to install gravity main so the Cedarhome Lift Station, Church Creek Lift Station, Taylor's Landing Lift Station, and Lindstrom Lift Station can be eliminated and abandoned by 2021. These improvements are discussed further in **Chapter 7**.

As indicated in **Table 4-5**, Main Lift Station will be at capacity prior to 2021. Capacity upgrades to this lift station will be necessary to handle future flows. These improvements are discussed further in **Chapter 7**.

4-7. EXISTING WASTEWATER QUALITY

Existing loads, load projections, permit limitations, and recommended improvements to the treatment plant were documented in the City's *Wastewater Facilities Plan* prepared by Tetra Tech/KCM in May 2000. This plan recommended upgrades for future flow and loading projections that were completed in 2004.

This Plan presents a cursory forecast of wastewater treatment plant flows and loadings for planning purposes to schedule improvements, studies, plans, and reports.

Average Loading

Monthly average influent five-day Biological Oxygen Demand (BOD_5) loadings ranged from 575 pounds per day (ppd) to 2,330 ppd for the 9-year period of analysis, as shown in **Appendix H**. The monthly average influent Total Suspended Solids (TSS) loadings ranged from 943 ppd to 1,813 ppd for the same period.

The average influent BOD_5 concentration for 2013 is 380 milligrams per liter (mg/L). The annual average loading of 1,578 ppd (**Table 4-6**) and an average sewer service population of 6,340 translate to an average BOD_5 loading of 0.25 pounds per capita day. This value is slightly higher than Ecology's Orange Book criteria of 0.2 pounds per capita per day, possibly due to industrial and commercial loading. The annual average TSS loading of 1,468 ppd and an average sewer service population of 6,340 translate to an average TSS loading of 0.23 pounds per capita day. This value is slightly higher than Ecology's Orange Book criteria of 0.2 pounds per capita per day, possibly due to industrial and commercial loading.

Table 4-6
Projected Wastewater Treatment Plant BOD_5 and TSS Loadings

Year	STA Service Area Population	Annual Average BOD_5 (ppd)	Maximum Average Month BOD_5 (ppd)	Annual Average TSS (ppd)	Maximum Average Month TSS (ppd)
2005	4,858	1,052	1,703	1,252	1,642
2006	5,287	1,354	2,028	1,259	1,763
2007	5,593	1,567	1,820	1,244	1,442
2008	5,885	1,559	1,828	1,232	1,401
2009	6,073	1,450	1,851	1,489	1,813
2010	6,231	1,468	1,796	1,403	1,769
2011	6,220	1,514	2,330	1,311	1,792
2012	6,300	1,456	1,722	1,305	1,497
2013	**6,340**	**1,578**	**1,786**	**1,468**	**1,683**
2014	6,530	1,625	1,839	1,512	1,733
2015	6,770	1,685	1,907	1,568	1,797
2016	7,010	1,744	1,975	1,623	1,860
2017	7,250	1,804	2,042	1,679	1,924
2018	7,490	1,864	2,110	1,734	1,988
2019	7,730	1,923	2,177	1,790	2,051
2020	7,970	1,983	2,245	1,845	2,115
2021 (+6 years)	**8,210**	**2,043**	**2,313**	**1,901**	**2,179**
2022	8,416	2,094	2,371	1,949	2,233
2023	8,622	2,145	2,429	1,996	2,288
2024	8,828	2,197	2,487	2,044	2,343
2025	9,034	2,248	2,545	2,092	2,397
2026	9,240	2,299	2,603	2,140	2,452
2027	9,446	2,350	2,661	2,187	2,507
2028	9,652	2,402	2,719	2,235	2,561
2029	9,858	2,453	2,777	2,283	2,616
2030	10,064	2,504	2,835	2,330	2,671
2031	10,269	2,555	2,893	2,378	2,725
2032	10,475	2,606	2,951	2,425	2,780
2033	10,681	2,658	3,009	2,473	2,835
2034	10,887	2,709	3,067	2,521	2,889
2035 (+20 years)	**11,085**	**2,758**	**3,122**	**2,567**	**2,942**

NOTE:
-The 2013 maximum average month BOD_5 loading per capita (0.28 lb/person/day), ratio of maximum average month BOD_5 loading to annual average BOD_5 loading (1.13:1), maximum average month TSS loading per capita (0.27 lb/person/day), and ratio of maximum average month TSS loading to annual average TSS loading (1.15:1) were used for the loading projections.

Maximum Average Loading

To convert the current maximum average month BOD_5 loading to a per capita basis, the service population of 6,340 and the 1,786 ppd maximum month BOD_5 loading for 2013 were used to calculate a maximum average month per capita BOD_5 loading of 0.28 pounds per capita per day. The ratio of the maximum average month BOD_5 loading to the annual average BOD_5 loading is 1,786:1,578 or 1.13:1. This ratio will be used in the development of future loadings to the wastewater treatment plant.

The maximum average month TSS loading for 2013 is 1,683 ppd. Using the same population as the BOD_5 analysis, this approach results in a current maximum average month value of 0.27 pounds TSS per capita per day and a ratio of maximum average month TSS loading to annual average TSS loading of 1,683:1,468 or 1.15:1. This ratio will be used in the development of future loadings to the wastewater treatment plant.

Future wastewater treatment plant maximum average month BOD_5 and TSS loadings were estimated by multiplying projected populations by the respective population-based loadings. Future annual average BOD_5 and TSS loadings were estimated using the ratio of maximum average month to annual average loadings of these parameters. **Table 4-6** provides a summary of projected future wastewater treatment plant average and maximum influent BOD_5 and TSS loadings.

The City's current NPDES Permit allows a maximum month influent BOD_5 of 4,100 ppd and a maximum month influent TSS of 4,100 ppd. **Table 4-6** demonstrates that the City may not reach capacity for BOD_5 and TSS loadings in the 20-year planning period. The numbers presented in **Table 4-6** are projected estimates based on current loading information. The City should closely monitor BOD_5 and TSS loadings on a yearly basis to see if these trends continue.

4-8. SUMMARY

Table 4-7 includes a summary of the population, flow and loading information presented in this chapter.

Table 4-7
Population, Flow, and Loading Analysis Summary

Description	2013 Existing	2021 Projected	2035 Projected
Population Data			
Service Area Population	6,340	8,210	11,085
Increase from Base Year 2013		1,870	4,745
Flow Basis Data (gal/day/capita)			
Average Day Flow Per Capita	83	100	100
Wastewater Treatment Plant Flow (MGD)			
Average Annual Plant Flow	0.52	0.84	1.15
Maximum Month Plant Flow	0.75	1.20	1.65
Wastewater Treatment Plant Loadings (ppd)			
Average Annual BOD_5	1,578	2,043	2,758
Maximum Average Month BOD_5	1,786	2,313	3,122
Average Annual TSS	1,468	1,901	2,567
Maximum Average Month TSS	1,683	2,179	2,942

The City's current NPDES Permit allows a maximum month average influent flow of 1.5 MGD at the wastewater treatment plant. The wastewater treatment plant will reach capacity based on flow within the 20-year planning period. The projected flows presented in **Table 4-7** were estimated using current flow rates and assuming a future average annual influent flow rate per capita of 100 gpcd, which is in accordance with the Ecology's sewer system design guidelines. In addition, the projected flows for future sewer drainage subbasins where primarily commercial and industrial development is expected were estimated assuming an average annual influent flow rate of 35 gpd per person per shift, which is in accordance with the Ecology's sewer system design guidelines. Based on the flow and loading analysis and using Ecology's recommended guidelines, the wastewater treatment plant will reach capacity based on flow before loading. The planning, engineering, and construction of the wastewater treatment plant upgrades are included in **Chapter 7** and the City's CIP.

The City's average annual influent flow rate per capita has been below 100 gpcd since 2007. Future sewer flow rates for commercial and industrial developments are difficult to estimate without specific information about the proposed developments. If the average annual gallons per capita day remains below Ecology's recommended guideline of 100 gpcd, it is likely that the wastewater treatment plant will not reach capacity in the 20-year planning period based on flow. Therefore, the City should closely monitor influent flow on a yearly basis to see if the average annual influent flow rate per capita continues to remain lower than the guidelines presented in Ecology's Orange Book.

CHAPTER 5

Policies and Design Criteria

5-1. 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 United States Environmental Protection Agency (EPA) 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 is detailed in **Chapter 6**, and the recommended improvements are identified in **Chapter 7**.

The Stanwood 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 Systems
- Lift Stations
- Operational
- Organizational
- Finance

5-2. 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 the waters of the State shall have an NPDES permit from Ecology. The City's permit allows 1.5 million gallons per day (MGD) 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 NPDES permit is included in **Appendix B**.

Other Regulations and Required Permits

The City also holds permits, is regulated by the Puget Sound Clean Air Agency (Registration No. 10947) and maintains a lab accreditation through Ecology.

5-3. 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.
- All proposed developments within the City's sewer service area shall connect directly to the City's sewer system, unless deemed unfeasible by the City 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 of Stanwood Comprehensive Sewer System Plan, City of Stanwood *Wastewater Facilities Plan*, Ecology, Snohomish County Health District 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 Spring 2006 Design and Construction Standards and Specifications is included in **Appendix I**.
- 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 City Code.
- Sewer extensions shall be given based on system capacity using the following priorities.
    1. Extensions shall first be given to applicants within City limits.
    2. Second priority shall be given to those applicants within the UGA.
    3. 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 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 regards 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 is 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.

5-4. 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 Sewerage Works Design*, prepared by Ecology, August 2008, 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, manhole 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 the public health and environment. The sewer lines shall also 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 submains and mains and 4 inches for laterals. A 6-inch diameter submain lateral is required for all commercial or business owners.
- Manholes 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 intervals for 18-to 30-inch sewers.
- Manholes shall also 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 manhole.

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 submain sewers should be designed to carry not less than 400 gallons daily per capita contribution sewage 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). 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; a "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 Sewerage Works Design*, prepared by Ecology, August 2008, 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 to maintain solids in suspension is 2 fps at average dry weather flow. 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, polyvinyl chloride (PVC), or high density polyethylene (HDPE) for sizes up to 12 inches. Ductile iron and PVC shall be used for pipe sizes 14-to-24 inches. 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 to 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 or alongside of existing properties.

5-5. 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 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.
    1. All structures will be non-combustible, where practical.
    2. All buildings will have adequate heating, cooling, ventilation, insulation, lighting, and work spaces necessary for on-site operation and repair.
    3. Sites will be fenced to reduce vandalism and City liability.
    4. Each station will be equipped with a flow meter and all necessary instrumentation to assist personnel in operating and troubleshooting the facility.
    5. Emergency power capability will be provided at all lift stations.
    6. Each station shall be equipped with a bypass to allow manual control.
    7. Each station shall address corrosion control.
    8. 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.

5-6. 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 operation and maintenance history.

Temporary and 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 process, equipment or structure with appropriate backup facilities.

5-7. ORGANIZATIONAL POLICIES

Structure

- The Utilities Department Manager (Public Works Director) is responsible for overall sewer utility financial planning and management.
- The Sewer Utility Superintendent 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

- The 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 Utility Manager and Finance Director coordinate all sewer-related financing requirements. The Finance Department is responsible for customer billing and payment collection, and the Finance Department collects connection fees for the Utility and the 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.

5-8. FINANCIAL POLICIES

General

- The City will set rates that comply with State regulations.
- Rates and additional charges established for the City should:
    1. Be cost-based rates that recover historical, current, and future costs associated with the City's sewer system and its services;
    2. Be equitable charges to recover costs from sewer customers commensurate with the benefits they receive;
    3. Be an adequate and stable source of funds to cover the current and future annual cash needs of the sewer utility; and
    4. 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.
- The 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 (SMC).

Connection Charges

The owners of properties that have not been assessed, charged or have not borne an equitable share of the cost of the sewer collection and sewer 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.

CHAPTER 6

Wastewater Collection and Treatment System Evaluation and Deficiencies

6-1. 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**.

6-2. GENERAL AND SEWER MODEL BACKGROUND

Staff and Maintenance

There are six public works staff members, including managers, operators, field staff, and office staff; all of whom report to the Utilities Manager/Public Works Director. A summary of Public Works staff with regard to wastewater includes:

- One utilities manager/public works director – oversees operation of the water and wastewater utilities for the City;
- One utilities superintendent – oversees operation and maintenance of the water and wastewater utilities for the City; and
- Four wastewater treatment plant operations and City collection system personnel – includes a lead wastewater treatment plant operator and staff to operate and maintain the wastewater treatment plant and equipment, operates and maintains sewage collection system and equipment, and performs development reviews, inspections, construction, and testing for the sewage collection system.

Maintenance operations are fully described in **Chapter 8**.

Hydraulic Model

Background

A computer-based hydraulic model of the existing sewer system was created in 2009 using Version 5.6 of the SewerCAD® program developed by Haestad Methods to support the City's 2010 *Comprehensive Sewer System Plan*. For this Comprehensive Sewer System Plan (Plan) update, Version 8i (SELECTseries 3) of the SewerCAD® program, developed by Bentley Systems, Inc., was used to model the sewer collection system, which included the gravity mains, force mains, and sewer lift stations. Pipe location, length, diameter, and material were added based on as-built drawings and various system maps acquired from the City since the previous Plan. Manhole 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 (USGS) data. Minimum slope and cover values were also 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 to identify improvements that will be required to handle existing and projected 6-year (2021) and 20-year (2035) wastewater flows. The model can be updated and maintained for use as a tool to aid in future planning and design.

The City conducted pump down capacity testing for the lift stations in 2008 as part of the previous Plan. These results are given in **Appendix A**. The pump down test results for Main and Copper Lift Stations were not presented in **Appendix A** because the pump down tests for these lift stations were not long enough in duration to provide accurate results. The pump down numbers received by the City were used in the model with the exception of Main, Copper Station, and Taylor's Landing Lift Stations. The pump down numbers received by the City are discussed further in **Chapter 2**.

Model Limitations

Due to the number of data gaps and assumptions used in the model, the accuracy of the GIS input information from the City 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 and 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 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. In addition, City staff have indicated that the modeling flow results are higher than what Main Lift Station experiences. Based on these two reasons, the average day flow and peak hour flow based on a peaking factor of four rather than the modeling results were used to analyze the capacity of the Main Lift Station in **Table 4-5**.

Flow Data

Hydraulic models were constructed to simulate peak flows in the years 2013, 2021, and 2035. All of these hydraulic scenarios were based on sanitary flow projections described in **Chapter 4.** The City's existing collection system can be broken into 5 sewer drainage basins and 11 subbasins, as shown in **Figure 7-1**. **Table 4-4** presents average day flow and peak hour flow for each sewer drainage basin based on a peaking factor of four. Similarly, **Table 4-5** presents this information for the lift stations. In order to model the flow loadings in the subbasins of the existing sewer system, the existing lift station flows for 2012 shown in **Table 4-5** were scaled to 2013 flows based on the wastewater treatment plant average day flow for 2012 and 2013. Flow data for the 2013 average day was distributed throughout the manholes 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 given in **Appendix E**. Flows from the City's largest water users were entered separately into the model at their appropriate service locations to account for the higher flows at these locations.

Population and employment data received from the City planning department provided the basis in distributing future flows throughout the City. As discussed in **Chapter 4**, residential wastewater future flow is based on 100 gallons per capita day and the future flow rate for sewer drainage subbasins where primarily commercial and industrial development is expected will be 35 gallons per day (gpd) per person per shift.

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 (TDH), horsepower, wetwell diameter, wetwell 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.

Hydraulic Analyses Results

Hydraulic analyses were performed with the existing flow rates (2013), as well as future flow rates for the 2021 (6-year) and 2035 (20-year) projections. In the evaluation, the criteria for listing a sewer pipe as deficient is that the peak hour flow exceeds 70 percent of the pipe flow capacity. The results of the hydraulic analyses are given in **Appendix J** and **Figures 7-1**, **7-2**, and **7-3** in **Chapter 7**. **Figure 7-1** provides sewer drainage basin flow rate summaries for existing conditions and highlights current system deficiencies. **Figure 7-2** provides sewer drainage basin flow rate summaries, capacity deficiencies, and improvements for anticipated developments for the 2021 projections. **Figure 7-3** provides sewer drainage basin flow rate summaries and improvements for anticipated developments for the 2035 projections.

6-3. COLLECTION SYSTEM AND LIFT STATION ANALYSES

Gravity Collection System Pipe Capacity Analysis and Deficiencies

Construction of the City's wastewater collection system began in the early 1960s in the downtown portion of the City and was constructed mostly of asbestos-cement pipe. Most of the downtown area sewer system still remains and is in use today. The City has approximately 27 miles of sewer piping, including collection sewers and interceptors. Approximately 78 percent of the existing system is 8-inch-diameter gravity main, totaling approximately 21 miles. **Chapter 2** provides additional history and background on the City's wastewater collection and treatment system.

Existing System (2013)

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

- In Sewer Drainage Basin 1, the pipelines with insufficient capacity at peak hour flows are located along 94th Drive NW, 271st Street NW, 99th Avenue NW, 272nd Place NW, 272nd Street NW, and Florence Road. These projects are included in **CIP EX1**, **EX13**, **EX14**, and **EX15**.

- In Sewer Drainage Basin 3, a significant portion of the pipeline along Pioneer Highway has insufficient capacity at peak hour flows. This project is included in **CIP EX16**.
- In Sewer Drainage Basins 3 and 5, a significant portion of the pipeline along Pioneer Highway and 72nd Avenue NW will need to be upsized, and there is pipe located along 261st Street NW and 265th Street NW that has insufficient capacity. These projects are included in **CIP EX17**, **EX18**, **EX19**, and **EX20**.

The hydraulically deficient sewers at current peak hour flows according to the modeling results, which equal approximately 10,410 linear feet (LF), are shown on **Figure 7-1** and included in the City's Capital Improvement Plan (CIP) in **Chapter 7**. The flow projections for 2035 were used to establish the proposed pipe diameters for the pipe capacity upgrades.

2021 (6-year) System Projection

Based on the hydraulic analysis of the system using projected flow rates for 2021 and assuming the improvements to resolve the existing deficiencies will be completed, sections of the collection system in Sewer Drainage Basin 5 will need to be upsized.

- In Sewer Drainage Basin 5, a portion of the pipelines located along 72nd Avenue NW, Church Creek Loop NW, and 68th Avenue NW will need to be upsized. These projects are included in **CIP DF2**, **DF3**, and **DF4**.

The hydraulically deficient sewers at projected 2021 peak hour flows according to the modeling results, which equal approximately 3,070 LF, are shown in **Figure 7-2** and are included in the City's CIP in **Chapter 7**. The pipe size upgrades for the 2021 flow projections are scheduled in accordance to the capacity of the existing pipes, with improvements to resolve the existing deficiencies completed, being reached at the projected 2021 flow rate. However, the flow projections for 2035 were used to establish the proposed pipe diameters for the pipe capacity upgrades. All of the growth and related improvements for 2021 are necessary to accommodate flow from future developments; therefore, they are expected to be developer-funded improvements.

2035 (20-year) System Projection

Based on the hydraulic analysis of the system using projected flow rates for 2035 and assuming the improvements to resolve the existing deficiencies and projected 2021 deficiencies will be completed, sections of the collection system in Sewer Drainage Basin 3 will need to be upsized.

- In Sewer Drainage Basin 3, a portion of the pipeline located along 274th Street NW will need to be upsized. This project is included in **CIP DF12**.

The hydraulically deficient sewers at projected 2035 peak hour flows according to the modeling results, which equal approximately 430 LF, are shown in **Figure 7-3** and are included in the City's CIP in **Chapter 7**. The pipe size upgrades for the 2035 flow projections are scheduled in accordance to the capacity of the existing pipes, with improvements to resolve the existing and projected 2021 deficiencies completed, being reached at the projected 2035 flow rate. The flow projections for 2035 were used to establish the proposed pipe diameters for the pipe capacity upgrades. All of the growth and related improvements for 2035 are necessary to accommodate flow from future developments; therefore, they are expected to be developer-funded improvements.

Other Existing Gravity Collection System Deficiencies

The projects listed in the previous sections are a result of the hydraulic modeling effort for 2013, 2021, and 2035. In addition to these projects, City staff desire to repair and rehabilitate other regions of the collection system due to their condition or frequently required maintenance. The City has also indicated that a few manholes have infiltration and inflow (I/I) issues. These projects are summarized as follows, shown on **Figure 7-1**, and described in **Chapter 7**.

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. The City has identified the sewer mains between 92nd Avenue NW and 104th Avenue NW for replacement in the next few years. In addition, some of the roads in the identified area need to be repaired. The City plans to complete these sewer main replacements in three phases: Phase I (addressed in **CIP EX14**) – replace sewer mains in 94th Drive NW between Main Lift Station and 271st Street NW and in 271st Street NW between 94th Drive NW and 99th Avenue NW ; Phase II (addressed in **CIP EX13**) – replace sewer mains in 99th Avenue NW between 271st Street NW and 272nd Place NW and in 272nd Place NW between 99th Avenue NW and 100th Avenue NW; and Phase III (addressed in **CIP EX1**) – replace the existing sewer mains between 92nd Avenue NW and 104th Avenue NW that are not part of Phases I or II. These improvements are discussed further in the City's CIP in **Chapter 7**.

270th Street NW – Road, storm, sewer, and water improvements are needed along 270th Street NW between 94th Drive NW and 97th Avenue NW. A sewer collector is needed to serve new residential, commercial, or industrial development along 270th Street NW between 94th Drive NW and 97th Avenue NW in Sewer Drainage Basin 1. The design for this improvement was completed in 2011. The sewer improvements are addressed in **CIP EX3** which is discussed further in **Chapter 7**.

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 in this area. The City has observed I/I issues with some of the manholes along 76th Drive NW. The City is currently planning replacement of the sewer mains and manholes 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 manholes along 76th Drive NW between 276th Street NW and 272nd Street NW to eliminate the root intrusion in this area. The sewer improvements are addressed in **CIP EX4** which is discussed further in **Chapter 7**.

Odor Complaints – The City has received odor complaints about the sanitary sewer system from customers in Sewer Drainage Basin 3 between Pioneer Highway, Cedarhome Drive NW, and 276th Place NW. The sewer improvements along Pioneer Highway, addressed in **CIP EX16**, could potentially reduce or eliminate the odor issues in this area. **CIP EX16** is discussed further in **Chapter 7**.

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 slightly below the criteria for infiltration set by the Environmental Protection Agency (EPA) 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 Plan. 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 7**.

Based on the existing per capita flow rates and the fact that the majority of the sewer system is constructed with modern materials, significant I/I problems are not anticipated for the future. However, the City should always be aware of the potential for I/I and continue efforts to construct new systems to prevent I/I and maintain existing facilities and pipelines as needed to remove I/I. The City should consider conducting an I/I study to confirm the results of the I/I evaluation and to locate the affected collection system areas to determine if there are any cost-effective sewer rehabilitation measures to remove any excessive inflow. This study is addressed in **CIP M1** which is discussed further in **Chapter 7**.

Lift Station Capacity Analysis and Deficiencies

The City's existing sewer system has seven lift stations, including Main Lift Station which pumps to the City's wastewater treatment plant. All of the City's existing lift stations were designed in the last 25-years. **Chapter 2** provides additional history and background on the City's lift stations.

Existing System

The hydraulic analysis of the City's existing lift stations indicates that the City's existing lift stations have no capacity deficiencies. As discussed previously, capacity analyses of the lift station are based on estimated peak hour flow. 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 begin to approach or exceed the pumping capacity of the lift stations.

2021 (6-year) System Projection

Future developer-funded lift stations will be required as growth within the City's Urban Growth Area (UGA) occurs. Future developer-funded lift stations and the related force mains are to be designed for the 2035 projected flows.

The hydraulic analysis of the system using projected flow rates for 2021 suggests Main Lift Station may need to be upgraded to accommodate flows from developments in the City's existing sewer service area and future developer-funded lift stations. An analysis of Main Lift Station is recommended to confirm the capacity of the lift station and determine what upgrades will be necessary for the lift station to handle future flows. The capacity upgrades to Main Lift Station would be developer-funded and are discussed further in **Chapter 7**. The hydraulic analysis of the system using projected flow rates for 2021 indicates there will be no capacity issues with the City's existing lift stations in 2021 with the exception of Main Lift Station.

2035 (20-year) System Projection

Future developer-funded lift stations will be required as growth within the City's UGA occurs. Future developer-funded lift stations and the related force mains are recommended to be designed for the 2035 projected flows.

The hydraulic analysis of the system using projected flow rates for 2035 indicates there will be no capacity issues with the City's existing lift stations in 2035 with the exception of Main Lift Station which may need to be upgraded prior to 2021, as discussed previously.

Other Existing Lift Station Facility Deficiencies

Taylor's Landing Lift Station Priming Issues – The depth of the wetwell can cause priming problems with the pumps in Taylor's Landing Lift Station. Since this lift station provides service to a small residential community, this lift station can be offline for several days without issues. In addition, this lift station will be replaced in the future with the construction of Lift Station 10 (**CIP DF8A**) and **CIP DF8B**, which are discussed further in **Chapter 7**, so this deficiency is not included in the City's CIP.

Cedarhome Lift Station Upgrades – The existing lift station has a few minor issues, which includes the following: the ventilation system is connected to the intrusion alarm; the ventilation system does not operate when the engine comes on; ragging issues; and cloudy oil. This lift station will be eliminated with **CIP EX5B**, which is discussed further in **Chapter 7**.

Pioneer Hills Lift Station Upgrades – The existing lift station has a few minor issues that include corrosion in the existing wetwell and cloudy oil. These issues should be investigated further and resolved with **CIP EX6**, which is discussed further in **Chapter 7**.

Church Creek Rehabilitation – The wetwell top is lower than the surrounding grade, which can lead to drainage problems and the site needs standby power. The elimination of this lift station is addressed in **CIP EX5A**, which is discussed further in **Chapter 7**.

Church Creek Park Lift Station – It is recommended that this lift station be decommissioned and a gravity line from the lift station restroom be routed to a nearby manhole or Church Creek Lift Station. This is addressed in **CIP EX5A**, which is discussed further in **Chapter 7**.

Main Lift Station Force Main Upgrades – Main Lift Station has one force main. If this force main needs to be repaired, a temporary bypass line must be set up from Main Lift Station across State Route 532 to the City's wastewater treatment plant. The City would like to install a redundant force main for Main Lift Station so repair work can be performed on the existing Main Lift Station force main without taking Main Lift Station out of service. In addition, this improvement may increase the capacity of Main Lift Station, which should be investigated when during the design and construction of this improvement. This improvement is addressed in **CIP EX12**, which is discussed further in **Chapter 7**.

Main Lift Station – As noted in **Chapter 4**, the capacity of the Main Lift Station may be exceeded prior to 2021. Concurrent with these capacity upgrades, the existing maintenance issues should be addressed. The existing Flygt pumps are installed in a drywell and have no means of cooling the motor. This should be resolved either by plumbing the existing water jackets or the replacement of the Flygt pumps with a self cooling pump that is designed to be installed in a drywell. In addition, the existing pumps in the lift station cannot be easily removed for maintenance and repair. This improvement is addressed in **CIP DF1B**, which is discussed further in **Chapter 7**.

Flow Meter Installation – The existing lift stations do not have flow meters installed with the exception of Copper Station Lift Station. The City staff document daily totalizer readings for each of the lift stations. It is recommended that flow meters are installed and the data transmitted to the supervisory control and data acquisition SCADA system as part of the telemetry upgrades as part of **CIP EX7**, which is discussed further in **Chapter 7**.

Telemetry System Upgrades – The existing telemetry system at some of the lift stations has become outdated and will need to be replaced. This improvement is addressed in **CIP EX7**, which is discussed further in **Chapter 7**.

6-4. WASTEWATER TREATMENT PLANT ANALYSIS

Wastewater Treatment Plant Capacity Analysis and Deficiencies

The City's existing wastewater treatment plant was originally constructed in 1963. Since that time, there have been several upgrades to the wastewater treatment plant. The last significant upgrade to the City's wastewater treatment plant took place in 2004 when the capacity of the wastewater treatment plant was increased to 1.5 million gallons per day (MGD) with the construction of headworks, oxidation ditches and secondary clarifiers, an ultraviolet (UV) disinfection system, a scum system, a plant water system, a yard pump station, sludge stabilization ponds, and a decant pump station. Effluent from the City's wastewater treatment plant is discharged into the Stilliguamish River. **Chapter 2** provides additional history and background on the City's wastewater treatment plant.

Existing System

The analysis of the City's existing wastewater treatment plant indicates that the City's existing wastewater treatment plant has no capacity deficiencies. As discussed previously, capacity analyses of the wastewater treatment plant are based on estimated maximum month average influent flow. According to discussions with the system operators, there are no known capacity deficiencies in the City's wastewater treatment plant. Flows at the wastewater treatment plant should be monitored to determine if influent flow during peak events begins to approach or exceed the capacity of the wastewater treatment plant.

2021 (6-year) System Projection

The analysis of the system using projected flow rates for 2021 indicates there will be no capacity issues with the City's existing wastewater treatment plant in 2021.

2035 (20-year) System Projection

The analysis of the system using projected flow rates for 2035 suggests the City's existing wastewater treatment plant may need to be upgraded to accommodate projected flows prior to 2035. Flows at the wastewater treatment plant should be monitored annually to determine if influent flow during peak events begins to approach or exceed the capacity of the wastewater treatment plant. Once the City's wastewater treatment plant reaches 85 percent of its capacity, wastewater treatment plant upgrade planning will need to begin. As part of the facility planning, an analysis of the City's wastewater treatment plant will be needed to determine what upgrades will be necessary for the wastewater treatment plant to handle future flows. The planning, engineering, and construction of the wastewater treatment plant upgrades are discussed further in **Chapter 7**.

It should be noted that the design of the City's existing wastewater treatment plant included space allocated for the installation of additional treatment equipment as part of any future improvement to the wastewater treatment plant. This included, at a minimum, space allocated for an additional oxidation ditch, two additional circular clarifiers, grit removal, and the installation of one additional UV disinfection module.

Other Existing Wastewater Treatment Plant Deficiencies

Telemetry System Upgrades – The existing telemetry system at the wastewater treatment plant has become outdated and will need to be replaced. This improvement is addressed in **CIP EX7** which is discussed further in **Chapter 7 (CIPM4 and M5)**.

Biosolids Utilization Study and Biosolids Removal and Utilization – Removal of biosolids in the City's sludge stabilization pond every few years is a short-term solution. The City is currently evaluating biosolids handling alternatives for its wastewater treatment plant to determine which alternative will be implemented. The City plans to contract out the dredging and dewatering of the biosolids stored in both of its existing ponds, one last time after the selected biosolids handling alternative is implemented, and transport of the Class B biosolids to an existing permitted facility. These improvements are addressed in **CIP EX8A**, **CIP EX8B**, and **CIP EX8C**, which are discussed further in **Chapter 7**.

Grit Removal Unit Installation – Installation of a grit removal unit at the headworks of the City's wastewater treatment plant is desired to remove debris, which causes operational and maintenance issues of the equipment downstream of the headworks. This improvement is addressed in **CIP EX9**, which is discussed further in **Chapter 7**.

Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades – The City wants to operate the UV disinfection system at the wastewater treatment plant more efficiently to conserve energy and extend the lamp life of the UV disinfection system. The UV disinfection system is currently programmed so that the UV lamps operate at full power. The City would like to operate the UV disinfection system more efficiently with programming modifications so the power of the UV lamps can vary based on the influent flows to the wastewater treatment plant in order to conserve energy and extend the lamp life of the UV bulbs. In addition, the City may want to install a recycle pump system for the UV disinfection system. The UV lamps currently overheat during prolonged periods of low flow while the UV lamps are in operation. The City could install a recycle pump system so adequate flow can be recirculated through the UV disinfection system during low flow events to prevent the UV lamps from overheating. The City will need to perform a study prior to implementing the energy efficiency and recycle pump upgrades to the UV disinfection system. This improvement is addressed in **CIP EX10**, which is discussed further in **Chapter 7**.

Sheet Pile Installation – The City's wastewater treatment plant location near Port Susan makes it a high risk to floods from the Stillaguamish River. The City would like to install sheet piles around its wastewater treatment plant to provide additional protection from flooding for its wastewater treatment plant. This improvement is addressed in **CIP EX11**, which is discussed further in **Chapter 7**.

CHAPTER 7

Capital Improvement Plan

7-1. 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 the projected sewer customer growth. The sewer system improvements were identified from an evaluation of the results of the system analyses presented in **Chapter 6**. 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 **Figures 7-1**, **7-2**, and **7-3**. The improvements are organized and presented in this chapter according to the following primary categories.

- Existing System Improvements
- 2021 (6-year) System Improvements
- 2035 (20-year) System Improvements

Improvements for gravity collection piping, lift stations, force mains, the wastewater treatment plant, and miscellaneous projects are listed under each of the three primary categories. The remainder of this chapter presents a brief description of each group of improvements, the criteria for prioritizing, the basis for the cost estimates, and the implementation schedule.

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 pipes, force main/gravity main combinations or multiple force 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.

7-2. 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. The CIP numbers for improvements to the existing system have an "EX" prefix (example: EX1). The CIP numbers for planning improvements have an "M" prefix (example: M1).

Some improvements will be necessary to serve currently undeveloped areas in the Urban Growth Area (UGA). The major pipe and facility improvements that will be required when development occurs in those areas are considered to be developer-funded projects. The CIP numbers for developer-funded improvements have a "DF" prefix (example: DF1). Additional developer-funded projects include localized on-site sewer main improvements that are not associated with the existing overall sewer collection/interceptor system, but will be necessary when the property served by the sewer system is redeveloped or expanded. The costs associated with all of these improvements shall be borne by the developers, rather than the existing sewer customers. The locations of improvements in the undeveloped areas are not shown as they will be designed in the future to fit the specific layout of the developments. 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.

Existing System Improvements

The following improvements were identified from the results of the system analyses and by City staff, as discussed in **Chapter 6**. These improvements are necessary to serve the existing sewer service area. The improvements include the major pipeline and facility construction that are required to properly serve the existing sewer service area. The improvement costs shall be borne by the existing customers, unless over-sizing of the improvements provides a benefit to developers.

The existing improvements are based on existing flow rates; however, the proposed pipe diameters are based on the flow projection for 2035. The existing system improvements are illustrated in **Figure 7-1**. A variety of alternatives are possible for the CIP projects listed and alternatives should and will be considered during the design of each project.

CIP EX1: Sewer Drainage Basin 1 Pipe Replacement Program

Estimated Cost: $5,763,000
Proposed Years: 2015 through 2035

Deficiency: There is approximately 31,845 lineal feet (LF) of gravity sewer pipe in Sewer Drainage Basin 1 (downtown Stanwood area), and most of it was constructed more than 45 years ago, making this area the greatest potential contributor to inflow and infiltration (I/I) in the collection system. Due to the age, non-standard materials, condition of this pipe, and overflows in this area, the City has identified approximately 22,225 LF of gravity sewer pipe between 92nd Avenue NW and 104th Avenue NW in Sewer Drainage Basin 1 for replacement.

In addition, portions of the sewer interceptor along 94th Drive NW, 271st Street NW, 99th Avenue NW, and 272nd Place NW in Sewer Drainage Basin 1 may have capacity deficiencies, as shown in **Figure 7-1**.

Improvement: These sewer main replacements will be completed in three phases: **CIP EX14** is Phase I of this replacement program; **CIP EX13** is Phase II of this replacement program; and Phase III of this replacement program is encompassed in this CIP. This provides the City with the flexibility to coordinate these projects with other projects that may occur within the same area.

Phase III of this replacement program will involve replacing the existing gravity sewer pipes between 92nd Avenue NW and 104th Avenue NW that are not part of Phases I or II of this replacement program. A portion of the collection system identified for this phase of the replacement program may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 530 LF of existing gravity sewer pipe along 94th Drive NW between Main Lift Station and 271st Street NW and along 271st Street NW between 94th Drive NW and 92nd Avenue NW should be upsized to 36-inch diameter pipe due to minimum pipeline grade.

The new gravity sewer pipe in Phase III will consist of approximately 1,185 linear feet of 36-inch diameter pipe, approximately 895 linear feet of 15-inch diameter pipe, approximately 1,685 linear feet of 12-inch diameter pipe, and approximately 15,830 linear feet of 8-inch diameter pipe, constructed in accordance with the City's public works standards. Lining and repair methods will be evaluated during the design process to determine feasibility and potential cost benefits. Repair of the roads in the identified area will be coordinated with the sewer pipe replacement.

CIP EX2: Collection/Interceptor System Flow Monitoring and Video

Estimated Cost: $353,000
Proposed Years: 2015 through 2028

Deficiency: The hydraulic model and discussions with the City indicate that portions of the interceptors along 94th Drive NW, 271st Street NW, Pioneer Highway, and 72nd Avenue NW and the sewer collectors along 99th Avenue NW and 272nd Place NW may be at or near capacity. Flow monitoring should be completed to verify existing flow rate conditions at various points in the system in order to determine if any additional capacity is available. Video inspection should also be performed to verify existing gravity sewer pipe conditions throughout the entire collection system.

Improvement: Install flow monitoring equipment in the sewer collection system at the locations shown in **Figure 7-1** and at other locations determined by the City in order to determine existing flow rates. If peak flow capacity is at or exceeds 70 percent of the pipeline capacity, then plans for an expansion and/or upgrade of the deficient pipe segments should be implemented. Acquire two additional flow monitors for this project and future flow monitoring projects. Complete video inspections of the entire collection system.

CIP EX3: 270th Street NW Pipe Construction

Estimated Cost: $100,000
Proposed Year: 2015

Deficiency: Road, storm, sewer, and water improvements are needed along 270th Street NW between 94th Drive NW and 97th Avenue NW. A sewer collector is needed to serve new residential, commercial, or industrial development along 270th Street NW between 94th Drive NW and 97th Avenue NW in Sewer Drainage Basin 1.

Improvement: Construct approximately 432 LF of 8-inch gravity pipe per City standards along 270th Street NW between 94th Drive NW and 97th Avenue NW. The design for this improvement was completed in 2011.

CIP EX4: 272nd Street NW and 76th Drive NW Gravity Main Replacement

Estimated Cost: $643,000
Proposed Years: 2018 and 2019

Deficiency: Portions of 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 have capacity or structural deficiencies, as shown in **Figure 7-1**. In addition, some of the manholes along 76th Drive NW have I/I issues.

Improvement: Replace 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.

This improvement will be coordinated with the planned transportation improvements on 272nd Street NW between Pioneer Highway and 72nd Avenue NW.

CIP EX5A: Church Creek Collection System Construction

Estimated Cost: $1,025,000
Proposed Years: 2022 trough 2028

Deficiency: Church Creek Lift Station (Lift Station 1) is nearing the end of its design life. The lift station does not have emergency backup power and is difficult to access for maintenance. In addition, portions of the gravity sewer line along 272nd Street NW between Pioneer Highway and 72nd Avenue NW in Sewer Drainage Basins 3 and 4 have capacity deficiencies. The installation of a gravity sewer line from the intersection of Church Creek Loop NW and Manor Place NW to the intersection of 72nd Avenue NW and 267th Street NW will eliminate Church Creek Lift Station and the gravity sewer line capacity deficiencies along 272nd Street NW between Pioneer Highway and 72nd Avenue NW. It is also recommended that Church Creek Park Lift Station be decommissioned and a gravity line from this restroom be routed to a nearby manhole.

Improvement: Construct approximately 2,640 LF of 12-inch gravity sewer pipe per City standards from the intersection of Church Creek Loop NW and Manor Place NW to the intersection of 72nd Avenue NW and 267th Street NW. Church Creek Lift Station can be abandoned after this construction. This improvement will be coordinated with the planned transportation improvements on 72nd Avenue NW between 268th Street NW and 276th Street NW.

A portion of the pipe along Pioneer Highway, 261st Street NW, and 72nd Avenue NW is undersized at its current diameter during peak flow conditions. As stated in **Chapter 6**, a peaking factor of four was used in the peak hour flow analysis throughout the collection system. Pioneer Highway is a primary interceptor and a peaking factor of 3 or 3.5 would be more commonly used. The City should install flow meters along this line in several locations so a peaking factor can be obtained for this interceptor. Once this information is gathered, further analysis will be necessary for this section of pipe. It is important to note that this pipe will be upgraded as part of **CIP EX17**, **CIP EX18**, and **CIP EX19** and will no longer be problematic after these improvements are constructed. This CIP item should be completed after **CIP EX17**, **CIP EX18**, and **CIP EX19**. If this CIP is not constructed, then the sewer main on 272nd Street NW between Pioneer Highway and 72nd Avenue NW may be at or near capacity and need to be upgraded.

CIP EX5B: Cedarhome Collection System Construction

Estimated Cost: $175,000
Proposed Years: 2029 through 2035

Deficiency: Elimination of a lift station reduces the burden on the operation and maintenance staff. In addition, portions of the gravity sewer line along 272nd Street NW between Pioneer Highway and 72nd Avenue NW in Sewer Drainage Basins 3 and 4 have capacity deficiencies. The installation of a gravity sewer line from the intersection of 68th Avenue NW and 277th Street NW to the Church Creek Court NW cul-de-sac will eliminate Cedarhome Lift Station (Lift Station 2) and the gravity sewer line capacity deficiencies along 272nd Street NW between Pioneer Highway and 72nd Avenue NW.

Improvement: Construct approximately 490 LF of 12-inch gravity sewer pipe per City standards from the intersection of 68th Avenue NW and 277th Street NW to the Church Creek Court NW cul-de-sac. Cedarhome Lift Station can be abandoned after this construction. This CIP item should be completed after **CIP EX5A**, **CIP EX17**, **CIP EX18**, and **CIP EX19**. If this CIP is not constructed, then the sewer main on 272nd Street NW between Pioneer Highway and 72nd Avenue NW may be at or near capacity and need to be upgraded.

CIP EX6: Miscellaneous Improvements

Estimated Cost: $665,000
Proposed Years: 2015 through 2035

Deficiency: Pioneer Hills Lift Station (Lift Station 3) has a few maintenance issues, including corrosion in the existing wetwell and cloudy oil. In addition, the minor operational issues noted by the City in **Chapter 6** are addressed under this CIP item.

Improvement: Upgrade Pioneer Hills Lift Station to eliminate the issues at the lift station. Replace or rehabilitate the manholes with inflow and infiltration (I/I) issues, as identified by the City.

CIP EX7: Telemetry System Upgrades

Estimated Cost: $275,000
Proposed Years: 2014 through 2035

Deficiency: Portions of the existing telemetry system is outdated and provides limited alarming and automated control of the pumping facilities. Additionally, the existing lift stations do not have flow meters installed with the exception of Copper Lift Station. City staff document daily pump run time readings for each of the lift stations. It is recommended that flow meters are installed and the data be transmitted to the supervisory control and data acquisition (SCADA) system as part of the telemetry upgrades.

Improvement: Upgrade the wastewater treatment plant Human Machine Interface (HMI); replace the remote unit at Lindstrom and Copper Lift Stations. Install flow meters at Main, Lindstrom, Church Creek, Cedarhome, Taylor's Landing, and Pioneer Hills Lift Stations.

CIP EX8A: Long-term Biosolids Utilization Study

Estimated Cost: $110,000
Proposed Year: 2015

Deficiency: The City's wastewater treatment plant produces biological sludge. This sludge is stabilized in two 1.25-acre ponds using an aerobic and facultative digestion process which reduces the mass and stabilizes the sludge so that it can be beneficially reused or disposed of as a solid waste. Removal of biosolids in the City's sludge stabilization pond every few years is a short-term solution. The City is currently considering long-term alternatives for biosolids management, which could include reusing as mulch, incinerating, hauling to a landfill, or land applying. Refer to the *Biosolids Utilization Plan Report* performed by RH2 Engineering, Inc., (RH2) in **Appendix K**.

Improvement: Conduct a long-term biosolids operations and management alternatives conceptual study and prepare a preliminary design for the recommended plan.

CIP EX8B: Long-term Biosolids Utilization Modifications

Estimated Cost: $1,925,000

Proposed Years: 2016 through 2019

Deficiency: The City's wastewater treatment plant produces biological sludge. This sludge is stabilized in two 1.25–acre ponds using an aerobic and facultative digestion process which reduces the mass and stabilizes the sludge so that it can be beneficially reused or disposed of as a solid waste. Removal of biosolids in the City's sludge stabilization pond every few years is a short-term solution. After **CIP EX8A** is complete, the City will need to design and construct the selected long-term alternative for the biosolids management system.

Improvement: Design and construct the selected long-term biosolids operations and management system.

CIP EX8C: Biosolids Removal and Utilization

Estimated Cost: $500,000
Proposed Year: 2020

Deficiency: The City's wastewater treatment plant produces biological sludge. This sludge is stabilized in two 1.25–acre ponds using an aerobic and facultative digestion process which 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 one final time once **CIP EX8B** is complete.

Improvement: Remove and land apply the biosolids contained in both of the City's sludge stabilization ponds once **CIP EX8B** is complete. Costs for this improvement were based on RH2 Engineering's *Biosolids Utilization Plan Report*, dated August 2008, included in **Appendix K**.

CIP EX9: Grit Removal Unit Installation

Estimated Cost: $203,000
Proposed Years: 2018 through 2020

Deficiency: The wastewater treatment plant needs a grit removal unit installed at the headworks to remove debris, which causes operational and maintenance issues of the equipment downstream of the headworks. The 2004 wastewater treatment plant upgrades design allocated space for this equipment.

Improvement: Install a grit removal unit at the headworks to remove debris that is causing operational and maintenance issues at its wastewater treatment plant.

CIP EX10: Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades

Estimated Cost: $48,000
Proposed Year: 2017

Deficiency: The ultraviolet (UV) disinfection system at the wastewater treatment plant is currently programmed so that the power of the UV lamps operate at full power. The UV disinfection system could be more efficiently operated with programming modifications in order to conserve energy and extend the lamp life of the UV bulbs. In addition, the UV lamps overheat during prolonged periods of low flow while the UV lamps are in operation.

Improvement: Perform a study for the energy efficiency and recycle pump upgrades to the UV disinfection system. Reprogram the SCADA system and/or local UV control panel so that the UV power is turned down based on the flow meter signal at the wastewater treatment plant. Install a recycle pump system so adequate flow can be recirculated through the UV disinfection system during low flow events to prevent the UV lamps from overheating.

CIP EX11: Sheet Pile Installation

Estimated Cost: $4,900,000
Proposed Years: 2018 through 2028

Deficiency: The City's wastewater treatment plant location near Port Susan make it a high risk to floods from the Stillaguamish River. The wastewater treatment plant has flooded on many occasions. The two floods in 1990 overtopped the sewage lagoons sending raw sewage onto neighboring properties and out into Irvine Slough and Port Susan. The dikes around the sewage lagoons were raised in 1991 after the 1990 floods to help prevent overtopping during future events. The sewage lagoons were decommissioned in 2003 after the City constructed improvements to the wastewater treatment plant, and the updated plant included two 1.25-acre ponds to store biological sludge. During the 2009 flood, flood waters reached high enough to overtop the raised wastewater treatment plant dike and Larson Dam, resulting in flood water inundating the biological sludge ponds and flushing the biological sludge out into Irvine Slough and Port Susan. The wastewater treatment plant needs additional protection from flooding.

Improvement: Design, permit and construct approximately 3,000 linear feet of flood protection wall around the City's wastewater treatment plant using sheet piles that are an average of 23 feet long.

CIP EX12: Main Lift Station (Lift Station 4) Force Main Upgrades

Estimated Cost: $486,000
Proposed Years: 2015 and 2016

Deficiency: If the force main for Main Lift Station needs to be repaired, a temporary bypass line must be set up from Main Lift Station across State Route (SR) 532 to the City's wastewater treatment plant. A redundant force main is needed for Main Lift Station so the existing force main can be repaired without needing to take Main Lift Station out of service.

Improvement: Construct approximately 700 LF of redundant force main for Main Lift Station per City standards with the capacity to handle at least approximately 1,900 gpm during peak hour flows with the existing Main Lift Station.

CIP EX13: 99th Avenue NW and 272nd Place NW Gravity Main Existing Deficiencies

Estimated Cost: $236,000
Proposed Years: 2018 and 2019

Deficiency: There is approximately 31,845 lineal feet (LF) of gravity sewer pipe in Sewer Drainage Basin 1 (downtown Stanwood area), and most of it was constructed more than 45 years ago, making this area the greatest potential contributor to inflow and infiltration (I/I) in the collection system. Due to the age, non-standard materials, condition of this pipe, and overflows in this area, the City has identified approximately 22,225 LF of gravity sewer pipe between 92nd Avenue NW and 104th Avenue NW in Sewer Drainage Basin 1 for replacement.

In addition, portions of the sewer interceptor along 94th Drive NW, 271st Street NW, 99th Avenue NW, and 272nd Place NW in Sewer Drainage Basin 1 may have capacity deficiencies, as shown in **Figure 7-1**.

Improvement: These sewer main replacements will be completed in three phases: **CIP EX14** is Phase I of this replacement program; this CIP is of Phase II of this replacement program; and Phase III of this replacement program is encompassed in **CIP EX1**. This provides the City with the flexibility to coordinate these projects with other projects that may occur within the same area.

Phase II of this replacement program will involve replacing existing gravity sewer pipes in 99th Avenue NW between 271st Street NW and 272nd Place NW and in 272nd Place NW between 99th Avenue NW and 100th Avenue NW. The portion of the collection system identified for this phase of the replacement program may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 780 LF of existing gravity sewer pipe along 99th Avenue NW between 271st Street NW and 272nd Place NW and along 272nd Place NW between 99th Avenue NW and 100th Avenue NW should be upsized to 12-inch diameter pipe due to minimum pipeline grade.

The new gravity sewer pipe in Phase II will consist of approximately 780 linear feet of 12-inch diameter pipe constructed in accordance with the City's public works standards. Repair methods will be evaluated during the design process to determine feasibility and potential cost benefits. Repair of the roads in the identified area will be coordinated with the sewer pipe replacement.

CIP EX14: 94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies

Estimated Cost: $1,690,000
Proposed Years: 2015 through 2017

Deficiency: There is approximately 31,845 lineal feet (LF) of gravity sewer pipe in Sewer Drainage Basin 1 (downtown Stanwood area), and most of it was constructed more than 45 years ago, making this area the greatest potential contributor to inflow and infiltration (I/I) in the collection system. Due to the age, non-standard materials, condition of this pipe, and overflows in this area, the City has identified approximately 22,225 LF of gravity sewer pipe between 92nd Avenue NW and 104th Avenue NW in Sewer Drainage Basin 1 for replacement.

In addition, portions of the sewer interceptor along 94th Drive NW, 271st Street NW, 99th Avenue NW, and 272nd Place NW in Sewer Drainage Basin 1 may have capacity deficiencies, as shown in **Figure 7-1**.

Improvement: These sewer main replacements will be completed in three phases: this CIP is Phase I of this replacement program; **CIP EX13** is of Phase II of this replacement program; and Phase III of this replacement program is encompassed in **CIP EX1**. This provides the City with the flexibility to coordinate these projects with other projects that may occur within the same area.

Phase I of this replacement program will involve replacing existing gravity sewer pipes in 94th Drive NW between Main Lift Station and 271st Street NW and in 271st Street NW between 94th Drive NW and 99th Avenue NW. A portion of the collection system identified for this phase of the replacement program may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 450 LF of existing gravity sewer pipe along 271st Street NW between 270th Street NW and 99th Avenue NW should be upsized to 12-inch diameter pipe due to minimum pipeline grade.

The new gravity sewer pipe in Phase I will consist of approximately 325 linear feet of 36-inch diameter pipe, approximately 1,075 linear feet of 15-inch diameter pipe, and approximately 450 linear feet of 12-inch diameter pipe, constructed in accordance with the City's public works standards. Lining and repair methods will be evaluated during the design process to determine feasibility and potential cost benefits. Repair of the roads in the identified area will be coordinated with the sewer pipe replacement.

CIP EX15: Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies

Estimated Cost: $271,000
Proposed Years: 2020 and 2021

Deficiency: Portions of the sewer interceptor in Sewer Drainage Basin 1 may have capacity deficiencies, as shown in **Figure 7-1**. At this time, the City has not identified any known capacity issues with this interceptor.

Improvement: Portions of the Sewer Drainage Basin 1 collection system may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 550 LF of existing gravity sewer pipe along Florence Road between 88th Avenue NW and 271st Street NW should be upsized to 42-inch diameter pipe due to minimum pipeline grade.

CIP EX16: Upper Pioneer Highway Interceptor Existing Deficiencies

Estimated Cost: $572,000
Proposed Years: 2018 and 2019

Deficiency: Portions of the sewer interceptor along Pioneer Highway in Sewer Drainage Basin 3 may have capacity deficiencies, as shown in **Figure 7-1**.

Improvement: Portions of the Sewer Drainage Basin 3 collection system may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 1,810 LF of existing gravity sewer pipe along Pioneer Highway between Cedarhome Drive NW and 86th Drive NW should be upsized to 15-inch diameter pipe due to minimum pipeline grade.

CIP EX17: Pioneer Highway Interceptor Existing Deficiencies

Estimated Cost: $559,000
Proposed Years: 2022 through 2028

Deficiency: Portions of the sewer interceptor along Pioneer Highway in Sewer Drainage Basins 3 and 5 may have capacity deficiencies, as shown in **Figure 7-1**. At this time, the City has not identified any known capacity issues with this interceptor.

Improvement: Portions of the collection system in Sewer Drainage Basins 3 and 5 may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 1,770 LF of existing gravity sewer pipe along Pioneer Highway between 272nd Street NW and 267th Street NW should be upsized to 15-inch diameter pipe due to minimum pipeline grade.

CIP EX18: Lower Pioneer Highway Interceptor Existing Deficiencies

Estimated Cost: $569,000
Proposed Years: 2028 and 2029

Deficiency: Portions of the sewer interceptor along Pioneer Highway in Sewer Drainage Basin 5 may have capacity deficiencies, as shown in **Figure 7-1**. At this time, the City has not identified any known capacity issues with this interceptor.

Improvement: Portions of the Sewer Drainage Basin 5 collection system may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 1,800 LF of existing gravity sewer pipe along Pioneer Highway between 265th Street NW and 77th Avenue NW should be upsized to 15-inch diameter pipe due to minimum pipeline grade.

CIP EX19: 72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies

Estimated Cost: $717,000
Proposed Years: 2021 and 2022

Deficiency: Portions of the sewer interceptor along 72nd Avenue NW and 261st Street NW in Sewer Drainage Basin 5 may have capacity deficiencies, as shown in **Figure 7-1**. At this time, the City has not identified any known capacity issues with this interceptor.

Improvement: Portions of the Sewer Drainage Basin 5 collection system may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 2,270 LF of existing gravity sewer pipe along 261st Street NW between Pioneer Highway and 72nd Avenue NW and along 72nd Avenue NW between 261st Street NW and 265th Street NW should be upsized to 15-inch diameter pipe due to minimum pipeline grade.

CIP EX20: 265th Street NW Gravity Main Existing Deficiencies

Estimated Cost: $145,000
Proposed Years: 2022 through 2028

Deficiency: The sewer collector along 265th Street NW in Sewer Drainage Basin 5 may have capacity deficiencies, as shown in **Figure 7-1**. At this time, the City has not identified any known capacity issues with this interceptor.

Improvement: The collection system along 265th Street NW between 72nd Avenue NW and 267th Street NW in Sewer Drainage Basin 5 collection system may be at or near capacity currently. This should be monitored closely by the City. The hydraulic model indicates that approximately 480 LF of existing gravity sewer pipe should be upsized to 12-inch diameter pipe due to minimum pipeline grade.

CIP M1: Inflow and Infiltration Study

Estimated Cost: $100,000
Proposed Years: 2016 and 2021

Deficiency: The existing per capita flow rates for the City are slightly above the criteria for inflow set by the Environmental Protection Agency (EPA) in the *Infiltration/Inflow, I/I Analysis and Project Certification* report, indicating that there might be an inflow problem, as discussed in **Chapter 4**.

Improvement: The City should conduct an I/I study to confirm the results of the I/I evaluation in **Chapter 4** and to locate the affected collection system areas to determine if there are any cost-effective sewer rehabilitation measures to remove any excessive inflow.

CIP M2: Comprehensive Sewer System Plan Update

Estimated Cost: $232,000
Proposed Years: 2014, 2015, and 2029 through 2035

Deficiency: The City's Comprehensive Sewer System Plan (Plan) should be updated every 10 years.

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

2021 System Improvements

The 2021 improvements were identified from the results of the system analyses discussed in **Chapter 6**. These improvements are necessary to serve currently undeveloped areas of the City's UGA. The improvements include the major pipeline and facility construction that will be required to properly serve that area. The improvement costs shall be borne by the developers, rather than the existing customers, unless over-sizing of the improvements provides benefit to the existing customers. Additional developer-funded projects that are not described in this section would include localized on-site improvements that are not associated with overall collection systems outside of the property being developed, but would be necessary to serve the interior portions of the development area.

The pipe diameter upgrades for the 2021 flow projections are scheduled based on the capacity of the existing pipes being reached at the 2021 flow rate; however, the proposed pipe diameters for the pipe capacity upgrades are based on the flow projections for 2035. The 2021 improvements are based on the assumption that the existing improvements are complete. The 2021 system improvements are illustrated in **Figure 7-2**. A variety of alternatives are possible for improving Lindstrom, and Taylor's Landing Lift Stations and pipe construction along 72nd Avenue NW, Church Creek Loop NW, 68th Avenue NW, and 274th Street NW and further evaluation should be performed when more information is available regarding when and where future developments will occur.

CIP DF1A: Main Lift Station (Lift Station 4) Alternatives Analysis

Estimated Cost: $54,000

Deficiency: Main Lift Station (Lift Station 4) has a design capacity of 1,900 gallons per minute (gpm). This is insufficient for projected 2021 peak hour flows, and the pumping capacity will be exceeded.

Improvement: An alternatives analysis for Main Lift Station upgrades is required so that the most cost-effective solution for the upgrades to Main Lift Station and the associated force main and gravity pipe is implemented. In addition, pump down testing should be performed on Main Lift Station to confirm its pumping capacity. This CIP item should be completed before **CIP DF1B**.

CIP DF1B: Main Lift Station (Lift Station 4) Rehabilitation

Estimated Cost: $1,544,000

Deficiency: Main Lift Station (Lift Station 4) has a design capacity of 1,900 gpm. This is insufficient for projected 2021 peak hour flows, and the pumping capacity will be exceeded.

Improvement: Upgrade the lift station capacity so it can handle at least approximately 3,200 gpm per City standards. Main Lift Station presents a few operational and maintenance difficulties but is operable and in good condition. The existing Flygt submersible pumps at Main Lift Station are installed in a drywell. The pumps have no means of cooling the motor as installed. This should be resolved either by plumbing the existing water jackets or replacing the Flygt pumps with a self-cooling pump that is designed to be installed in a drywell. In addition, the existing pumps in the lift station cannot be easily removed for maintenance and repair. This CIP item should be completed after **CIP DF1A**.

CIP DF2: 72nd Avenue NW Gravity Main Replacement

Estimated Cost: $193,000

Deficiency: The capacity of this sewer collector will be exceeded if any residential, commercial, or industrial growth occurs in Sewer Drainage Basin 5, as shown on **Figure 7-2**.

Improvement: Replace approximately 610 LF of existing gravity pipe with 15-inch diameter gravity pipe per City standards along 72nd Avenue NW between 265th Street NW and 267th Street NW.

CIP DF3: Church Creek Loop NW Gravity Main Replacement

Estimated Cost: $423,000

Deficiency: The capacity of this sewer collector will be exceeded if any residential, commercial or industrial growth occurs in Sewer Drainage Basin 5, as shown on **Figure 7-2**.

Improvement: Replace approximately 1,400 LF of existing gravity pipe with 12-inch diameter gravity pipe per City standards along Church Creek Loop NW from Manor Place NW to the Church Creek Court NW cul-de-sac.

CIP DF4: 68th Avenue NW Gravity Main Replacement

Estimated Cost: $321,000

Deficiency: The capacity of this sewer collector will be exceeded if any residential, commercial, or industrial growth occurs in Sewer Drainage Basin 5, as shown on **Figure 7-2**.

Improvement: Replace approximately 1,060 LF of existing gravity pipe with 12-inch diameter gravity pipe per City standards along 68th Avenue NW between 277th Street NW and 280th Street NW.

CIP DF5: 90th Avenue NW and Viking Way Pipe Construction

Estimated Cost: $514,000

Deficiency: Storm, sewer, and water improvements are needed along 90th Avenue NW between 271st Street NW and State Route (SR) 532 and along Viking Way between 88th Avenue NW and 92nd Avenue NW. The City plans to construct these improvements in the next few years as development occurs in this area. A sewer collector will be required to serve new residential, commercial or industrial development along 90th Avenue NW between 271st Street NW and SR 532 and along Viking Way between 88th Avenue NW and 92nd Avenue NW in Sewer Drainage Basin 1.

Improvement: Construct approximately 1,830 LF of 8-inch gravity pipe per City standards along 90th Avenue NW between 271st Street NW and State Route (SR) 532 and along Viking Way between 88th Avenue NW and 92nd Avenue NW. The City will verify the gravity pipe is sized adequately prior to construction. This improvement will be coordinated with the planned transportation improvements on 90th Avenue NW and Viking Way.

CIP DF6: Lift Station 8 Construction

Estimated Cost: $1,842,000

Deficiency: A facility will be required to serve new residential, commercial, or industrial development in future Sewer Drainage Basin 5C.

Improvement: Construct a new lift station in future Sewer Drainage Basin 5C with the capacity to handle at least approximately 100 gpm during peak hour flows and approximately 725 LF of force main per City standards to connect Lift Station 8 to the west end of the City's existing sewer collection system along 72nd Avenue NW or into the proposed gravity pipe in **CIP EX5A**. Due to equipment limitations and requirements, a 125 gpm pump may be required so that a 3-inch solid can be passed.

CIP DF7: Lift Station 9 Construction

Estimated Cost: $1,769,000

Deficiency: A facility will be required to serve new residential, commercial, or industrial development in future Sewer Drainage Basin 5D.

Improvement: Construct a new lift station in future Sewer Drainage Basin 5D with the capacity to handle at least approximately 50 gpm during peak hour flows and approximately 450 LF of force main per City standards to connect Lift Station 9 to the City's existing sewer collection system along 68th Avenue NW. Due to equipment limitations and requirements, a 125 gpm pump may be required so that a 3-inch solid can be passed.

CIP DF8A: Lift Station 10 Construction

Estimated Cost: $1,927,000

Deficiency: A facility will be required to serve new residential, commercial, or industrial development in future Sewer Drainage Basin 5E.

Improvement: Construct a new lift station in future Sewer Drainage Basin 5E with the capacity to handle at least approximately 70 gpm during peak hour flows and approximately 1,050 LF of force main per City standards to connect Lift Station 10 to the City's existing sewer collection system along Pioneer Highway. Due to equipment limitations and requirements, a 125 gpm pump may be required so that a 3-inch solid can be passed.

CIP DF8B: Taylor's Landing Lift Station (Lift Station 5) Pipe Construction

Estimated Cost: $481,000

Deficiency: Taylor's Landing Lift Station (Lift Station 5) can be abandoned with the construction of Lift Station 10.

Improvement: Construct approximately 1,500 LF of 12-inch diameter gravity pipe per City standards from the City's existing sewer collection system in Sewer Drainage Basin 5B to Lift Station 10.

CIP DF9: Lift Station 11 Construction

Estimated Cost: $1,875,000

Deficiency: A facility will be required to serve new residential, commercial, or industrial development in future Sewer Drainage Basin 5F.

Improvement: Construct a new lift station in future Sewer Drainage Basin 5F with the capacity to handle at least approximately 60 gpm during peak hour flows and approximately 850 LF of force main per City standards to connect Lift Station 11 to the east end of the City's existing sewer collection system on 261st Street NW. Due to equipment limitations and requirements, a 125 gpm pump may be required so that a 3-inch solid can be passed.

CIP DF10A: Lift Station 12 Construction

Estimated Cost: $2,099,000

Deficiency: A facility will be required to serve new residential, commercial, or industrial development in future Sewer Drainage Basin 5G.

Improvement: Construct a new lift station in future Sewer Drainage Basin 5G with the capacity to handle at least approximately 60 gpm during peak hour flows and approximately 1,700 LF of force main per City standards to connect Lift Station 12 to the City's existing sewer collection system along 72nd Avenue NW. Due to equipment limitations and requirements, a 125 gpm pump may be required so that a 3-inch solid can be passed.

CIP DF10B: Lindstrom Lift Station (Lift Station 7) Pipe Construction

Estimated Cost: $420,000

Deficiency: Lindstrom Lift Station (Lift Station 7) can be abandoned with the construction of Lift Station 12.

Improvement: Construct approximately 1,300 LF of 12-inch diameter pipe per City standards from the City's existing sewer collection system in Sewer Drainage Basin 5A to Lift Station 12.

CIP M3: Sewer Rate Study

Estimated Cost: $50,000
Proposed Year: 2017

Deficiency: The City's sewer rates should be evaluated often to meet projected needs.

Improvement: The City will conduct a sewer rate study and update as necessary based on the study results.

2035 System Improvements

The 2035 improvements were identified from the results of the system analysis discussed in **Chapter 6**. These additional improvements will be necessary to serve the remaining undeveloped areas of the City's UGA. The improvements include the major pipeline and facility construction that will be required to properly serve the system. The improvement costs shall be borne by the developers, rather than the existing customers, unless over-sizing of the improvements provides benefit to the existing customers. Additional developer-funded projects that are not described below would include localized on-site improvements that are not associated with the overall collection system outside of the property being developed, but would be necessary to serve the interior portions of the development area.

The 2035 improvements are based on the 2035 flow rate projections and the assumption that the 2021 improvements are complete. The additional system improvements required for 2035 are illustrated in **Figure 7-3**.

CIP DF11: 271st Street NW Monitoring and Potential Pipe Replacement

Estimated Cost: $1,397,000

Deficiency: A portion of 271st Street NW sewer pipe could possibly be exceeded with residential, commercial, industrial, or infill growth within the City's UGA.

Improvement: The City should monitor the flow in the interceptor along 271st Street NW between 94th Drive NW and 88th Avenue NW and along 88th Avenue NW between 271st Street NW and Florence Road as growth occurs. Capacity in this area may be exceeded based on a peak hour factor of four. This peaking factor may be too conservative for this area and will be verified by City staff during flow monitoring. Flow monitoring locations are shown on **Figure 7-3**. If the capacity of this interceptor is exceeded, the developers would bear the cost of improving the collection piping to the 2035 projected flows.

CIP DF12: 274th Street NW Gravity Main Replacement

Estimated Cost: $130,000

Deficiency: The capacity of this sewer collector will be exceeded if any residential, commercial, or industrial growth occurs in Sewer Drainage Basin 3, as shown on **Figure 7-2**.

Improvement: Replace approximately 430 LF of existing pipe along 274th Street NW between Cedarhome Drive and 80th Drive NW with 12-inch diameter gravity pipe per City standards.

CIP DF13: Lift Station 13 Construction

Estimated Cost: $2,099,000

Deficiency: A facility will be required to serve new residential, commercial, or industrial development in future Sewer Drainage Basin 1A.

Improvement: Construct a new lift station in future Sewer Drainage Basin 1A with the capacity to handle at least approximately 30 gpm during peak hour flows and approximately 1,700 LF of force main per City standards to connect Lift Station 13 to the west end of the City's existing sewer collection system on Saratoga Drive. Due to equipment limitations and requirements, a 125 gpm pump may be required so that a 3-inch solid can be passed.

CIP M4: Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates

Estimated Cost: $200,000
Proposed Years: 2021 and 2022

Deficiency: According to the flow projections in **Chapter 4**, the City's wastewater treatment plant will reach flow capacity prior to 2035. The City will need to update its *Wastewater Facilities Plan* once its wastewater treatment plant reaches 85 percent of its flow capacity to determine what modifications are necessary to increase the flow capacity of the wastewater treatment plant.

In addition, the City's Plan should be updated every 10 years.

Improvement: The City will update its *Wastewater Facilities Plan* prior to the City's wastewater treatment plant reaching 85 percent of its flow capacity.

The City will update its *Wastewater Facilities Plan* in coordination with updating its Plan. The City will perform a review of the Plan at the five-year mark and adjust the projections and improvements as necessary.

CIP M5: Wastewater Treatment Plant Update and Expansion

Estimated Cost: $11,498,000
Proposed Years: 2029 through 2035

Deficiency: According to the flow projections in **Chapter 4**, the City's wastewater treatment plant will reach flow capacity prior to 2035. The City will need to upgrade its wastewater treatment plant to increase its flow capacity. Since the extent of the treatment plant expansion cannot be determined until **CIP M4** is conducted, it is difficult to determine a cost. A planning-level estimate is shown in the CIP to allow the City to budget for the future.

Improvement: Design and construct upgrades to the wastewater treatment plant to increase its flow capacity in accordance with the Washington State Department of Ecology (Ecology) approved plans and phasing.

It should be noted that the design of the City's existing wastewater treatment plant included space allocated for the installation of additional treatment equipment as part any future improvement to the wastewater treatment plant. This included, at a minimum, space allocated for an additional oxidation ditch, two additional circular clarifiers, grit removal, and the installation of one additional UV disinfection module.

7-3. ESTIMATING COSTS OF IMPROVEMENTS

Project 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 2014 dollars. The cost estimates include the estimated construction cost of the improvement and indirect costs estimated at 25 percent of the construction cost for engineering preliminary design, final design, construction management services, permitting, and legal and administrative services. The construction cost estimates include a 15 percent contingency and sales tax of 8.8 percent. The project costs presented in the CIP are capital cost estimates, and do not represent life cycle cost estimates.

Construction cost estimates for sewer pipe projects were determined from the unit costs (i.e., cost per foot length) shown in **Table 7-1** and the proposed diameter and approximate length of each improvement.

Table 7-1
Gravity Sewer Pipe Unit Costs

Sewer Pipe Diameter (inches)	Construction Cost Per Foot Length (2014 $/LF)
8	$208
12	$224
15	$234
18	$252
24	$273
36	$328
42	$365

The unit costs for each pipe size are based on estimates 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 unit costs also include a contingency and sales tax. Additional costs were added to some improvements to cover anticipated increased costs related to the project location and degree of difficulty.

7-4. PRIORITIZING IMPROVEMENTS

The existing 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. Priority and schedule for developer-funded projects is dependent on the timing and design of specific developments areas. For planning purposes, a general schedule has been established for the developer-funded projects; however, the estimated schedule will need to be modified as development occurs.

Future projects that are not identified as part of the City's CIP may become necessary. Such projects may be required in order to remedy an emergency situation or to 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 City Council, when new information becomes available for review and analysis.

7-5. 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 six-year CIP. The implementation schedule for the proposed improvements is shown in **Table 7-2**. Developer-funded improvement projects are planned to start in 2015. The City will identify and schedule the repair/replacement projects during the annual budget process. This provides the City with the flexibility to coordinate these projects with road or other projects within the same area. The developer-funded improvement projects and their associated cost estimates are also shown in **Table 7-2**. However, the implementation dates for these improvements are likely to change, due to the uncertainty of the timing of the future developments that will be responsible for these improvements.

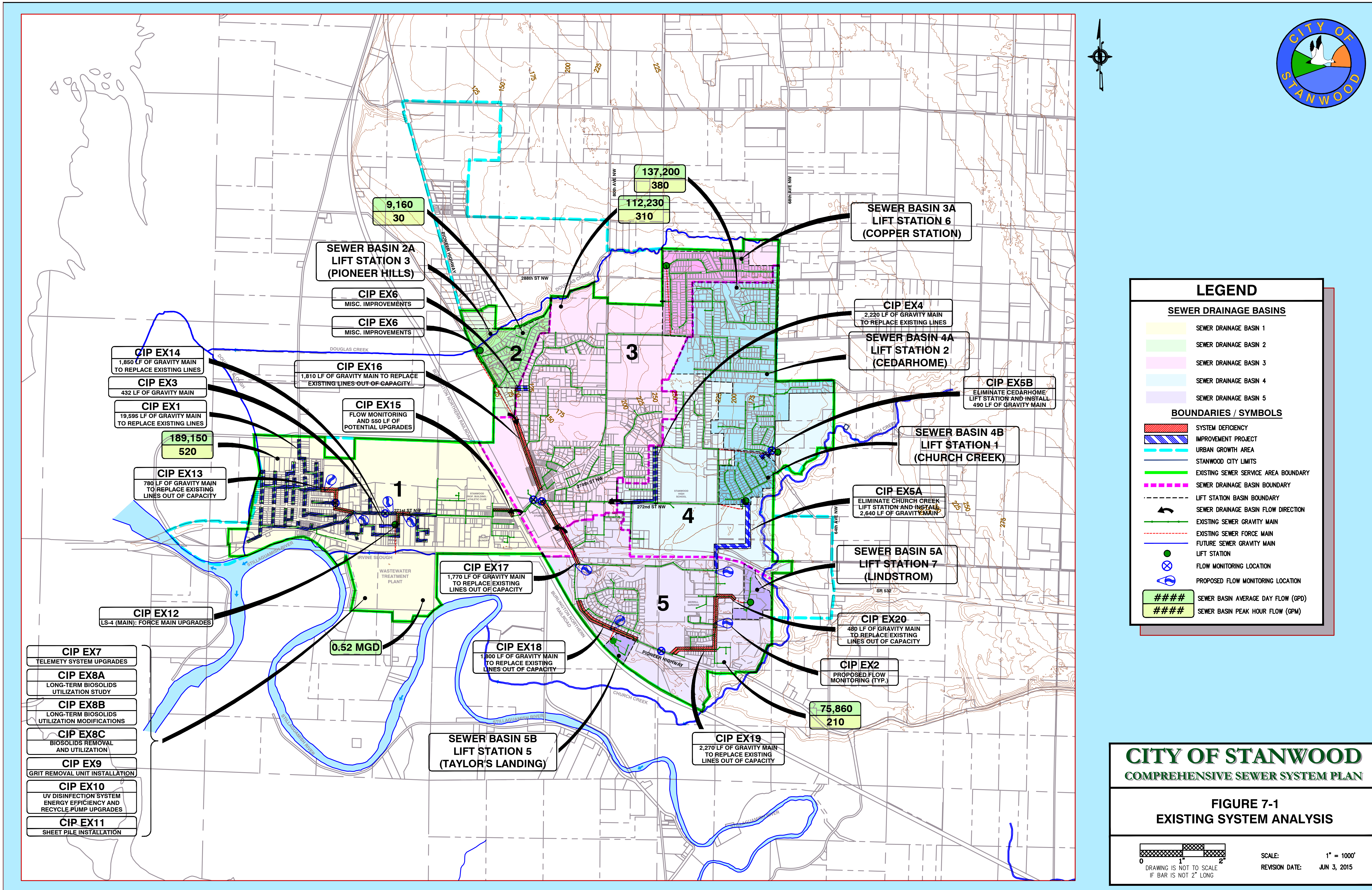
Future Project Cost Adjustments

All cost estimates shown in the tables are presented in year 2014 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 (ENR) 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 7-2
Proposed Capital Improvements Plan (CIP) Implementation Schedule

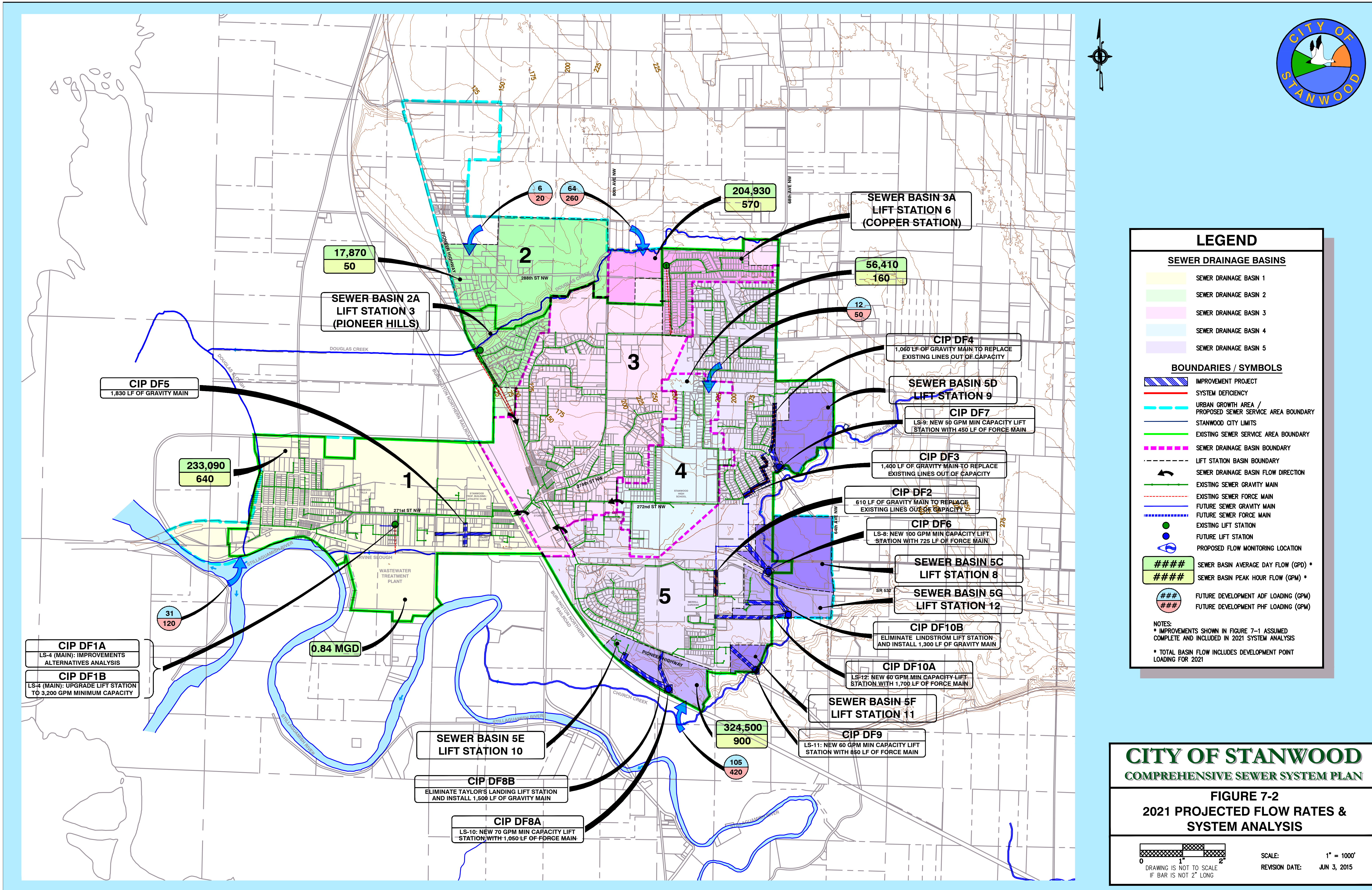
No.	Description	Estimated Cost (2014 $$)	Schedule of Improvements Planned Year of Project and Estimated Cost in 2014 $$ 2014	2015	2016	2017	2018	2019	2020	2021	2022-2028	2029-2035
Pipeline Improvements												
EX1	Sewer Drainage Basin 1 Pipe Replacement Program	$5,763K		$274K	$274K	$274K	$274K	$274K	$274K	$274K	$1,921K	$1,921K
EX2	Collector/Interceptor System Flow Monitoring and Video	$353K		$40K		$40K		$40K		$40K	$193K	
EX3	270th Street NW Pipe Construction	$100K		$100K								
EX4	272nd Street NW and 76th Drive NW Gravity Main Replacement	$643K					$96K	$547K				
EX5A	Church Creek Collection System Construction	$1,025K									$1,025K	
EX5B	Cedarhome Collection System Construction	$175K										$175K
EX13	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	$236K					$47K	$189K				
EX14	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	$1,690K		$169K	$761K	$761K						
EX15	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	$271K							$41K	$230K		
EX16	Upper Pioneer Highway Interceptor Existing Deficiencies	$572K					$86K	$486K				
EX17	Pioneer Highway Interceptor Existing Deficiencies	$559K									$559K	
EX18	Lower Pioneer Highway Interceptor Existing Deficiencies	$569K									$85K	$484K
EX19	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	$717K								$108K	$609K	
EX20	265th Street NW Gravity Main Existing Deficiencies	$145K									$145K	
Facility Improvements												
EX6	Miscellaneous Improvements	$665K		$35K	$35K	$35K	$35K	$35K	$35K	$35K	$210K	$210K
EX7	Telemetry System Upgrades	$275K	$40K	$10K	$50K	$15K					$80K	$80K
EX8A	Long-term Biosolids Utilization Study	$110K		$110K								
EX8B	Long-term Biosolids Utilization Modifications	$1,925K			$289K	$545K	$545K	$545K				
EX8C	Biosolids Removal and Utilization	$500K							$500K			
EX9	Grit Removal Unit Installation	$203K					$51K	$76K	$76K			
EX10	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	$48K				$48K						
EX11	Sheet Pile Installation	$4,900K					$200K		$250K	$250K	$4,200K	
EX12	Main Lift Station (Lift Station 4) Force Main Upgrades	$486K		$73K	$413K							
Planning and Wastewater Treatment Plant Improvements												
M1	Inflow and Infiltration Study	$100K			$50K					$50K		
M2	Comprehensive Sewer System Plan Update	$232K	$101K	$15K								$116K
M3	Sewer Rate Study	$50K				$50K						
M4	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates[1]	$200K								$67K	$133K	
M5	Wastewater Treatment Plant Update and Expansion[2,3]	$11,498K										$11,498K
Total Estimated Project Costs of City Funded Improvements		**$34,010,000**	**$141K**	**$826K**	**$1,872K**	**$1,768K**	**$1,335K**	**$2,193K**	**$1,176K**	**$1,054K**	**$9,161K**	**$14,484K**
Developer Funded Improvements - Prior to 2021												
DF1A	Main Lift Station (Lift Station 4) Alternatives Analysis	$54K	Timing of Project Based on Timing of Future Developments									
DF1B	Main Lift Station (Lift Station 4) Rehabilitation	$1,544K	Timing of Project Based on Timing of Future Developments									
DF2	72nd Avenue NW Gravity Main Replacement	$193K	Timing of Project Based on Timing of Future Developments									
DF3	Church Creek Loop NW Main Replacement	$423K	Timing of Project Based on Timing of Future Developments									
DF4	68th Avenue NW Gravity Main Replacement	$321K	Timing of Project Based on Timing of Future Developments									
DF5	90th Avenue NW and Viking Way Pipe Construction	$514K	Timing of Project Based on Timing of Future Developments									
DF6	Lift Station 8 Construction	$1,842K	Timing of Project Based on Timing of Future Developments									
DF7	Lift Station 9 Construction	$1,769K	Timing of Project Based on Timing of Future Developments									
DF8A	Lift Station 10 Construction	$1,927K	Timing of Project Based on Timing of Future Developments									
DF8B	Taylor's Landing Lift Station (Lift Station 5) Pipe Construction	$481K	Timing of Project Based on Timing of Future Developments									
DF9	Lift Station 11 Construction	$1,875K	Timing of Project Based on Timing of Future Developments									
DF10A	Lift Station 12 Construction	$2,099K	Timing of Project Based on Timing of Future Developments									
DF10B	Lindstrom Lift Station (Lift Station 7) Pipe Construction	$420K	Timing of Project Based on Timing of Future Developments									
Developer Funded Improvements - Prior to 2035												
DF11	271st Street NW Monitoring and Potential Pipe Replacement	$1,397K	Timing of Project Based on Timing of Future Developments									
DF12	274th Street NW Gravity Main Replacement	$130K	Timing of Project Based on Timing of Future Developments									
DF13	Lift Station 13 Construction	$2,099K	Timing of Project Based on Timing of Future Developments									
Total Estimated Project Costs of Developer Funded Improvements		**$17,088,000**										

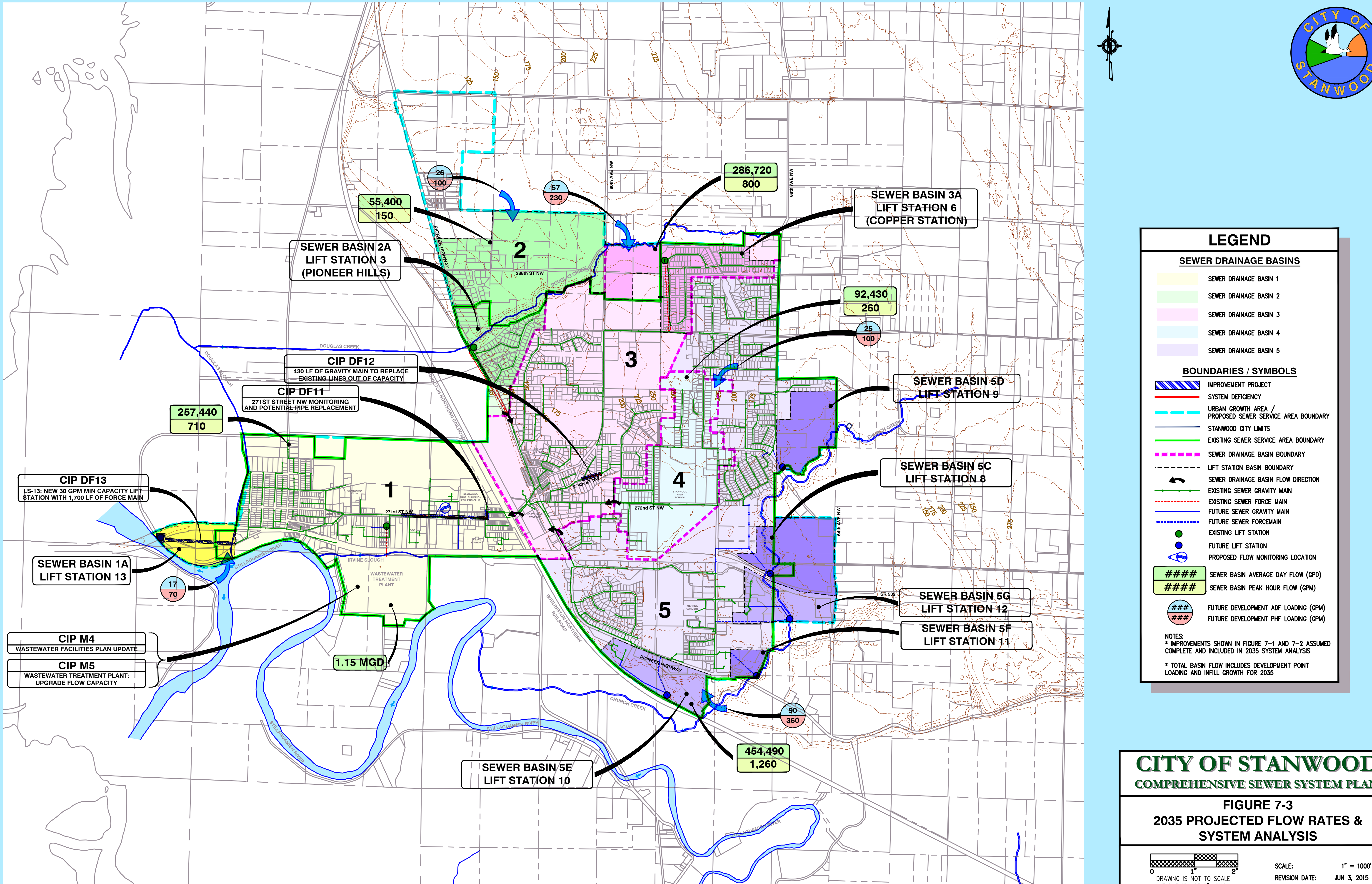
NOTES:
1 - Time scheduled is based on projected maximum month average flow reaching 85 percent of the capacity of the wastewater treatment plant.
2 - Price is dependent on wastewater treatment system requirements in the future. Time scheduled is based on projected maximum month average flow reaching the capacity of the wastewater treatment plant.
3 - Price is dependent on plan update conducted in M4.



CITY OF STANWOOD
COMPREHENSIVE SEWER SYSTEM PLAN

FIGURE 7-1
EXISTING SYSTEM ANALYSIS


CITY OF STANWOOD
2
3
4
5
1
17,870
50
6
20
64
260
204,930
570
SEWER BASIN 3A
LIFT STATION 6
(COPPER STATION)
56,410
160
12
50
SEWER BASIN 2A
LIFT STATION 3
(PIONEER HILLS)
CIP DF4
1,060 LF OF GRAVITY MAIN TO REPLACE EXISTING LINES OUT OF CAPACITY
CIP DF5
1,830 LF OF GRAVITY MAIN
SEWER BASIN 5D
LIFT STATION 9
CIP DF7
LS-9: NEW 50 GPM MIN CAPACITY LIFT STATION WITH 450 LF OF FORCE MAIN
233,090
640
CIP DF3
1,400 LF OF GRAVITY MAIN TO REPLACE EXISTING LINES OUT OF CAPACITY
CIP DF2
610 LF OF GRAVITY MAIN TO REPLACE EXISTING LINES OUT OF CAPACITY
CIP DF6
LS-8: NEW 100 GPM MIN CAPACITY LIFT STATION WITH 725 LF OF FORCE MAIN
SEWER BASIN 5C
LIFT STATION 8
SEWER BASIN 5G
LIFT STATION 12
31
120
CIP DF10B
ELIMINATE LINDSTROM LIFT STATION AND INSTALL 1,300 LF OF GRAVITY MAIN
CIP DF1A
LS-4 (MAIN): IMPROVEMENTS ALTERNATIVES ANALYSIS
CIP DF1B
LS-4 (MAIN): UPGRADE LIFT STATION TO 3,200 GPM MINIMUM CAPACITY
0.84 MGD
CIP DF10A
LS-12: NEW 60 GPM MIN CAPACITY LIFT STATION WITH 1,700 LF OF FORCE MAIN
SEWER BASIN 5F
LIFT STATION 11
324,500
900
CIP DF9
LS-11: NEW 60 GPM MIN CAPACITY LIFT STATION WITH 850 LF OF FORCE MAIN
SEWER BASIN 5E
LIFT STATION 10
105
420
CIP DF8B
ELIMINATE TAYLOR'S LANDING LIFT STATION AND INSTALL 1,500 LF OF GRAVITY MAIN
CIP DF8A
LS-10: NEW 70 GPM MIN CAPACITY LIFT STATION WITH 1,050 LF OF FORCE MAIN
DOUGLAS CREEK
PIONEER HIGHWAY
BURLINGTON NORTHERN RAILROAD
STILLAGUAMISH RIVER
CHURCH CREEK
WASTEWATER TREATMENT PLANT
271st ST NW
272nd ST NW
276th ST NW
288th ST NW
64th AVE NW
68th AVE NW
SR 532
LEGEND
SEWER DRAINAGE BASINS
SEWER DRAINAGE BASIN 1
SEWER DRAINAGE BASIN 2
SEWER DRAINAGE BASIN 3
SEWER DRAINAGE BASIN 4
SEWER DRAINAGE BASIN 5
BOUNDARIES / SYMBOLS
IMPROVEMENT PROJECT
SYSTEM DEFICIENCY
URBAN GROWTH AREA / PROPOSED SEWER SERVICE AREA BOUNDARY
STANWOOD CITY LIMITS
EXISTING SEWER SERVICE AREA BOUNDARY
SEWER DRAINAGE BASIN BOUNDARY
LIFT STATION BASIN BOUNDARY
SEWER DRAINAGE BASIN FLOW DIRECTION
EXISTING SEWER GRAVITY MAIN
EXISTING SEWER FORCE MAIN
FUTURE SEWER GRAVITY MAIN
FUTURE SEWER FORCE MAIN
EXISTING LIFT STATION
FUTURE LIFT STATION
PROPOSED FLOW MONITORING LOCATION
SEWER BASIN AVERAGE DAY FLOW (GPD) *
SEWER BASIN PEAK HOUR FLOW (GPM) *
FUTURE DEVELOPMENT ADF LOADING (GPM)
FUTURE DEVELOPMENT PHF LOADING (GPM)
NOTES:
* IMPROVEMENTS SHOWN IN FIGURE 7-1 ASSUMED COMPLETE AND INCLUDED IN 2021 SYSTEM ANALYSIS
* TOTAL BASIN FLOW INCLUDES DEVELOPMENT POINT LOADING FOR 2021
CITY OF STANWOOD
COMPREHENSIVE SEWER SYSTEM PLAN
FIGURE 7-2
2021 PROJECTED FLOW RATES & SYSTEM ANALYSIS
0 1" 2"
DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG
SCALE: 1" = 1000'
REVISION DATE: JUN 3, 2015



CITY OF STANWOOD

COMPREHENSIVE SEWER SYSTEM PLAN

FIGURE 7-3
2035 PROJECTED FLOW RATES & SYSTEM ANALYSIS

0 1" 2"
DRAWING IS NOT TO SCALE IF BAR IS NOT 2" LONG

SCALE: 1" = 1000'
REVISION DATE: JUN 3, 2015

CHAPTER 8

Operations and Maintenance

8-1. INTRODUCTION

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

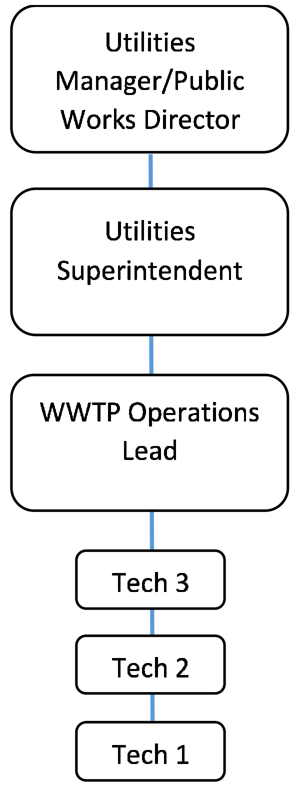
1.	Normal Operations	2.	Emergency Operations
3.	Preventive Maintenance	4.	Maintenance
5.	Development Review	6.	Construction Inspection

8-2. 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 department operations and maintenance staff consists of several operation and maintenance personnel that function under the Wastewater Utility Supervisor; the organization structure of the sewer utility is presented below. The sewer system tasks that are performed by the operations and maintenance 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.



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 below.

Public Works Director (1) – Supervises, organizes, directs, and performs activities related to the overall operation of the water, sewer, and storm utilities.

Contracted City Engineer (1) – Oversees the 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 Superintendent (1) – 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 Operator/Laboratory Analyst (1) – Evaluates samples and analyzes water quality data collected by wastewater treatment staff. Assures compliance with applicable Washington State Department of Ecology (Ecology) regulations and directs all necessary routine tasks. This position is also required to be a fully licensed and trained WWTPO III.

Wastewater Treatment Plant Operator (1) – Performs skilled routine maintenance activities at the wastewater treatment plant to efficiently operate and maintain the City's wastewater treatment plant and other related facilities. This position is also required to be a fully licensed and trained WWTPO I.

Collection System Specialist II (1) – Performs non-routine troubleshooting, maintenance, development review, inspection, installation, and repair work for the sewage collection system and directs all necessary routine tasks. This position is also required to be a fully licensed and trained WWTPO I.

Collection System Specialist (1) – Performs all necessary routine activities in the installation, construction, maintenance, repair, and testing of the sewage collection system. It is desired that this position be staffed by a fully licensed and trained WWTPO I.

Available Equipment

The sewer department 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 8-1**.

Table 8-1
Water/Sewer Department Equipment List

Wastewater Department Equipment
1 - Vactor truck
1 - 1 Ton Service Truck
1 - Ford Ranger
1 - Pressure Washer
1 - Portable Generator
Miscellaneous small tools, etc.

Equipment Available from Other Departments
1 - John Deere (210-C) Backhoe
1 - CAT Backhoe
1 - 5yd Dump Truck
2 - 3yd Dump Trucks
1 - Tymco Street Sweeper
1 - Trailer-Mounted Air Compressor
Miscellaneous small tools, etc.

Chemical Inventory
Sodium Hypochlorite (12.5% and 0.8%)

Communications Equipment
Cell Phones

The following representatives typically provide the 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

The sewer department 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 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

The Washington State Department of 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 NPDES permit, a copy of which is included in **Appendix B**.

Operations and Maintenance Records

Facilities Operations and Maintenance Manuals

Operations and maintenance 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. The drawing records are currently in paper format and stored in an organized file at the utilities office that is maintained by the Utilities Division. The Utilities Division is in the process of converting all files to an electronic format for storage in the City's database.

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, utility superintendent, and each utility safety coordinator. The City is fully dedicated to providing a safe and secure work environment for each of its employees.

The following identifies procedures to be followed for operations and maintenance tasks that involve the most common potential work place 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, 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 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 follow 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; competent persons; heavy equipment operation; 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 OSHA and WISHA regulations in its day-to-day operations and complies with the following State requirements.

- WAC 296-62-145 to 14529 Part M – Entry into confined spaces.
- WAC 296-155-650 to 66411 Part N – Shoring of open ditches.
- WAC 296-155-429 – Lockout-tagout for work on energized or de-energized equipment or circuits.
- WAC 296-155 Part C1 – Fall restraint for access to pump stations, vaults, and manholes.
- MUTCD – Traffic control for work in the public right-of-way.

8-3. 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 Nextel phones or home contact numbers. Emergency contact information, including cell phones, pagers, and home phone numbers, is provided to each City department.

On-Call Personnel

The on-call person is equipped with an optional service vehicle and is required to respond to a call within 40 minutes during non-peak traffic times. A list of emergency telephone numbers is provided to each on-call employee. New employees are not placed on-call until they are familiar with the systems and maintenance procedures and are properly certified as required.

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.

8-4. 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 two-to-five years or As Needed	Inspect, clean, and evaluate manholes and sewer pipe line 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 all 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; indoor and outdoor facility maintenance and repairs.

Sewage Lift Stations	
Frequency	***Task or Activity***
Daily	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; routine maintenance of equipment.

Engine Generator Sets	
Frequency	***Task or Activity***
Weekly	Operate to achieve normal operating temperatures; observe output.
Semi-Annually	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	Backup 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.
Semi-Annually	Vacuum clean all modules.
Semi-Annually	Test alarm indicator units.
Semi-Annually	Clean and flush all pressure sensitive devices.
Semi-Annually	Visually inspect all 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); 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 recommendation.

8-5. 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 Utilities Manager, Utilities Superintendent, 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, maintenance workers, 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 four full-time sewer utility employees. To stay consistent with standard practices, the City should consider adding one additional plant operator to assist with the testing and operation of the wastewater treatment plant.

An estimate of sewer utility full-time employees is based on assigned tasks and duties and currently is as follows.

Task/Duty Assignment	Current Full-time Employees	Recommended Full-Time Employees
Managerial	.20	.20
Supervisory	.55	.55
Wastewater Treatment Plant Operator	1	2
Wastewater Collections	2	3

8-6. OPERATIONS AND MAINTENANCE IMPROVEMENTS

Telemetry and supervisory control improvements are needed to enhance the operation of the sewer system. The City will evaluate converting its existing hard-wire telephone-based telemetry system to a radio-based telemetry system. Radio telemetry is more reliable in an earthquake and major storms than hard-wire telemetry, which is vulnerable to ground faulting, settlement, slides, and underground construction activities.

8-7. CONSTRUCTION INSPECTION

The sewer department staff has spent a considerable amount of time during peak construction periods to verify that new facilities are properly constructed. The City should consider having these inspections performed by either additional staff or an on-call consultant that could be funded through developer extension projects.

CHAPTER 9

Financial Plan

9-1. INTRODUCTION

This chapter was prepared by FCS GROUP to provide a financial program that allows the 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 ability to support the financial impact related to the completion of the capital projects identified in this General Sewer Plan (Plan) update. Furthermore, this chapter provides a review of the utility's current rate structure with respect to rate adequacy and customer affordability. **Appendix L** presents backup documentation related to this financial plan.

9-2. PAST FINANCIAL STATEMENT

This section includes an historical summary of financial performance as reported by the City of Stanwood (City) on the fund resources and uses arising from cash transactions, as well as an historical summary of comparative statements of net position, which are useful indicators of the financial position of the City.

Comparative Financial Statements

The City legally owns and operates a sewer utility. **Table 9-1** shows a summary of the combined utility fund resources and uses arising from cash transactions for the previous 6 years (2008 through 2013). **Table 9-2** shows a summary of sewer construction funds 403 to 407. In 2010, the City combined all sewer funds, including operation and construction, for reporting purposes. Noteworthy findings and trends are discussed in this section to demonstrate the historical performance and condition of the City's sewer utility fund.

Table 9-1
Summary of Historical Fund Resources and Uses Arising From Cash Transactions Sewer Fund 401

Sewer Fund 401		2008	2009	2010	2011	2012	2013
Beginning Net Cash and Investments							
	Unspecified	$1,032,378	$1,166,454	-	-	-	-
308.1	Reserved	-	-	$ 67,933	$ 68,430	$ 604,442	$ 592,996
308.8	Unreserved	-	-	$4,253,043	$4,054,619	$3,641,483	$3,356,846
	Total Beginning Cash Balance	$1,032,378	$1,166,454	$4,320,976	$4,123,049	$4,245,925	$3,949,842
Revenues:							
340	Charges for Services	$1,473,253	$1,539,960	$1,579,935	$1,541,882	$1,574,702	$1,603,401
360	Miscellaneous	$ 65,141	$ 23,263	$ 108,324	$ 102,116	$ 290,230	$ 426,163
390	Other Financing Sources	$ 112,000	$ 120,000	-	-	$ 2,987	-
	Total Revenues and Other Sources	**$1,650,394**	**$1,683,223**	**$1,688,259**	**$1,643,998**	**$1,867,919**	**$2,029,564**
	Total Resources	**$2,682,772**	**$2,849,677**	**$6,009,235**	**$5,767,047**	**$6,113,844**	**$5,979,406**
Operating Expenditures							
510	General Government						
530	Physical Environment	$ 715,562	$ 937,264	$ 900,948	$ 717,202	$ 775,755	$ 733,416
	Total Operating Expenditures	$ 715,562	$ 937,264	$ 900,948	$ 717,202	$ 775,755	$ 733,416
591-593	Debt Service	$ 27,424	$ 21,756	$ 19,797	$ 17,838	$ 686,737	$1,129,200
594-596	Capital Outlay	$ 579	-	$ 294,583	$ 115,222	$ 701,511	$ 85,924
	Total Expenditures	$ 743,565	$ 959,020	$1,215,328	$ 850,262	$2,164,003	$1,948,540
597	Other Financing Uses	$ 128,000	$ 40,000	-	-	-	-
	Total Uses	$ 871,565	$ 999,020	$1,215,328	$ 850,262	$2,164,003	$1,948,540
Excess (Deficit) of Resources Over Uses		$1,811,207	$1,850,657	$4,793,907	$4,916,785	$3,949,841	$4,030,866
380	Non-revenues	$ 50,000	$ 50,000	-	-	-	-
580	Non-expenditures	$ 694,753	$ 670,858	$ 670,858	$ 670,858	-	-
Ending Net Cash and Investments							
	Unspecified	$1,166,454	$1,229,800	-	-	-	-
508.1	Reserved	-	-	$ 68,430	$ 604,442	$ 592,996	$ 591,569
508.8	Unreserved	-	-	$4,054,619	$3,641,485	$3,356,846	$3,439,297
	Total	$1,166,454	$1,229,799	$4,123,049	$4,245,927	$3,949,841	$4,030,866

Table 9-2
Summary of Historical Fund Resources and Uses Arising From Cash Transactions Sewer Construction Funds 403-407

Sewer Construction Funds (403-407)		2008	2009	2010-2013*
Beginning Net Cash and Investments		2,914,850	3,063,003	
Revenues:				
390	Other Financing Sources	290,683	1,002,337	
	Total Revenues and Other Sources	**290,683**	**1,002,337**	
	Total Resources	**3,205,533**	**4,065,340**	
Operating Expenditures				
591-593	Debt Service	-	-	
594-596	Capital Outlay	-	-	
	Total Expenditures	-	-	
597	Other Financing Uses	244,105	1,070,053	
	Total Uses	244,105	1,070,053	
Excess (Deficit) of Resources Over Uses		2,961,428	2,995,287	
380	Non-revenues	101,575	-	
580	Non-expenditures	-	-	
Ending Net Cash and Investments		**3,063,003**	**2,995,287**	

*The City maintained about $3 million in the Capital Funds in 2008 and 2009 before reporting of these fund levels was grouped with the Sewer Fund 401.

Findings and Trends

- The City's sewer charges for services increased steadily from about $1.5 million in 2008 to $1.6 million in 2013, with the exception of a 2.4 percent drop in 2011. Expenses stay between $715,000 and $775,000 with the exception of 2 years at over $900,000 in 2009 and 2010, due to a higher indirect cost allocation and resulting transfer to the General Fund in those 2 years.
- The Operations and Maintenance (O&M) Coverage Ratio (total operating revenue divided by total operating expenses) began 2008 at 167 percent, and grew to 277 percent by 2013, due to a rapidly increasing miscellaneous revenue category. The Plant Investment Fee (PIF) revenue is included in the miscellaneous line item and 2012 and 2013 experienced higher than typical residential growth and connection revenue. A ratio of 100 percent or greater shows that revenue will successfully cover expenses, and the City has remained above this percentage for the past 6 years.
- Net Operating Income as a percent of Operating Revenue in 2008 was 40 percent and climbed to 64 percent by 2013. Similar to the O&M Coverage Ratio, these trends help to show how successful operating revenue actually covered operating expenses, with higher positive numbers being the best and negative numbers showing need for improvement.

- The Debt Service Coverage Ratio is to ensure the City is positioned to achieve favorable terms in the municipal bond market when issuing bonds for capital funding needs. Typically, bond debt service coverage requires a minimum factor of 1.25 during the life of the loans. This ratio is calculated by dividing cash operating income (revenue less expenses before depreciation) by annual revenue bond expenses. The sewer utility has no outstanding bond debt. The Debt Service Coverage Ratio for all outstanding debt changes from 1.65 in 2008 to 1.09 in 2013, indicating the City's capacity for new debt is eroding over the 6-year period.

9-3. CURRENT FINANCIAL STRUCTURE

This section summarizes the current financial structure used as the baseline for the capital financing strategy and financial forecast developed for this GSP.

Financial Plan

The sewer utility is responsible for funding all of its costs. The primary source of funding is derived from ongoing monthly charges for service, with additional revenues coming from miscellaneous revenues. The City controls the level of user charges and, subject to the City Council, can adjust user charges as needed to meet financial objectives.

The financial plan can only provide a qualified assurance of 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, plant investment fee (PIF), 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 available for capital funding.
2. **Financial Forecast**. Identifies future annual non-capital costs associated with the operating, 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 projection period.

Capital Funding Plan

The CIP developed for this GSP identifies $10.3 million in project costs ($11.9 inflated) over the 6-year planning horizon (including study period years 2014 and 2015). The 20-year period totals $34 million ($53.1 million inflated). Costs are stated in 2014 dollars and are escalated by 3.62 percent annually to the year of planned spending, based on a 10-year average cost inflation rate from the Engineering News Record (ENR) Construction Cost Index (CCI).

A summary of the 20-year CIP is shown in **Table 9-3**. As shown, each year has varied capital cost obligations depending on construction schedules and infrastructure planning needs. Approximately 30 percent (2014 dollars) of the capital costs are included in the 6-year planning period. Two projects were identified as expensed costs rather than capitalized and are grouped with operating costs for funding purposes in the financial analysis to exclude the use of capital revenues for operating costs. **Table 9-4** provides more detail for the 6-year CIP.

Table 9-3
6- and 20-Year CIP

Year	2014 dollars	Inflated
Study Year 2014/2015	$ 967,329	$ 997,232
2016	$ 1,821,779	$ 1,956,017
2017	$ 1,718,345	$ 1,911,727
2018	$ 1,335,045	$ 1,539,040
2019	$ 2,192,520	$ 2,619,003
2020	$ 1,176,204	$ 1,455,839
2021	$ 1,003,995	$ 1,287,659
6-Year Capital Total	**$ 10,215,217**	**$ 11,766,515**
Expensed Outlay	$ 100,000	$ 109,311
6-Year CIP Total	**$ 10,315,217**	**$ 11,875,826**
2022-2035	$ 23,644,783	$ 41,112,932
Expensed Outlay	$ 50,000	$ 64,127
20-Year CIP Total	**$ 34,010,000**	**$ 53,052,885**

Table 9-4
6-Year CIP (2014 Dollars)

	Study Year	Six-Year CIP					
Project	**2014/2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Sewer Drainage Basin 1 Pipe Replacement Program	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429
Collector/Interceptor System Flow Monitoring and Video	40,000	-	$ 40,000	-	$ 40,000	-	$ 40,000
270th Street NW Pipe Construction	100,000	-	-	-	-	-	-
272nd Street NW and 76th Drive NW Gravity Main Replacement	-	-	-	$ 96,450	$ 546,550	-	-
Church Creek Collection System Construction	-	-	-	-	-	-	-
Cedarhome Collection System Construction	-	-	-	-	-	-	-
99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	-	-	-	$ 47,200	$ 188,800	-	-
94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	$ 169,000	$ 760,500	$ 760,500	-	-	-	-
Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	-	-	-	-	-	$ 40,650	$ 230,350
Upper Pioneer Highway Interceptor Existing Deficiencies	-	-	-	$ 85,800	$ 486,200	-	-
Pioneer Highway Interceptor Existing Deficiencies	-	-	-	-	-	-	-
Lower Pioneer Highway Interceptor Existing Deficiencies	-	-	-	-	-	-	-
72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	-	-	-	-	-	-	$ 107,550
265th Street NW Gravity Main Existing Deficiencies	-	-	-	-	-	-	-
Miscellaneous Improvements	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000
Telemetry System Upgrades	$ 50,000	$ 50,000	15,000	-	-	-	-
Long-term Biosolids Utilization Study	$ 110,000	-	$ -	-	-	-	-
Long-term Biosolids Utilization Modifications	-	$ 288,750	$ 545,417	$ 545,417	$ 545,417	-	-
Biosolids Removal and Utilization	-	-	-	-	-	$ 500,000	-
Grit Removal Unit Installation	-	-	-	$ 50,750	$ 76,125	$ 76,125	-
Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	-	-	$ 48,000	-	-	-	-
Sheet Pile Installation	-	-	-	$ 200,000	-	$ 250,000	$ 250,000
Main Lift Station (Lift Station 4) Force Main Upgrades	$ 72,900	$ 413,100	-	-	-	-	-
Comprehensive Sewer System Plan Update	$ 116,000	-	-	-	-	-	$ 66,667
Total	$ 967,329	$1,821,779	$1,718,345	$1,335,045	$2,192,520	$1,176,204	$1,003,995

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 bond financing to meet needs for which the City's available cash resources are insufficient. Revenue bonds have been used as the debt funding instrument in this analysis. 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.
- Annual cash from rates earmarked for rate funded system reinvestment.
- Interest earned on Construction Fund balances and other miscellaneous capital resources.
- Revenue bond financing.

Based on information provided by the City, the wastewater utility began 2014 with $826,879 in the Operating Fund and $2.6 million between the Construction Fund and PIF Fund. Additional funds beyond the Operating Fund target of 60 days of O&M expenses are transferred to the Construction Fund, ranging from over $500,000 in 2014 to $0 in some years. Rate Funded System Reinvestment Funds are available in years 2015 through 2019 until increasing debt principal repayment exceeds depreciation Per City policy, when debt principal is greater than depreciation no system reinvestment is funded through rates in an effort not to overburden rates with debt service and cash funded capital, both of which are seen as reinvestment in the system.

The cash resources described above are forecasted to fund 43 percent of the 6-year CIP and 62 percent of the 20-year CIP. Table 9-5 presents the corresponding 20-year capital financing strategy.

Table 9-5

20-Year Capital Funding Strategy

Year	Capital Expenditures 2014 Dollars	Capital Expenditures Escalated	Debt Financing	Cash Funding	Total Financial Resources
2014/2015	$ 967,329	$ 997,232	$ -	$ 997,232	$ 997,232
2016	$ 1,821,779	$ 1,956,017	-	$ 1,956,017	$ 1,956,017
2017	$ 1,718,345	$ 1,911,727	$ 1,087,656	$ 824,071	$ 1,911,727
2018	$ 1,335,045	$ 1,539,040	$ 1,248,272	$ 290,768	$ 1,539,040
2019	$ 2,192,520	$ 2,619,003	$ 2,338,613	$ 280,390	$ 2,619,003
2020	$ 1,176,204	$ 1,455,839	$ 1,197,342	$ 258,497	$ 1,455,839
2021	$ 1,003,995	$ 1,287,659	$ 867,564	$ 420,095	$ 1,287,659
Subtotal	**$ 10,215,217**	**$ 11,766,515**	**$ 6,739,446**	**$ 5,027,069**	**$ 11,766,515**
2022-2035	$ 23,644,783	$ 41,112,932	$ 13,587,282	$ 27,525,650	$ 41,112,932
Total	**$ 33,860,000**	**$ 52,879,447**	**$ 20,326,728**	**$ 32,552,719**	**$ 52,879,447**

Capital expenditures net of expensed outlay per Table 9-3

9-4. AVAILABLE FUNDING ASSISTANCE AND FINANCING RESOURCES

Feasible long-term capital funding strategies must be defined to ensure that adequate resources are available to fund the CIP identified in this GSP. In addition to the City's resources, such as accumulated cash reserves, capital revenues, and rate revenues designated for capital purposes, capital needs can be met from outside sources such as grants, low-interest loans, and bond financing. The following is a summary of the City's internal and external 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 PIF revenue. The first two resources will be discussed in the Fiscal Policies section of the Financial Forecast. Capital-related charges are discussed below.

Capital Connection Charges

A connection charge, such as the PIF, refers to a one-time charge imposed on new customers as a condition of connecting to the sewer system. The purpose of the connection charge is two-fold: to promote equity between new and existing customers, and to provide a source of revenue to fund capital projects. Revenue can only be used to fund utility capital projects or to pay debt service incurred to finance those projects. The City currently charges all new customers a PIF based on a charge of $6,476 per Equivalent Residential Unit (ERU).

The updated PIF analysis produced a charge of $8,687 per ERU. To be conservative, the revenue needs forecast calculates future PIF revenue on the current charge. The City is considering increasing the PIF based on the updated calculation.

Local Facilities Charges

While a connection charge is the manner in which new customers pay their share of plant investment costs, local facilities 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 up-front by either connecting customers, 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 PIF); (b) a developer funds 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 (LUD), 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 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 late-comer agreement, resulting in a late-comer charge to new connections to 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.

LID/ULID 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 general facilities 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 miscellaneous grant programs are generally lightly funded and heavily subscribed. Nonetheless, even the benefit of low-interest loans makes the effort of applying worthwhile. Grants and low-cost loans for Washington State utilities are available from the Department of Commerce, including the following two assistance programs that the City may be eligible for.

Public Works Trust Fund (PWTF) – Cities, counties, special purpose districts, public utility districts, and quasi-municipal governments are eligible to receive loans from the PWTF. Eligible projects include repair, replacement, and construction of infrastructure for domestic water, sanitary wastewater, stormwater, solid waste, road, and bridge projects that improve public health and safety, respond to environmental issues, promote economic development, or upgrade system performance. Due to current funding restrictions and funding allocations, the Public Works Board has suspended the non-Construction Programs. As the economy builds, the Board will attempt to re-institute these programs.

PWTF loans are available at interest rates ranging from 1.28 percent to 2.55 percent depending on the repayment term, with reduced interest rates available for all projects located in communities that have been declared a natural disaster. The standard loan offer is 2.55 percent interest repaid over a 5- to 20-year term. All loan terms are subject to negotiation and Public Works Board approval. Currently no local match is required and the maximum loan amount is $7 million per jurisdiction per biennium.

Due to legislative budget changes made on June 30, 2013, the 2014 Construction Loan cycle did not receive funding. The Legislature also passed a statute with the intent of redirecting tax revenue from the Public Works Assistance Account for 6 years to the state General Fund. Loan repayment revenues will continue to be available in future biennia. The effect of this diversion resulted in a decrease in funding available to local governments for high-priority infrastructure projects from the PWTF. For drinking water and sanitary wastewater projects not on the 2014 unfunded PWTF list, applicants must first apply to the Washington State Departments of Health or Ecology during their normal funding cycle. Only projects that were not selected for funding and/or were partially funded by these agencies are eligible for the 2016 Construction Loan program.

Information regarding the application process as well as rates and terms are posted on the PWTF website in early spring.

Further detail is available at http://www.pwb.wa.gov.

Drinking Water State Revolving Fund (DWSRF) Loan Program – DWSRF funding historically targets protection of public health, compliance with drinking water regulations, and assistance for small and disadvantaged communities. Terms are up to 20 years to pay back, and in some cases, provide partial loan forgiveness. Interest rates are 1.0 to 1.5 percent, and no local match is required.

Applicants need an approved water system plan, or plan amendment, containing the DWSRF project prior to submitting an application. All public water systems that receive a DWSRF loan must undergo an environmental review, a cultural review, and an Investment Grade Efficiency Audit (IGEA). The IGEA is an effort to apply energy efficiency to water systems and may be financed as part of the DWSRF loan.

Two loan cycles were offered in the spring and fall of 2013. The DWSRF Loan Program has shifted their application cycle to the fall and will likely now accept applications annually in September.

Further detail is available at http://www.doh.wa.gov.

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:

> *(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 availability of G.O. bonds for utility purposes, these can sometimes play a valuable role in project financing. A 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 also 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 bonds problematic.

9-5. 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 to also include debt covenant requirements, and specific fiscal policies and financial goals of the City.

The analysis determines the amount of revenue needed in a given year to meet that year's expected financial obligations. 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 purposes of this analysis, revenue bond debt is assumed for any needed debt issuance. 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 1.0 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, plus an additional 25 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. Targeting a higher coverage factor can help the City achieve a better credit rating and provide lower interest rates for future debt issues.

In determining the annual revenue requirement, both the cash and coverage sufficiency test must be met and the test with the greatest deficiency drives the level of needed rate increase in any given year.

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 below.

Operating Fund – 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. The City's current policy is to maintain a minimum balance in the Operating Fund equal to 60 days of O&M expenses for working capital, plus a rate stabilization reserve equal to 25 percent of annual rate revenues. Establishing the recently adopted rate stabilization reserve is done as a phased-in approach, reaching 60 percent of target by the end of the 6-year forecast.

Capital Fund – 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 to 2 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 standards with the risk level of the City. The City's current policy is to maintain a minimum balance in the Construction Fund equal to 1 percent of fixed assets.

System Reinvestment – System reinvestment funding promotes system integrity through reinvestment in the system. Target system reinvestment funding levels are commonly linked to annual depreciation expense 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. A common 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 currently funds system reinvestment based on annual depreciation, net of debt principal payment. The transfer increases from $13,281 in 2015, up to $54,280 in 2017 due to added depreciation from CIP assets. In 2018, the transfer begins declining until 2020 when debt principal repayment outstrips depreciation completely and there is no transfer again until 2025.

Debt Management – It is prudent to consider policies related to debt management as part of 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 City has no outstanding sewer revenue bond debt or coverage requirement.

Financial Forecast

The financial forecast is developed from 2014 budget documents along with other key factors and assumptions to develop a complete portrayal of the City's annual financial obligations for the sewer utility. The following is a list of the key revenue and expense factors and assumptions used to develop the financial forecast:

- **Revenue** – The City has two general revenue sources: sewer service charges (rate revenue) and sewer other (non-rate) revenue. In the event of a forecasted annual shortfall, rate revenue can be increased to meet the annual revenue requirement. Non-rate revenues are forecast to increase with customer growth or not escalate depending on the nature of the revenue.

- **Plant Investment Fee Revenue** – The current PIF of $6,476 per ERU expected to increase annually based on construction cost inflation and to generate $205,800 in 2016 after a year of no growth projected in 2015. It is projected to generate a total of $17.6 million by 2035 collected from 1,701 new connections.

- **Growth** – Rate revenue is escalated based on the growth rates provided in **Chapter 3** of this GSP. The financial analysis utilizes a near-term growth rate that considers recent historical growth, and uses a rate in later years that results in the same total average growth rate over the 20-year period. The growth rate through 2021 averages 1.80 percent per year and 3.31 percent per year thereafter.

- **Expenses** – O&M expense projections are based on the 2014 budget and are forecasted to increase with general and labor cost inflation of 2.23 percent, construction cost inflation of 3.62 percent, and benefit cost inflation of 5.00 percent. Budget 2014 figures were used for 2014 taxes; future taxes are calculated based on forecasted revenues and prevailing tax rates.
- **Existing Debt** – The City currently has two outstanding debt issues, including one PWTF loan and one DWSRF loan. The PWTF annual payments range from $113,871 decreasing to $107,456, and expire in 2027. DWSRF annual payments are principal only at $465,029 annually until 2024, with two final payments less than $25,000 in 2025 and 2026.
- **Future Debt** – The capital financial strategy developed for this GSP forecasts the need to issue $20.3 million new debt. The analysis performed assumes all revenue bond financing.
- **Revenue Bond Assumptions** – The forecast assumes a revenue bond interest rate of 5.0 percent, an issuance cost of 1.5 percent and a term of 20 years.
- **Transfer to Capital** – Any Operating Fund balance above the minimum requirement is assumed to be available to fund capital projects and is projected to be transferred to the Construction Fund each year. The 2015 Operating Fund balance is expected to end the year at 139 days of O&M expenses, which is the minimum target for the combined reserves. The Capital Fund balance is expected to end the year at approximately $2.4 million.

Although the financial plan is completed for the 20-year time horizon of this GSP, the rate strategy focuses on the shorter-term planning period 2015 through 2021. It is recommended that the City revisit the proposed rates every 2 to 3 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 9-6 summarizes the annual revenue requirements based on the forecast of revenues, expenditures, fund balances and fiscal policies.

Table 9-6
6-Year Financial Forecast

Revenue Requirement	Study Years 2014	2015	6-Year Forecast 2016	2017	2018	2019	2020	2021
Revenues								
Rate Revenues Under Existing Rates	$1,625,618	$1,625,618	$1,647,273	$1,668,929	$1,690,585	$1,712,240	$1,733,896	$1,808,536
Non-Rate Revenues	$ 3,236	$ 4,109	$ 6,188	$ 8,448	$ 10,274	$ 12,505	$ 14,651	$ 14,144
Total Revenues	**$1,628,854**	**$1,629,727**	**$1,653,462**	**$1,677,377**	**$1,700,859**	**$1,724,745**	**$1,748,547**	**$1,822,680**
Expenses								
Cash Operating Expenses	$ 961,087	$ 938,692	$1,015,445	$1,037,687	$1,002,804	$1,024,002	$1,045,666	$1,142,548
Existing Debt Service	$ 578,900	$ 578,365	$ 577,831	$ 577,296	$ 576,761	$ 576,227	$ 575,692	$ 575,158
New Debt Service	-	-	-	$ 96,464	$ 207,172	$ 414,583	$ 520,775	$ 597,719
Rate Funded System Reinvestment	-	$ 13,281	$ 52,401	$ 54,280	$ 41,518	$ 11,732	-	-
Total Expenses	**$1,539,987**	**$1,530,338**	**$1,645,677**	**$1,765,726**	**$1,828,255**	**$2,026,544**	**$2,142,133**	**$2,315,425**
								-
Net Surplus (Deficiency)	**$ 88,867**	**$ 99,389**	**$ 7,784**	**$ (88,349)**	**$ (127,396)**	**$ (301,799)**	**$ (393,586)**	**$ (492,745)**
Additions to Meet Coverage	-	-	-	-	-	-	-	-
Total Surplus (Deficiency)	**$ 88,867**	**$ 99,389**	**$ 7,784**	**$ (88,349)**	**$ (127,396)**	**$ (301,799)**	**$ (393,586)**	**$ (492,745)**
	-	-	-	-	-	-	-	-
% of Rate Revenue	0.00%	0.00%	0.00%	5.29%	7.54%	17.63%	22.70%	27.25%
Annual Rate Adjustment	**0.00%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**4.50%**	**7.50%**
Cumulative Annual Rate Adjustment	**0.00%**	**3.50%**	**7.12%**	**10.87%**	**14.75%**	**18.77%**	**24.11%**	**33.42%**
								-
Rate Revenues After Rate Increase	$1,625,618	$1,682,514	$1,764,600	$1,850,372	$1,939,985	$2,033,604	$2,151,994	$2,412,979
Additional Taxes from Rate Increase	$ -	$ 2,191	$ 4,517	$ 6,986	$ 9,602	$ 12,373	$ 16,097	$ 23,271
	-	-	-	-	-	-	-	-
Net Cash Flow After Rate Increase	**88,867**	**154,095**	**120,594**	**86,108**	**112,402**	**7,192**	**8,415**	**88,428**
Coverage After Rate Increases	**n/a**	**n/a**	**n/a**	**11.22**	**5.86**	**3.12**	**2.81**	**3.68**

The financial forecast indicates that the City's adopted rate plan of 3.5 percent rate increases through 2019 are sufficient, followed by 4.5 percent in 2020 and 7.5 percent in 2021. Rate increases move above the 3.5 percent adopted level to support new debt service from funding the capital program. The City's existing debt service is $578,365 and approximately doubles, adding $597,719 by 2021. This is partially offset by rate-funded system reinvestment dropping to $0 as debt principal outstrips annual depreciation. As schedule and cost for projects in the outer years become more firm, the forecast should be updated to reflect the resulting rate impacts.

City Funds and Reserves

Table 9-7 shows a summary of the projected Operating Fund and Construction Fund ending balances through 2021 based on the rate forecasts presented above. The combined minimum target balance is based on 60 days of O&M expenses plus 25 percent of rate revenue (according to the phase-in). The bond reserve minimum balance is equal to one annual debt service payment. Funds remain above the targets throughout the forecast.

Maintaining a rate stabilization reserve is conservative for a sewer utility which generally has more stable revenues due to the fixed nature of the rate structure. Sewer utilities typically reserve closer to a 45 day operating reserve rather than the 60 days that is the current City policy. The City might reevaluate the sewer reserve policies in the future to better align the reserve levels with the financial exposure of the sewer utility revenues. A lower reserve level would increase the funding available for capital funds and reducing rate impacts from borrowing.

Table 9-7
Ending Cash Balance Summary

Ending Fund Balances	Study Years 2014	2015	6-Year Forecast 2016	2017	2018	2019	2020	2021
Sewer Fund	$ 354,240	$ 357,508	$ 377,237	$ 463,345	$ 575,747	$ 582,939	$ 426,091	$ 510,615
Sewer Construction Fund	3,064,909	2,388,110	824,071	290,768	280,390	258,497	420,095	907,106
Sewer Bond Reserve	467,571	467,571	467,571	564,035	674,743	882,154	988,346	1,065,290
Total	**$3,886,720**	**$3,213,189**	**$1,668,879**	**$1,318,148**	**$1,530,880**	**$1,723,590**	**$1,834,532**	**$2,483,011**
Combined Minimum Target Balance	*388,354*	*400,184*	*439,473*	*568,971*	*700,058*	*948,345*	*1,084,358*	*1,258,703*

9-6. Current and Projected Rates

Current Rates

The City's current rate structure consists of a fixed monthly charge based on customer class and a variable monthly charge per hundred cubic feet (ccf) of winter average use. **Table 9-8** shows the existing rate structure.

Table 9-8
Existing Schedule of Rates

2014 Sewer Rates

Residential	**Current**
Individually Metered	$ 37.15
Master Metered	$ 37.15
Residential Volume Charge	$ 5.19
Commercial	
Light Commercial	$ 37.15
Light Commercial Volume Charge	$ 5.19
Heavy Commercial	$ 42.23
Heavy Commercial Volume Charge	$ 6.03
General Industrial	$ 47.31
General Industrial Charge	$ 6.88

Projected Rates

The analysis for this GSP shows a need for increases of 3.5 percent per year in 2015 through 2019, 4.5 percent increase in 2020 and 7.5 percent increase in 2021. **Table 9-9** shows the proposed rates for the 6-year planning period.

Table 9-9
6-Year Proposed Rates

Across the Board Projected Rate Increases

Residential	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Individually Metered	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
Master Metered	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
Residential Volume Charge	$ 5.19	$ 5.37	$ 5.56	$ 5.75	$ 5.96	$ 6.16	$ 6.44	$ 6.92
Commercial								
Light Commercial	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
Light Commercial Volume Charge	$ 5.19	$ 5.37	$ 5.56	$ 5.75	$ 5.96	$ 6.16	$ 6.44	$ 6.92
Heavy Commercial	$ 42.23	$ 43.71	$ 45.24	$ 46.82	$ 48.46	$ 50.16	$ 52.41	$ 56.34
Heavy Commercial Volume Charge	$ 6.03	$ 6.24	$ 6.46	$ 6.69	$ 6.92	$ 7.16	$ 7.48	$ 8.05
General Industrial	$ 47.31	$ 48.97	$ 50.68	$ 52.45	$ 54.29	$ 56.19	$ 58.72	$ 63.12
General Industrial Charge	$ 6.88	$ 7.12	$ 7.37	$ 7.63	$ 7.89	$ 8.17	$ 8.54	$ 9.18

Table 9-10 shows residential monthly bill comparisons for the proposed annual increases.

Table 9-10
6-Year Proposed Rates

Residential	**Current**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Monthly Bill	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57
% Increase		3.50%	3.50%	3.50%	3.50%	3.50%	4.50%	7.50%
$ Difference		$ 1.30	$ 1.35	$ 1.39	$ 1.44	$ 1.49	$ 1.99	$ 3.46

Sample Bill at 5 ccf winter average assumption

9-7. AFFORDABILITY

The 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 2.0 percent of the median household income for the service area. The average median household income for Stanwood was $53,858 in 2009 to 2013 according to the U.S. Census Bureau. The 2013 value is escalated based on the assumed 2.23 percent general cost inflation to show the median household income in future years. **Table 9-11** presents the City's rates with the projected rate increases for the forecast period, tested against the 2.0 percent monthly affordability threshold.

Table 9-11
Affordability Test

Year	Inflation	Median HH income	2.00% Monthly Threshold	Projected Monthly Bill	% of Median HH Income
2013	2.23%	$ 55,059	$ 91.77	$ 37.15	-
2014	2.23%	$ 56,287	$ 93.81	$ 38.45	0.82%
2015	2.23%	$ 57,543	$ 95.90	$ 39.80	0.83%
2016	2.23%	$ 58,826	$ 98.04	$ 41.19	0.84%
2017	2.23%	$ 60,138	$ 100.23	$ 42.63	0.85%
2018	2.23%	$ 61,479	$ 102.47	$ 44.12	0.86%
2019	2.23%	$ 62,851	$ 104.75	$ 46.11	0.88%
2020	2.23%	$ 64,252	$ 107.09	$ 49.57	0.93%
2021	2.23%	$ 65,685	$ 109.48	$ 52.18	0.95%

Applying the 2.0 percent test, the City's rates are forecasted to remain within the indicated affordability range through 2021.

9-8. CONCLUSION

The results of this analysis indicate that rate increases are necessary to fund ongoing operating needs and future debt requirements to fund the CIP. Implementation of the proposed rate increases should provide for continued financial viability while maintaining generally affordable rates.

It is important to remember that the analysis performed in this chapter assumes growth rates from **Chapter 3** of this GSP. If the future growth rates change, the proposed annual rate increases may need to be updated and revised.

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

LIFT STATION PUMP DOWN TESTING RESULTS

CHURCH CREEK

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
5.9167	NA	NA	27.48	150

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Feet	Inches	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		10.00	10	0							308.33
1.3 min	75 sec			Emptying				1.83	50.4			0.72	322	
		Off			11.83	11	10							
10.0 min	600 sec			Filling				1.00	27.5	0.046	20.6			
		On	Pump #2		10.83	10	10							
1.3 min	75 sec			Emptying				1.67	45.8			0.66	295	
					12.50	12	6							

CHURCH CREEK RECALCULATED #1

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
5.9167	NA	NA	27.48	150

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Feet	Inches	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		10.50	0	126							238.10
1.0 min	60 sec			Emptying				0.92	25.2			0.45	202	
		Off			11.42	0	137							
10.0 min	600 sec			Filling				0.67	18.3	0.031	13.7			
		On	Pump #2		10.75	0	129							
1.0 min	60 sec			Emptying				1.25	34.4			0.61	274	
		Off			12.00	0	144							
10.0 min	600 sec			Filling				0.83	22.9	0.038	17.1			
					11.17	0	134							

CHURCH CREEK RECALCULATED #2

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
5.9167	NA	NA	27.48	150

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Feet	Inches	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		9.17	0	110							250.95
2.0 min	120 sec			Emptying				2.00	55.0			0.48	218	
		Off			11.17	0	134							
10.0 min	600 sec			Filling				0.58	16.0	0.027	12.0			
					10.58	0	127							
		On	Pump #2		10.25	0	123							
1.5 min	90 sec			Emptying				2.00	55.0			0.63	284	
		Off			12.25	0	147							
10.0 min	600 sec			Filling				0.50	13.7	0.023	10.3			
					11.75	0	141							

CEDARHOME

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
	17	12.0833	205.42	345

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		5.50							332.91
3.0 min	180 sec			Emptying		0.50	102.7			0.74	333	
		Off			6.00							
10.0 min	600 sec			Filling		0.50	102.7	0.171	76.8			
		On	Pump #2		5.50							
3.0 min	180 sec			Emptying		0.50	102.7			0.74	333	
					6.00							

PIONEER HILLS

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
	20	14.5	290.00	500

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		5.08							470
2.0 min	120 sec			Emptying		0.42	120.8			1.05	470	
		Off			5.50							
10.0 min	600 sec			Filling		0.08	24.2	0.040	18.1			
		On	Pump #2		5.42							
2.0 min	120 sec			Emptying		0.42	120.8			1.05	470	
					5.83							

TAYLOR

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
5	NA	NA	19.625	150

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		13.08							91.28
3.3 min	197 sec			Emptying		1.33	26.2			0.13	60	
		Off			14.42							
10.0 min	600 sec			Filling		0.00	0.0	0.0	0.0			
		On	Pump #2		14.42							
3.3 min	197 sec			Emptying		2.75	54.0			0.27	123	
					17.17							

LINDSTROM

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
8.5	NA	NA	56.72	160

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Feet	Inches	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		9.92	9	11							286.87
1.2 min	70 sec			Emptying				0.92	52.0			0.77	347	
		Off			10.83	10	10							
10.0 min	600 sec			Filling				0.33	18.9	0.032	14.1			
		On	Pump #2		10.50	10	6							
1.2 min	70 sec			Emptying				0.58	33.1			0.50	226	
					11.08	11	1							

LINDSTROM RECALCULATED #1

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
8.5	NA	NA	56.72	160

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Feet	Inches	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		12.25	0	147							235.10
1.0 min	60 sec			Emptying				0.50	28.4			0.48	216	
		Off			12.75	0	153							
10.0 min	600 sec			Filling				0.08	4.7	0.008	3.5			
		On	Pump #2		12.67	0	152							
1.0 min	60 sec			Emptying				0.58	33.1			0.57	255	
					13.25	0	159							
10.0 min	600 sec			Filling				0.17	9.5	0.016	7.1			
					13.08	0	157							

LINDSTROM RECALCULATED #2

Diameter (ft)	Length (ft)	Width (ft)	Area (SF)	Pump Rating (gpm)
8.5	NA	NA	56.72	160

Time Delta	Time Delta	Pump Event	Pump #	Wetwell Status	Elev (ft)	Feet	Inches	Elev Delta (ft)	Volume Delta (CF)	Fill Rate (cfs)	Fill Rate (gpm)	Pumping Rate (cfs)	Pumping Rate (gpm)	Avg Pumping (gpm)
		On	Pump #1		12.00	0	144							197.98
1.0 min	60 sec			Emptying				0.50	28.4			0.47	212	
		Off			12.50	0	150							
10.0 min	600 sec			Filling				0.00	0.0	0.000	0.0			
		On	Pump #2		12.50	0	150							
1.0 min	60 sec			Emptying				0.42	23.6			0.41	184	
					12.92	0	155							
10.0 min	600 sec			Filling				0.17	9.5	0.016	7.1			
					12.75	0	153							

Lift Station:	Church Creek			Church Creek	
Date:	6/19/2014			7/3/2014	
Assessment:	No. 1			No. 2	
Nominal Pump Capacity (gpm):	150			150	

Wetwell Diameter (ft.):	6.083
Wetwell Surface Area (sq. ft.)	29.05

Pump Down		**Pump No. 1**	**Pump No. 2**	**Pump No. 1**	**Pump No. 2**
Test No. 1	Distance Pumped Down (ft.)	3.67	3.67	3.67	3.67
	Time to Pump Down (min.)	3.48	3.15	3.20	3.22
Test No. 2	Distance Pumped Down (ft.)	3.67	3.67	3.67	3.67
	Time to Pump Down (min.)	3.48	2.87	2.23	2.85
Test No. 3	Distance Pumped Down (ft.)			3.67	3.67
	Time to Pump Down (min.)			3.12	2.93
Test No. 4	Distance Pumped Down (ft.)			3.67	3.67
	Time to Pump Down (min.)			3.17	2.90
Fill					
Test No. 1	Distance to Fill (ft.)	3.67	3.67	3.67	3.67
	Time to Fill (min.)	22.77	11.17	11.32	11.97
Test No. 2	Distance to Fill (ft.)	3.67	3.67	3.67	3.67
	Time to Fill (min.)	10.53	11.47	12.33	11.63
Test No. 3	Distance to Fill (ft.)			3.67	3.67
	Time to Fill (min.)			12.10	12.20
Test No. 4	Distance to Fill (ft.)			3.67	
	Time to Fill (min.)			11.05	
	Pump Down No. 1 (gpm)	228.73	252.94	248.99	247.70
	Pump Down No. 2 (gpm)[2]	228.73	277.94		279.56
	Pump Down No. 3 (gpm)			255.64	271.62
	Pump Down No. 4 (gpm)			251.61	274.74
	Fill No. 1 (gpm)[1]		71.35	70.41	66.58
	Fill No. 2 (gpm)	75.64	69.48	64.60	68.49
	Fill No. 3 (gpm)			65.85	65.31
	Fill No. 4 (gpm)			72.10	
	Average with Fill Correction (gpm)	304.38	335.86	320.32	335.20

NOTES:
1 - Time to fill for Test No. 1 on Pump No. 1 on June 19, 2014, (Assessment No. 1) was discounted since it was so much longer than all the other fill times.
2 - Time to pump down for Test No. 2 on Pump No. 1 on July 3, 2014, (Assessment No. 2) was discounted since it was so much shorter than all the other pump down times.

Lift Station: Cedarhome
Date: 6/19/2014
Assessment: No. 1
Nominal Pump Capacity (gpm): 345

	Wetwell Length (ft.):	17	
	Wetwell Width (ft.):	12	
	Wetwell Surface Area (sq. ft.)	204	
Pump Down		**Pump No. 1**	**Pump No. 2**
Test No. 1	Distance Pumped Down (ft.)	3.00	3.00
	Time to Pump Down (min.)	22.17	18.57
Test No. 2	Distance Pumped Down (ft.)	3.00	3.00
	Time to Pump Down (min.)	22.15	18.10
Fill			
Test No. 1	Distance to Fill (ft.)	3.00	3.00
	Time to Fill (min.)	47.32	49.95
Test No. 2	Distance to Fill (ft.)	3.00	3.00
	Time to Fill (min.)	49.75	53.75
	Pump Down No. 1 (gpm)	206.52	246.56
	Pump Down No. 2 (gpm)	206.67	252.91
	Fill No. 1 (gpm)	96.75	91.65
	Fill No. 2 (gpm)	92.02	85.17
	Average with Fill Correction (gpm)	300.97	338.14

Lift Station:	Pioneer Hills
Date:	6/19/2014
Assessment:	No. 1
Nominal Pump Capacity (gpm):	500

Wetwell Length (ft.):	18
Wetwell Width (ft.):	15
Wetwell Surface Area (sq. ft.)	270

Pump Down		**Pump No. 1**	**Pump No. 2**
Test No. 1	Distance Pumped Down (ft.)	1.42	1.42
	Time to Pump Down (min.)	6.63	6.20
Test No. 2	Distance Pumped Down (ft.)	1.42	1.42
	Time to Pump Down (min.)	6.58	6.08
Test No. 3	Distance Pumped Down (ft.)	1.42	1.42
	Time to Pump Down (min.)	6.40	6.08
Fill			
Test No. 1	Distance to Fill (ft.)	1.42	1.42
	Time to Fill (min.)	35.97	34.77
Test No. 2	Distance to Fill (ft.)	1.42	1.42
	Time to Fill (min.)	38.35	36.80
	Pump Down No. 1 (gpm)	431.32	461.47
	Pump Down No. 2 (gpm)	434.60	470.32
	Pump Down No. 3 (gpm)	447.05	470.32
	Fill No. 1 (gpm)	79.55	82.29
	Fill No. 2 (gpm)	74.60	77.75
	Average with Fill Correction (gpm)	514.73	547.39

Lift Station:	Taylor's Landing	
Date:	6/19/2014	
Assessment:	No. 1	
Nominal Pump Capacity (gpm):	150	
	Wetwell Diameter (ft.):	5.25
	Wetwell Surface Area (sq. ft.)	21.64
Pump Down		**Pump No. 2**
Test No. 1	Distance Pumped Down (ft.)	3.00
	Time to Pump Down (min.)	7.57
Test No. 2	Distance Pumped Down (ft.)	3.00
	Time to Pump Down (min.)	7.57
Test No. 3	Distance Pumped Down (ft.)	3.00
	Time to Pump Down (min.)	7.40
Test No. 4	Distance Pumped Down (ft.)	3.00
	Time to Pump Down (min.)	7.73
Fill		
Test No. 1	Distance to Fill (ft.)	3.00
	Time to Fill (min.)	33.68
Test No. 2	Distance to Fill (ft.)	3.00
	Time to Fill (min.)	33.90
Test No. 3	Distance to Fill (ft.)	3.00
	Time to Fill (min.)	35.28
Test No. 4	Distance to Fill (ft.)	3.00
	Time to Fill (min.)	35.35
	Pump Down No. 1 (gpm)	64.17
	Pump Down No. 2 (gpm)	64.17
	Pump Down No. 3 (gpm)	65.61
	Pump Down No. 4 (gpm)	62.78
	Fill No. 1 (gpm)	14.41
	Fill No. 2 (gpm)	14.32
	Fill No. 3 (gpm)	13.76
	Fill No. 4 (gpm)	13.73
	Average with Fill Correction (gpm)	78.24

Lift Station: Copper Station
Date: 6/19/2014
Assessment: No. 1
Nominal Pump Capacity (gpm): 300

	Wetwell Diameter (ft.):	6	
	Wetwell Surface Area (sq. ft.)	28.26	
Pump Down		**Pump No. 1**	**Pump No. 2**
Test No. 1	Distance Pumped Down (ft.)	3.25	3.25
	Time to Pump Down (min.)	2.23	2.08
Test No. 2	Distance Pumped Down (ft.)	3.25	3.25
	Time to Pump Down (min.)	2.25	2.30
Fill			
Test No. 1	Distance to Fill (ft.)	3.25	3.25
	Time to Fill (min.)	31.20	28.35
Test No. 2	Distance to Fill (ft.)	3.25	3.25
	Time to Fill (min.)	29.93	24.68
	Pump Down No. 1 (gpm)	307.61	329.76
	Pump Down No. 2 (gpm)	305.33	298.70
	Fill No. 1 (gpm)	22.02	24.23
	Fill No. 2 (gpm)	22.95	27.83
	Average with Fill Correction (gpm)	328.96	340.26

Lift Station:	Lindstrom
Date:	6/19/2014
Assessment:	No. 1
Nominal Pump Capacity (gpm):	160

	Wetwell Diameter (ft.):	7.583
	Wetwell Surface Area (sq. ft.)	45.14

Pump Down		**Pump No. 1**	**Pump No. 2**
Test No. 1	Distance Pumped Down (ft.)	2.00	2.00
	Time to Pump Down (min.)	10.02	8.68
Test No. 2	Distance Pumped Down (ft.)	2.00	2.00
	Time to Pump Down (min.)	6.62	7.78
Test No. 3	Distance Pumped Down (ft.)	2.00	
	Time to Pump Down (min.)	7.08	
Test No. 4	Distance Pumped Down (ft.)	2.00	
	Time to Pump Down (min.)	7.90	
Fill			
Test No. 1	Distance to Fill (ft.)	2.00	2.00
	Time to Fill (min.)	17.75	17.75
Test No. 2	Distance to Fill (ft.)	2.00	2.00
	Time to Fill (min.)	27.88	20.23
Test No. 3	Distance to Fill (ft.)	2.00	
	Time to Fill (min.)	20.95	
Test No. 4	Distance to Fill (ft.)	2.00	
	Time to Fill (min.)	19.73	
	Pump Down No. 1 (gpm)[1]		77.77
	Pump Down No. 2 (gpm)	102.07	86.77
	Pump Down No. 3 (gpm)	95.34	
	Pump Down No. 4 (gpm)	85.49	
	Fill No. 1 (gpm)	38.05	38.05
	Fill No. 2 (gpm)[2]		33.38
	Fill No. 3 (gpm)	32.24	
	Fill No. 4 (gpm)	34.22	
	Average with Fill Correction (gpm)	129.13	117.98

NOTES:
1 - Time to pump down for Test No. 1 on Pump No. 1 was discounted since it was so much longer than all the other pump down times.
2 - Time to fill for Test No. 2 on Pump No. 1 was discounted since it was so much longer than all the other fill times.

APPENDIX B

NPDES PERMIT

Issuance Date: October 25, 2011
Effective Date: November 1, 2011
Expiration Date: October 31, 2016

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.

STANWOOD WASTEWATER TREATMENT PLANT
CITY OF STANWOOD

10220 – 270th Street NW

Stanwood, Washington 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
Plant Type: Oxidation Ditch (Extended Aeration) – Secondary Treatment System	

Kevin C. Fitzpatrick
Water Quality Section Manager
Northwest Regional Office
Washington State Department of Ecology

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GENERAL CONDITIONS

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions of this permit for additional submittal requirements.

Permit Section	Submittal	Frequency	Submittal Date
S2.A(4)	Permit Reapplication - Conventional Parameters Monitoring Results	3/permit cycle	May 1, 2016 - With the permit renewal application - in Part B6 (Effluent Testing Data)
S2.A(5)	Permit Reapplication - Priority Pollutants Monitoring Results	Testing 3/permit cycle: January 2013 July 2014 June 2015	May 1, 2016 - With the permit renewal application - in Part D (Expanded Effluent Testing Data)
S3.	Discharge Monitoring Report	Monthly	
S3.E	Reporting Permit Violations	As necessary	
S3.F	Other Reporting	As necessary	
S4.B	Plans for Maintaining Adequate Capacity	As necessary	
S4.D	Notification of New or Altered Sources	As necessary	
S8.	Application for Permit Renewal	1/permit cycle	May 1, 2016
S9.A	Acute Toxicity Effluent Test Results with Written Reports	Testing 2/permit cycle: April 2015 October 2015	May 1, 2016 - With the permit renewal application
S10.A	Chronic Toxicity Effluent Test Results with Written Reports	Testing 2/permit cycle: July 2015 January 2016	May 1, 2016 - With the permit renewal application
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	Reporting Anticipated Noncompliance	As necessary	
G21	Contract Submittal	As necessary	

SPECIAL CONDITIONS

In this permit, the word "must" denotes an action that is mandatory and is equivalent to the word "shall" used in previous permits.

S1. DISCHARGE LIMITS

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 and lasting through the expiration date, the Permittee may discharge municipal wastewater to the Old Stillaguamish River, at the permitted location subject to compliance with the following limits:

Effluent Limits: Outfall # 001 Latitude 48.2358° Longitude -122.3561°		
Parameter	**Average Monthly [a]**	**Average Weekly [b]**
Biochemical Oxygen Demand (5-day) (BOD_5)	30 mg/L, 376 lbs/day 85% removal of influent BOD_5	45mg/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	**Monthly Geometric Mean**	**7- day Geometric Mean**
Fecal Coliform Bacteria [c]	200/100 mL	400/100 mL
Parameter	**Daily Minimum**	**Daily Maximum**
pH [d]	6.0 standard units	9.0 standard units

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.
b	Average weekly discharge limitation 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.
c	Ecology provides directions to calculate the monthly and the 7-day geometric mean in publication No. 04-10-020, *Information Manual for Treatment Plant Operators*, available at: http://www.ecy.wa.gov/pubs/0410020.pdf
d	The Permittee must report the instantaneous maximum and minimum pH, monthly.

B. Mixing Zone Authorization

The following paragraphs define the maximum boundaries of the mixing zones:

Chronic Mixing Zone:

(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:

(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.

Available Dilution Factors	
Acute Aquatic Life Criteria	8
Chronic Aquatic Life Criteria	36
Human Health Criteria - Non-carcinogen	36

S2. MONITORING REQUIREMENTS

A. Monitoring Schedule

The Permittee must monitor in accordance with the following schedule and the requirements specified in Appendix A.

Parameter	Units	Sample Point [c, d]	Minimum Sampling Frequency	Sample Type [b]
(1) Compliance				
Flow	MGD	Plant Influent Final Effluent	Continuous [a]	Measurement
pH	Standard Units	Final Effluent	7/week	Grab
BOD_5	mg/L	Plant Influent Final Effluent	2/week	24-hr composite
	lbs/day	Plant Influent Final Effluent	2/week	Calculate

Parameter	Units	Sample Point [c, d]	Minimum Sampling Frequency	Sample Type [b]
BOD_5 % removal	%		1/month	Calculate
TSS	mg/L	Plant Influent Final Effluent	2/week	24-hr composite
	lbs/day	Plant Influent Final Effluent	2/week	Calculate
TSS % removal	%		1/month	Calculate
Fecal Coliform Bacteria	#/100 ml	Final Effluent	2/week	Grab
(2) Effluent Characterization for Nutrients				
The final effluent must be analyzed for the following parameters quarterly for two years (2014 and 2015) during the permit cycle. The quarterly analysis results must be submitted with the **quarterly** discharge monitoring report (see Permit Condition S3.A(5)(b) for submittal schedule). In addition, the analysis results must be submitted in Part B6 of the next permit renewal application - EPA Form 3510-2A.				
Total Ammonia (NH3-N)	mg/L as N	Final Effluent	Quarterly [e] for two years - in 2014 and 2015	24-hr composite
(Nitrate + Nitrite) Nitrogen ((NO_3 + NO_2)-N)				
Total Kjeldahl Nitrogen (TKN)				
Total Ammonia (NH3-N)	lbs/day as N	Final Effluent	Quarterly [e] for two years - in 2014 and 2015	Calculate
(Nitrate + Nitrite) Nitrogen ((NO_3 + NO_2)-N)				
Total Kjeldahl Nitrogen (TKN)				
(3) Whole Effluent Toxicity (WET) Testing – Final Effluent				
Acute Toxicity Testing	As specified in Condition S9.	Final Effluent	2/permit cycle: April 2015 October 2015	24-hr composite
Chronic Toxicity Testing	As specified in Condition S10.	Final Effluent	2/permit cycle: July 2015 January 2016	24-hr composite
(4) Permit Reapplication Monitoring Requirements – Conventional Parameters [f]				
The final effluent must be analyzed for the following parameters during the permit cycle. The analysis results (except for temperature) must be submitted in Part B6 of the next permit renewal application - EPA Form 3510-2A. The analysis results for temperature must be submitted in Part A12 of the next permit renewal application.				
Total Phosphorus	mg/L as P	Final Effluent	3/permit cycle	24-hr composite
Total Phosphorus	lbs/day as P	Final Effluent	3/permit cycle	Calculate
Dissolved Oxygen	mg/L	Final Effluent	3/permit cycle	Grab
Oil and Grease				
Total Dissolved Solids				
Temperature	°C	Final Effluent	4/permit cycle (2 in August & 2 in January)	Grab

Parameter	Units	Sample Point [c, d]	Minimum Sampling Frequency	Sample Type [b]
(5) Permit Reapplication Requirements – Priority Pollutants shown in Appendix A [g]				
Cyanide	µg/L	Final Effluent	3/permit cycle: January 2013 July 2014 June 2015	Grab
Total Phenols	µg/L			Grab
Priority Pollutants (PP) – Metals	µg/L			24-hr composite (except, for mercury, which shall be Grab)
PP – Volatile Organic Compounds	µg/L			Grab
PP – Acid-extractable compounds	µg/L			24-hr composite
PP – Base-neutral compounds	µg/L			24-hr composite

a	Continuous means uninterrupted except for brief lengths of time for calibration, for power failure, or for unanticipated equipment repair or maintenance.
b	Grab means an individual sample collected over a fifteen (15)-minute, or less, period. 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	Plant Influent means the raw sewage and must be sampled at the headworks of the treatment plant excluding any side-stream returns from inside the plant.
d	Final Effluent means wastewater which is exiting, or has exited, the last treatment process or operation. Typically, this is after or at the exit from the chlorine contact chamber or other disinfection process.
e	Quarterly sampling periods are January through March, April through June, July through September, and October through December. See Permit Condition S3.A(5)(b) for quarterly monitoring report submittal schedule.
f	The test results for the conventional parameters analysis shall be reported in Part B6 of the next NPDES permit renewal application (EPA Form 3510-2A).
g	The Permittee must collect the final effluent samples for priority pollutants analysis three (3) times during this permit cycle - in January 2013, July 2014 and June 2015. The Permittee must analyze the final effluent for the priority pollutants listed under the following groups of compounds in Appendix A of this permit: • Metals, Cyanide & Total Phenols • Volatile Organic Compounds • Acid-extractable Compounds • Base-neutral Compounds The test results for the priority pollutants analysis must be reported in Part D of the next NPDES permit renewal application (EPA Form 3510-2A). All laboratory reports providing data for organic and metal parameters must include the following information: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected. Analytical results from samples sent to a contract laboratory must include information on the chain of custody, the analytical method, QA/QC results, and documentation of accreditation for the parameter. See Appendix A for the parameter list and the required detection (DL) or quantitation (QL) levels.

	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. Report single analytical values below detection as "less than (detection level)" where (detection level) is the numeric value specified in Appendix A. Report single analytical values between the agency-required detection and quantitation levels with qualifier code of j following the value. To calculate the monthly average value: • Use the reported numeric value for all parameters measured between the agency-required detection value and the agency-required quantitation value. • For values reported below detection, use one-half the detection value if the lab detected the parameter in another sample for the reporting period. For values reported below detection, use zero if the lab did not detect the parameter in another sample for the reporting period. 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 MDL and a QL to Ecology with appropriate laboratory documentation.

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.

C. Flow Measurement

The Permittee must:

1. Select and use appropriate flow measurement 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 and the manufacturer's recommendation for that type of device.

3. Calibrate these devices at the frequency recommended by the manufacturer and at a minimum frequency of at least one calibration per year.

4. Maintain calibration records for at least three years;

D. Laboratory Accreditation

The Permittee must ensure that all monitoring data required by Ecology is prepared by a laboratory registered or accredited under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories.* Flow, pH, and internal process control parameters are exempt from this requirement. The Permittee must obtain accreditation for 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.

A. Reporting

The first monitoring period begins on the effective date of the permit. The Permittee must:

1. Summarize, report, and submit monitoring data obtained during each monitoring period on a Discharge Monitoring Report (DMR) form provided, or otherwise approved, by Ecology. If submitting DMRs electronically, report a value for each day sampling occurred and for the summary values (when applicable) included on the form.

2. Submit the form as required with the words "no discharge" entered in place of the monitoring results, if the facility did not discharge during a given monitoring period. If submitting DMRs electronically, you must enter “no discharge” for an entire DMR, for a specific monitoring point, or for a specific parameter as appropriate.

3. Report the test method, the DL, and the QL on the discharge monitoring report or in the required report, if the Permittee used an alternative method not specified in the permit and as allowed in Appendix A.

4. Include the following information for priority pollutant organic and metal parameters lab reports: sampling date, sample location, date of analysis, parameter name, CAS number, analytical method/number, method detection limit (MDL), laboratory practical quantitation limit (PQL), reporting units, and concentration detected. The Permittee must submit a copy of the contract laboratory report to provide this information. Analytical results from samples sent to a contract laboratory must also include information on the chain of custody, QA/QC results, and documentation of accreditation for the parameter.

5. Submit DMRs for parameters with the monitoring frequencies specified in S2 (monthly, quarterly, etc.) at the reporting schedule identified below. The Permittee must:

a. Ensure that **monthly DMR** forms are postmarked or received by Ecology no later than the 15th day of the following month, unless otherwise specified in this permit. If submitting DMRs electronically, submit the DMR no later than the 15th day of the following month, unless otherwise specified in this permit.

b. Submit **quarterly DMR** forms 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. Quarterly sampling for nutrients analysis [see Condition S2.A(2)] must be conducted in 2014 and 2015. The quarterly analysis results for 2014 must be submitted by April 15, 2014; July 15, 2014; October 15, 2014; and January 15, 2015, respectively. The quarterly analysis results for 2015 must be submitted by April 15, 2015; July 15, 2015; October 15, 2015; and January 15, 2016, respectively.

6. Submit reports to Ecology online using Ecology's electronic DMR submittal forms or send reports to Ecology at:

Ms. Chris Smith, Water Quality
Department of Ecology
3190 – 160th Avenue SE
Bellevue, WA 98008-5452

B. 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.

C. 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.

D. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by 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.

E. Reporting Permit Violations

The Permittee must take the following actions when it violates or is unable to comply with any permit condition:

- Immediately take action to stop, contain, and cleanup unauthorized discharges or otherwise stop the noncompliance and correct the problem.

- If applicable, immediately repeat sampling and analysis. Submit the results of any repeat sampling to Ecology within thirty (30) days of sampling.

1. Immediate Reporting

   The Permittee must immediately report to Ecology and the Department of Health, Shellfish Program at the numbers listed below:

   - 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,	360-236-3330 (business hours)
Shellfish Program	360-789-8962 (after business hours)

2. Twenty-four-hour Reporting

   The Permittee must report the following occurrences of noncompliance by telephone, to Ecology at the telephone number listed above, within 24 hours from the time the Permittee becomes aware of any of the following circumstances:

   a. Any noncompliance that may endanger health or the environment, unless previously reported under subpart 1, above.

   b. Any unanticipated **bypass** that exceeds any effluent limitation in the permit (See Part S4.B, "Bypass Procedures").

   c. Any **upset** that exceeds any effluent limitation in the permit (See G.15, "Upset").

d. Any violation of a maximum daily or instantaneous maximum discharge limitation for any of the pollutants in Section S1.A of this permit.

e. Any overflow prior to the treatment works, whether or not such overflow endangers health or the environment or exceeds any effluent limitation in the permit.

3. Report within Five Days

The Permittee must also provide a written submission within five days of the time that the Permittee becomes aware of any event required to be reported under subparts 1 or 2, above. The written submission must contain:

a. A description of the noncompliance and its cause.

b. The period of noncompliance, including exact dates and times.

c. The estimated time noncompliance is expected to continue if it has not been corrected.

d. Steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

e. If the noncompliance involves an overflow prior to the treatment works, an estimate of the quantity (in gallons) of untreated overflow.

4. Waiver of Written Reports

Ecology may waive the written report required in subpart 3, above, on a case-by-case basis upon request if a timely oral report has been received.

5. 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 paragraph E.3, 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.

6. Report Submittal

The Permittee must submit reports to the address listed in S3.

F. Other Reporting

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 .

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.

The Permittee must submit a new application or supplement 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.

G. 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

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 lbs/day
TSS influent loading for maximum month	4,100 lbs/day

B. Plans for Maintaining Adequate Capacity

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, or

2. The projected increase would reach design capacity within five years.

   The plan and schedule for continuing to maintain capacity must be sufficient to achieve the effluent limits and other conditions of this permit. This plan must identify any of the following actions or any other actions necessary to meet the objective of maintaining capacity.

a. Analysis of the present design, including the introduction of any process modifications that would establish the ability of the existing facility to achieve the effluent limits and other requirements of this permit at specific levels in excess of the existing design criteria specified in S4. A.

b. Reduction or elimination of excessive infiltration and inflow of uncontaminated ground and surface water into the sewer system.

c. Limitation on future sewer extensions or connections or additional waste loads.

d. Modification or expansion of facilities necessary to accommodate increased flow or waste load.

e. Reduction of industrial or commercial flows or waste loads to allow for increasing sanitary flow or waste load.

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. The plan must specify any contracts, ordinances, methods for financing, or other arrangements necessary to achieve this objective.

If the Permittee intends to apply for state or federal funding for the design or construction of a facility project, the plan may also need to meet the environmental review requirements as described in 40 CFR 35.3040 and 40 CFR 35.3045 and it may also need to demonstrate cost effectiveness as required by WAC 173-95-730.

C. <u>Duty to Mitigate</u>

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.

D. <u>Notification of New or Altered Sources</u>

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 Permittee’s Wastewater Treatment Plant (WWTP) is proposed which:

   a. Would interfere with the operation of, or exceed the design capacity of, any portion of the WWTP;

   b. Is not part of an approved general sewer plan or approved plans and specifications; or

   c. Would be 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 sewage conveyance system's ability to adequately transport and the WWTP's ability to treat the added flow and/or waste load, the quality and volume of wastewater to be discharged to the WWTP, and the anticipated impact on the WWTP's effluent [40 CFR 122.42(b)].

3. Approval of the new or increased discharge may be required under Condition G4 of this permit.

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) that 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.

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.

B. O & M 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.

C. Effluent Diversion to the Storage Lagoon

The Permittee must immediately begin diverting the treatment plant effluent into the emergency storage lagoon under the following conditions affecting the ultraviolet light (UV) disinfection system. The permittee must also immediately report such incident(s) to the Department of Health, Shellfish Program, at the telephone numbers listed in Condition S3.E.1., *Immediate Reporting*, of this permit.

1. The turbidity of the effluent entering the UV system is greater than 35 NTU.

2. UV system sensors fail to detect UV radiation greater than the intensity set point of 2 milliWatts/square centimeter (mW/cm^2).

3. The UV dosage is less than 36 milliJoules/cm^2 (mJ/cm^2).

4. The primary electrical power at the treatment plant fails, except when the standby generator is operating the treatment plant, including the UV system (see subsection E, *Electrical Power Failure*).

D. 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 in a manner 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.

E. 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 I (EPA 430/9-74-001) at the wastewater treatment plant. Reliability Class I requires a backup power source sufficient to operate all vital components and critical lighting and ventilation during peak wastewater flow conditions.

The Permittee must cease the effluent discharge into state waters and begin diverting the treatment plant effluent into the emergency storage lagoon immediately after the primary electrical power failure at the treatment plant. If, during the primary electrical power failure, the standby generator is turned on to operate the treatment plant, including the UV disinfection system, the Permittee may begin discharging the effluent to the state waters provided the effluent complies with the terms and conditions of this permit. Until the standby generator is turned on to operate the treatment plant, or until the primary electrical power to the treatment plant is restored, the Permittee must maintain the effluent diversion into the emergency storage lagoon.

F. 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.

G. Bypass Procedures

This permit prohibits a bypass which is the intentional diversion of waste streams from any portion of a treatment facility. Ecology may take enforcement action against a Permittee for a bypass unless one of the following circumstances (1, 2, or 3) applies.

1. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limits or other conditions of this permit, or adversely impact public health as determined by Ecology prior to the bypass. The Permittee must submit prior notice, if possible, at least ten (10) days before the date of the bypass.

2. Bypass which is unavoidable, unanticipated, and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. 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.

   b. No feasible alternatives to the bypass exist, such as:

      - The use of auxiliary treatment facilities.

      - Retention of untreated wastes.

      - 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.

      - Transport of untreated wastes to another treatment facility or preventative maintenance), or transport of untreated wastes to another treatment facility.

c. Ecology is properly notified of the bypass as required in Condition S3.E of this permit.

3. If bypass is anticipated and has the potential to result in noncompliance of this permit.

a. The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

- A description of the bypass and its cause.
- An analysis of all known alternatives which would eliminate, reduce or mitigate the need for bypassing.
- A cost-effectiveness analysis of alternatives including comparative resource damage assessment.
- 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 reoccurrence 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 preparation of the engineering report or facilities plan and plans and specifications and must include these 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 consider the following prior to issuing an administrative order for this type of bypass:

- If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

- If feasible alternatives to bypass exist, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

- If the Permittee planned and scheduled the bypass to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve or deny the request. Ecology will give the public an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Ecology will approve a request to bypass by issuing an administrative order under RCW 90.48.120.

G. Operations and Maintenance Manual

The Permittee must:

1. Keep the approved O&M Manual at the permitted facility.
2. Follow the instructions and procedures of this manual.

S6. PRETREATMENT

A. General Requirements

The Permittee must work with Ecology to ensure that all commercial and industrial users of the Permittee’s wastewater treatment plant (WWTP) comply with the pretreatment regulations in 40 CFR Part 403 and any additional regulations that may be promulgated under Section 307(b) (pretreatment) and 308 (reporting) of the Federal Clean Water Act.

B. Duty to Enforce Discharge Prohibitions

1. Under 40 CFR 403.5(a), the Permittee must not authorize or knowingly allow the discharge of any pollutants into its Wastewater Treatment Plant (WWTP) 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 its treatment works:

   a. Pollutants which create a fire or explosion hazard in the WWTP (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 WWTP, 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 WWTP.

d. Any pollutant, including oxygen demanding pollutants, (BOD, etc.) released in a discharge at a flow rate and/or pollutant concentration which will cause interference with the WWTP.

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 WWTP in a quantity which may cause acute worker health and safety problems.

g. Heat in amounts that will inhibit biological activity in the WWTP resulting in interference but in no case heat in such quantities such that the temperature at the WWTP 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 Publicly Owned Treatment Works (POTWs) 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 its WWTP 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 WWTP.

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.

C. Wastewater Discharge Permit Required

The Permittee must require all non-domestic dischargers to apply for a permit, and may not allow any significant industrial users (SIUs) to discharge wastewater to the Permittee's sewer system until such user has received a wastewater discharge permit from Ecology in accordance with chapter 90.48 RCW and chapter 173-216 WAC.

S7. SOLID WASTES

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.

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. APPLICATION FOR PERMIT RENEWAL

The Permittee must submit an application for renewal of this permit by May 1, 2016.

S9. ACUTE TOXICITY

A. Testing When There Is No Permit Limit for Acute Toxicity

The Permittee must:

1. Conduct acute toxicity testing on final effluent during the months shown in the following table.
2. Submit the results to Ecology with the permit renewal application.
3. Conduct acute toxicity testing on a series of at least five concentrations of effluent, including 100% effluent and a control.
4. Use each of the following species and protocols for each acute toxicity test:

Acute Toxicity Tests	Species	Method	Test Date	Written Report Submittal Date
Fathead minnow 96-hour static-renewal test	*Pimephales promelas*	EPA-821-R-02-012	April 2015	With the permit renewal application May 1, 2016
Daphnid 48-hour static test	*Ceriodaphnia dubia*, *Daphnia pulex*, or *Daphnia magna*	EPA-821-R-02-012	October 2015	With the permit renewal application May 1, 2016

B. Sampling and Reporting Requirements

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.

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 Department 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 Department of 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 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

A. Testing When There Is No Permit Limit for Chronic Toxicity

The Permittee must:

1. Conduct chronic toxicity testing on final effluent during the months shown in the following table.

2. Submit the results to Ecology with the permit renewal application.

3. 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.

4. 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.

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	Test Date	Written Report Submittal Date
Topsmelt survival and growth	*Atherinops affinis*	EPA/600/R-95/136	July 2015	With the permit renewal application May 1, 2016
Mysid shrimp survival and growth	*Mysidopsis bahia/ Americamysis bahia*	EPA-821-R-02-014	January 2016	With the permit renewal application May 1, 2016

B. <u>Sampling and Reporting Requirements</u>

1. The Permittee must submit all reports for toxicity testing in accordance with the most recent version of Department of Ecology Publication No. WQ-R-95-80, *Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria*. Reports must contain bench sheets and reference toxicant results for test methods. If the lab provides the toxicity test data in electronic format for entry into Ecology's database, then the Permittee must send the data to Ecology along with the test report, bench sheets, and reference toxicant results.

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 Department of Ecology Publication # 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 A. and the Department of Ecology Publication # 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 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 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 2.3% effluent. The ACEC equals 5.2% 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.

GENERAL CONDITIONS

G1. SIGNATORY REQUIREMENTS

A. All applications, reports, or information submitted to Ecology must be signed and certified.

1. In the case of corporations, by a responsible corporate officer.

   For the purpose of this section, a responsible corporate officer means:

   (i) 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

   (ii) 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.

2. In the case of a partnership, by a general partner.

3. In the case of sole proprietorship, by the proprietor.

4. 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.

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. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

C. Changes to authorization. If an authorization under paragraph 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 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:

> "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:

A. 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.

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.

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.

A. The following are causes for terminating this permit during its term, or for denying a permit renewal application:

1. Violation of any permit term or condition.

2. Obtaining a permit by misrepresentation or failure to disclose all relevant facts.

3. A material change in quantity or type of waste disposal.

4. 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.

5. 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.

6. Nonpayment of fees assessed pursuant to RCW 90.48.465.

7. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

B. The following are causes for modification but not revocation and reissuance except when the Permittee requests or agrees:

1. A material change in the condition of the waters of the state.

2. New information not available at the time of permit issuance that would have justified the application of different permit conditions.

3. Material and substantial alterations or additions to the permitted facility or activities which occurred after this permit issuance.

4. Promulgation of new or amended standards or regulations having a direct bearing upon permit conditions, or requiring permit revision.

5. The Permittee has requested a modification based on other rationale meeting the criteria of 40 CFR Part 122.62.

6. Ecology has determined that good cause exists for modification of a compliance schedule, and the modification will not violate statutory deadlines.

7. Incorporation of an approved local pretreatment program into a municipality's permit.

C. The following are causes for modification or alternatively revocation and reissuance:

1. When cause exists for termination for reasons listed in A1 through A7 of this section, and Ecology determines that modification or revocation and reissuance is appropriate.

2. 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 G8) 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 sixty (60) 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; or
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 must be construed as excusing 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.

A. Transfers by Modification

Except as provided in paragraph (B) 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.

B. Automatic Transfers

This permit may be automatically transferred to a new Permittee if:

1. The Permittee notifies Ecology at least thirty (30) days in advance of the proposed transfer date.

2. 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.

3. 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 must 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 will 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 Condition S3.E; and
4) the Permittee complied with any remedial measures required under S4.C 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 must, 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 must 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. CONTRACT REVIEW

The Permittee must submit to Ecology any proposed contract 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. In the event that Ecology does not comment within a thirty (30)-day period, the Permittee may assume consistency and proceed with the contract.

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.

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.

CONVENTIONAL PARAMETERS

Pollutant & CAS No. *(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
Chemical Oxygen Demand	SM5220-D		10 mg/L
Total Organic Carbon	SM5310-B/C/D		1 mg/L
Total Suspended Solids	SM2540-D		5 mg/L
Total Ammonia (as N)	SM4500-NH3- GH		0.3 mg/L
Flow	Calibrated device		
Dissolved oxygen	SM4500-OC/OG		0.2 mg/L
Temperature (max. 7-day avg.)	Analog recorder or Use micro-recording devices known as thermistors		0.2º C
pH	SM4500-H^+ B	N/A	N/A

NONCONVENTIONAL PARAMETERS

Pollutant & CAS No. *(if available)*	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL) [2]** ***µg/L unless specified***
Total Alkalinity	SM2320-B		5 mg/L as CaCO3
Chlorine, Total Residual	SM4500 Cl G		50.0
Color	SM2120 B/C/E		10 color units
Fecal Coliform	SM 9221D/E,9222	N/A	N/A
Fluoride (16984-48-8)	SM4500-F E	25	100
Nitrate-Nitrite (as N)	SM4500-NO3-E/F/H		100
Nitrogen, Total Kjeldahl (as N)	SM4500-NH3-C/E/FG		300
Ortho-Phosphate (PO_4 as P)	SM4500- PE/PF	3	10
Phosphorus, Total (as P)	SM4500-PE/PF	3	10
Oil and Grease (HEM)	1664A	1,400	5,000
Salinity	SM2520-B		3 PSS
Settleable Solids	SM2540 -F		100
Sulfate (as mg/L SO_4)	SM4110-B		200
Sulfide (as mg/L S)	SM4500-S^2F/D/E/G		200
Sulfite (as mg/L SO_3)	SM4500-SO3B		2000
Total Coliform	SM 9221B, 9222B, 9223B	N/A	N/A
Total dissolved solids	SM2540 C		20 mg/L
Total Hardness	SM2340B		200 as CaCO3
Aluminum, Total (7429-90-5)	200.8	2.0	10
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
Cobalt, Total (7440-48-4)	200.8	0.05	0.25
Iron, Total (7439-89-6)	200.7	12.5	50
Magnesium, Total (7439-95-4)	200.7	10	50
Molybdenum, Total (7439-98-7)	200.8	0.1	0.5
Manganese, Total (7439-96-5)	200.8	0.1	0.5
NWTPH Dx	Ecology NWTPH Dx	250	250
NWTPH Gx	Ecology NWTPH Gx	250	250
Tin, Total (7440-31-5)	200.8	0.3	1.5
Titanium, Total (7440-32-6)	200.8	0.5	2.5

PRIORITY POLLUTANTS

Pollutant & CAS No. *(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 (7440-36-0)	200.8	0.3	1.0
Arsenic, Total (7440-38-2)	200.8	0.1	0.5
Beryllium, Total (7440-41-7)	200.8	0.1	0.5
Cadmium, Total (7440-43-9)	200.8	0.05	0.25
Chromium (hex) dissolved (18540-29-9)	SM3500-Cr EC	0.3	1.2
Chromium, Total (7440-47-3)	200.8	0.2	1.0
Copper, Total (7440-50-8)	200.8	0.4	2.0
Lead, Total (7439-92-1)	200.8	0.1	0.5
Mercury, Total (7439-97-6)	1631E	0.0002	0.0005
Nickel, Total (7440-02-0)	200.8	0.1	0.5
Selenium, Total (7782-49-2)	200.8	1.0	1.0
Silver, Total (7440-22-4)	200.8	0.04	0.2
Thallium, Total (7440-28-0)	200.8	0.09	0.36
Zinc, Total (7440-66-6)	200.8	0.5	2.5
Cyanide, Total (57-12-5)	335.4	5	10
Cyanide, Weak Acid Dissociable	SM4500-CN I	5	10
Phenols, Total	EPA 420.1		50

Pollutant & CAS No. *(if available)*	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
ACID COMPOUNDS			
2-Chlorophenol (95-57-8)	625	1.0	2.0
2,4-Dichlorophenol (120-83-2)	625	0.5	1.0
2,4-Dimethylphenol (105-67-9)	625	0.5	1.0
4,6-dinitro-o-cresol (534-52-1) (2-methyl-4,6,-dinitrophenol)	625/1625B	1.0	2.0
2,4 dinitrophenol (51-28-5)	625	1.0	2.0
2-Nitrophenol (88-75-5)	625	0.5	1.0
4-nitrophenol (100-02-7)	625	0.5	1.0
Parachlorometa cresol (59-50-7) (4-chloro-3-methylphenol)	625	1.0	2.0
Pentachlorophenol (87-86-5)	625	0.5	1.0
Phenol (108-95-2)	625	2.0	4.0
2,4,6-Trichlorophenol (88-06-2)	625	2.0	4.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	**Recommended Analytical Protocol**	**Detection (DL)[1]** ***µg/L unless specified***	**Quantitation Level (QL)[2]** ***µg/L unless specified***
VOLATILE COMPOUNDS			
Acrolein (107-02-8)	624	5	10
Acrylonitrile (107-13-1)	624	1.0	2.0
Benzene (71-43-2)	624	1.0	2.0
Bromoform (75-25-2)	624	1.0	2.0
Carbon tetrachloride (56-23-5)	624/601 or SM6230B	1.0	2.0
Chlorobenzene (108-90-7)	624	1.0	2.0
Chloroethane (75-00-3)	624/601	1.0	2.0
2-Chloroethylvinyl Ether (110-75-8)	624	1.0	2.0
Chloroform (67-66-3)	624 or SM6210B	1.0	2.0
Dibromochloromethane (124-48-1)	624	1.0	2.0
1,2-Dichlorobenzene (95-50-1)	624	1.9	7.6
1,3-Dichlorobenzene (541-73-1)	624	1.9	7.6
1,4-Dichlorobenzene (106-46-7)	624	4.4	17.6
Dichlorobromomethane (75-27-4)	624	1.0	2.0
1,1-Dichloroethane (75-34-3)	624	1.0	2.0
1,2-Dichloroethane (107-06-2)	624	1.0	2.0
1,1-Dichloroethylene (75-35-4)	624	1.0	2.0
1,2-Dichloropropane (78-87-5)	624	1.0	2.0
1,3-dichloropropene (mixed isomers) (1,2-dichloropropylene) (542-75-6) [3]	624	1.0	2.0
Ethylbenzene (100-41-4)	624	1.0	2.0
Methyl bromide (74-83-9) (Bromomethane)	624/601	5.0	10.0
Methyl chloride (74-87-3) (Chloromethane)	624	1.0	2.0
Methylene chloride (75-09-2)	624	5.0	10.0
1,1,2,2-Tetrachloroethane (79-34-5)	624	1.9	2.0
Tetrachloroethylene (127-18-4)	624	1.0	2.0
Toluene (108-88-3)	624	1.0	2.0
1,2-Trans-Dichloroethylene (156-60-5) (Ethylene dichloride)	624	1.0	2.0
1,1,1-Trichloroethane (71-55-6)	624	1.0	2.0
1,1,2-Trichloroethane (79-00-5)	624	1.0	2.0
Trichloroethylene (79-01-6)	624	1.0	2.0
Vinyl chloride (75-01-4)	624/SM6200B	1.0	2.0

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(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 (83-32-9)	625	0.2	0.4
Acenaphthylene (208-96-8)	625	0.3	0.6
Anthracene (120-12-7)	625	0.3	0.6
Benzidine (92-87-5)	625	12	24
Benzyl butyl phthalate (85-68-7)	625	0.3	0.6
Benzo(*a*)anthracene (56-55-3)	625	0.3	0.6
Benzo(b)fluoranthene (3,4-benzofluoranthene) (205-99-2) [4]	610/625	0.8	1.6
Benzo(j)fluoranthene (205-82-3) [4]	625	0.5	1.0
Benzo(k)fluoranthene (11,12-benzofluoranthene) (207-08-9) [4]	610/625	0.8	1.6
Benzo(r,s,t)pentaphene (189-55-9)	625	0.5	1.0
Benzo(*a*)pyrene (50-32-8)	610/625	0.5	1.0
Benzo(*ghi*)Perylene (191-24-2)	610/625	0.5	1.0
Bis(*2-chloroethoxy)*methane (111-91-1)	625	5.3	21.2
Bis(*2-chloroethyl*)ether (111-44-4)	611/625	0.3	1.0
Bis(*2-chloroisopropyl*)ether (39638-32-9)	625	0.3	0.6
Bis(*2-ethylhexyl*)phthalate (117-81-7)	625	0.1	0.5
4-Bromophenyl phenyl ether (101-55-3)	625	0.2	0.4
2-Chloronaphthalene (91-58-7)	625	0.3	0.6
4-Chlorophenyl phenyl ether (7005-72-3)	625	0.3	0.5
Chrysene (218-01-9)	610/625	0.3	0.6
Dibenzo (a,j)acridine (224-42-0)	610M/625M	2.5	10.0
Dibenzo (a,h)acridine (226-36-8)	610M/625M	2.5	10.0
Dibenzo(a-*h*)anthracene (53-70-3)(1,2,5,6-dibenzanthracene)	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 (91-94-1)	605/625	0.5	1.0
Diethyl phthalate (84-66-2)	625	1.9	7.6
Dimethyl phthalate (131-11-3)	625	1.6	6.4
Di-n-butyl phthalate (84-74-2)	625	0.5	1.0
2,4-dinitrotoluene (121-14-2)	609/625	0.2	0.4
2,6-dinitrotoluene (606-20-2)	609/625	0.2	0.4

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(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)			
Di-n-octyl phthalate (117-84-0)	625	0.3	0.6
1,2-Diphenylhydrazine (*as Azobenzene*) (122-66-7)	1625B	5.0	20
Fluoranthene (206-44-0)	625	0.3	0.6
Fluorene (86-73-7)	625	0.3	0.6
Hexachlorobenzene (118-74-1)	612/625	0.3	0.6
Hexachlorobutadiene (87-68-3)	625	0.5	1.0
Hexachlorocyclopentadiene (77-47-4)	1625B/625	0.5	1.0
Hexachloroethane (67-72-1)	625	0.5	1.0
Indeno(*1,2,3-cd*)Pyrene (193-39-5)	610/625	0.5	1.0
Isophorone (78-59-1)	625	0.5	1.0
3-Methyl cholanthrene (56-49-5)	625	2.0	8.0
Naphthalene (91-20-3)	625	0.3	0.6
Nitrobenzene (98-95-3)	625	0.5	1.0
N-Nitrosodimethylamine (62-75-9)	607/625	2.0	4.0
N-Nitrosodi-n-propylamine (621-64-7)	607/625	0.5	1.0
N-Nitrosodiphenylamine (86-30-6)	625	0.5	1.0
Perylene (198-55-0)	625	1.9	7.6
Phenanthrene (85-01-8)	625	0.3	0.6
Pyrene (129-00-0)	625	0.3	0.6
1,2,4-Trichlorobenzene (120-82-1)	625	0.3	0.6

Pollutant & CAS No. *(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 (176-40-16)	1613B	1.3 pg/L	5 pg/L

PRIORITY POLLUTANTS (continued)

Pollutant & CAS No. *(if available)*	Recommended Analytical Protocol	Detection (DL)[1] *µg/L unless specified*	Quantitation Level (QL) [2] *µg/L unless specified*
PESTICIDES/PCBs			
Aldrin (309-00-2)	608	0.025	0.05
alpha-BHC (319-84-6)	608	0.025	0.05
beta-BHC (319-85-7)	608	0.025	0.05
gamma-BHC (58-89-9)	608	0.025	0.05
delta-BHC (319-86-8)	608	0.025	0.05
Chlordane (57-74-9) [5]	608	0.025	0.05
4,4'-DDT (50-29-3)	608	0.025	0.05
4,4'-DDE (72-55-9)	608	0.025	0.05[10]
4,4' DDD (72-54-8)	608	0.025	0.05
Dieldrin (60-57-1)	608	0.025	0.05
alpha-Endosulfan (959-98-8)	608	0.025	0.05
beta-Endosulfan (33213-65-9)	608	0.025	0.05
Endosulfan Sulfate (1031-07-8)	608	0.025	0.05
Endrin (72-20-8)	608	0.025	0.05
Endrin Aldehyde (7421-93-4)	608	0.025	0.05
Heptachlor (76-44-8)	608	0.025	0.05
Heptachlor Epoxide (1024-57-3)	608	0.025	0.05
PCB-1242 (53469-21-9) [6]	608	0.25	0.5
PCB-1254 (11097-69-1)	608	0.25	0.5
PCB-1221 (11104-28-2)	608	0.25	0.5
PCB-1232 (11141-16-5)	608	0.25	0.5
PCB-1248 (12672-29-6)	608	0.25	0.5
PCB-1260 (11096-82-5)	608	0.13	0.5
PCB-1016 (12674-11-2) [6]	608	0.13	0.5
Toxaphene (8001-35-2)	608	0.24	0.5

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. 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).

4. Total Benzofluoranthenes - Because Benzo(b)fluoranthene, Benzo(j)fluoranthene and Benzo(k)fluoranthene co-elute you may report these three isomers as total benzofluoranthenes.

5. 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.

6. PCB 1016 & PCB 1242 – You may report these two PCB compounds as one parameter called PCB 1016/1242.

FACT SHEET FOR NPDES PERMIT WA0020290

STANWOOD WASTEWATER TREATMENT PLANT

October 25, 2011

PURPOSE of this Fact Sheet

This fact sheet explains and documents the decisions the Department of Ecology (Ecology) made in drafting the proposed National Pollutant Discharge Elimination System (NPDES) permit for 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 were available for public review and comment. For more details on preparing and filing comments about these documents, please see *Appendix A – Public Involvement Information.*

City of Stanwood staff reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions regarding the facility's location, history, discharges, or receiving water.

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 F – Response to Comments*, and publish it when issuing the final NPDES permit. Ecology will not revise the rest of the fact sheet, but the full document will become part of the legal history contained in the facility's permit file.

SUMMARY

The City of Stanwood (City) owns and operates the wastewater treatment plant (WWTP) located in Stanwood. The treatment plant provides secondary treatment to the incoming wastewater, using an oxidation ditch (extended aeration) type secondary treatment system.

The WWTP treats domestic wastewater from residential and light commercial activities, and process wastewater from two industrial facilities in Stanwood. Stanwood discharges the secondary treated and disinfected effluent from the WWTP to the Old Stillaguamish River.

The proposed permit includes effluent limits for (5-day) biochemical oxygen demand (BOD_5), total suspended solids (TSS), fecal coliform bacteria, and pH. The limits for these parameters in the proposed permit are same as the existing permit.

TABLE OF CONTENTS

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 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 municipal 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) and for ground waters (chapter 173-200 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 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. Ecology will summarize the responses to comments and any changes to the permit in *Appendix F.*

II. BACKGROUND INFORMATION

Table 1. General Facility Information

Applicant	City of Stanwood
Facility Name and Address	Stanwood WWTP 26279 – 98th Avenue NW Stanwood, WA 98292
Type of Treatment	Oxidation Ditch (Extended Aeration) – Secondary Treatment System
Discharge Location	Old Stillaguamish River Latitude: 48.23583^{o} Longitude: -122.35611^{o}

A. Facility Description

History

Because of the water quality concerns in the receiving water (Old Stillaguamish River), Stanwood replaced the previous lagoon treatment system with a new secondary treatment plant using extended aeration (oxidation ditch) technology, which became operational in August 2004.

Collection System Description

The current status of the collection system is provided in detail in the *City of Stanwood Comprehensive Sewer System Plan*, RH2 Engineering, March 2010. Ecology approved the plan on November 5, 2010.

Stanwood's collection system consists of approximately 27 miles of sewer piping and seven lift stations. Majority of the sewer system is 8-inch-diameter gravity main.

The hydraulic analysis of the existing sewer system indicated no capacity deficiencies in sewer pipes. However Stanwood WWTP staff indicated that there are several structural deficiencies or other problem areas that were not apparent based on the results of the hydraulic model. Most of the noted problem areas are associated with minimum pipeline grades; therefore, frequent pipe cleaning may be required. The City plans to address these problem areas as described in its Capital Improvement Plan.

The I/I evaluation shows that the existing per capita flow rates for Stanwood are just below the criteria set by the EPA for infiltration, indicating that the City may have a minimal I/I problem.

Based on the hydraulic analysis of the lift stations and Stanwood WWTP staff's knowledge, there are no known lift station capacity deficiencies.

Treatment Processes Description

The treatment process at the Stanwood WWTP includes influent flow measurement (in the main pump station force main), preliminary treatment through a rock trap and a mechanical fine screen, biological treatment in oxidation ditches, solids settling in secondary clarifiers, disinfection with an ultraviolet (UV) light system, and effluent flow measurement with a magnetic flow meter. Stanwood uses two aerated sludge lagoons at the WWTP to store and stabilize waste activated sludge.

To protect the South Skagit Bay shellfish growing area, Stanwood uses a large 35-acre lagoon at the plant for diversion and storage of treated effluent during emergencies, as described in Conditions S5.C and S5.E of the permit. A diagram showing the facility layout is included in *Appendix D.*

Discharge Outfall

Stanwood discharges the secondary treated and disinfected effluent from the WWTP into the Old Stillaguamish River at river mile 4.1. The discharge outfall consists of a 24-inch 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. A diagram showing the outfall location is included in *Appendix D.*

Solid Wastes

During treatment of wastewater, Stanwood WWTP removes large solids (screenings) at the headworks, and biological solids (activated sludge) in secondary clarifiers. Screenings are disposed of as solid waste at a local landfill. The waste activated sludge from secondary clarifiers is transferred to the aerated lagoons at the plant for stabilization.

B. Permit Status

Ecology issued the existing permit for this facility on December 22, 2005, with an expiration date of December 22, 2010. Ecology received a permit renewal application from Stanwood on June 10, 2010. Ecology accepted it as complete on December 13, 2010. Ecology extended this permit on December 14, 2010. Stanwood is operating the WWTP under the terms and conditions of this extended permit.

C. Summary of Compliance with the Existing Permit

Ecology staff last conducted a non-sampling compliance inspection on July 24, 2008. The treatment plant appeared to be operated and maintained well and producing excellent quality effluent.

Stanwood has complied with the effluent limits and permit conditions throughout the duration of the existing permit. Stanwood WWTP staff received Ecology's OUTSTANDING TREATMENT PLANT AWARDS for outstanding performance at the WWTP during 2006, 2007, 2008, 2009, and 2010. Ecology assessed compliance based on its review of the facility's discharge monitoring reports (DMRs) and on inspections conducted by Ecology.

D. Effluent Characterization

Stanwood reported the concentration of pollutants in the discharge in the NPDES application and in monthly discharge monitoring reports. The effluent is characterized as follows:

Table 2. Effluent Characterization

Parameter	Average Daily Concentration	Maximum Daily Concentration	Number of Samples
BOD_5 (mg/L)	4	14	37
TSS (mg/L)	9	27	37
Fecal Coliform Bacteria (CFU/100 mL)	6	135	34
pH (Standard Units)	Ranged from 6.77 (minimum daily) to 8.05 (maximum daily)		
Ammonia (NH3-N) (mg/L)	0.44	15.8	58
Dissolved Oxygen (mg/L)	5.6	6.3	3
Total Nitrogen (TKN) (mg/L)	1.80	1.84	3
Nitrate + Nitrite (as N) (mg/L)	1.0	1.3	3
Oil and Grease (mg/L)	ND	ND	3
Phosphorus (Total) (mg/L)	2.4	3.4	3
Hardness (mg/L as $CaCO_3$)	153	160	3
Arsenic (ug/L)	4.0	4.0	3
Nickel (ug/L)	3.0	4.0	3
Zinc (ug/L)	51.0	64.0	3
Total Phenolic Compounds (ug/L)	31	52	3
Toluene (ug/L)	0.2	0.6	3
Parameter	**Average Daily Value**	**Maximum Daily Value**	**Number of Samples**
Temperature (^oC – Winter)	13.7^{o}C	14.9^{o}C	24
Temperature (^oC – Summer)	22.2^{o}C	24.6^{o}C	26

E. Description of the Receiving Water

Stanwood WWTP discharges to the Old Stillaguamish River. Ecology used the references shown below to obtain the ambient background data and determine the impacts of the wastewater discharge on the receiving water. Based on the results of the salinity measurements taken during Ecology's dye study in the river in 1996, the receiving water in the vicinity of Stanwood WWTP discharge is considered a marine estuary.

- *(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.
- *An Analysis of the Effect of Discharged Wastewater on the Stillaguamish River at Stanwood*, July 1996, Norm Glenn, Ecology Publication Number 96-330.
- *City of Stanwood – Wastewater Facilities Plan*, May 2000, Tetra Tech/KCM, Inc.,

F. SEPA Compliance

Regulation exempts reissuance or modification of any wastewater discharge permit from the SEPA process as long as the permit conditions are no less stringent than state rules and regulations. 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 reports, plans and specifications, 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 develop limits for pollutants that were not reported in the permit application but that may be present in the discharge. The permit does not authorize discharge of the non-reported pollutants. If significant changes occur in any constituent of the effluent discharge, Stanwood is required to notify Ecology (40 CFR 122.42(a)). Stanwood may be in violation of the permit until Ecology modifies the permit to reflect additional discharge of pollutants.

A. Design Criteria

Under WAC 173-220-150 (1)(g), flows and waste loadings must not exceed approved design criteria. Ecology obtained the design criteria for this WWTP from *City of Stanwood Wastewater Treatment Plant Upgrade and Expansion – Plans and Specifications* prepared by Tetra Tech/KCM Inc. Ecology approved these plans and specifications on March 5, 2002.

Table 3. Design Criteria for Stanwood WWTP

Parameter	Design Quantity
Maximum Month Design Flow (MMDF)	1.5 MGD
BOD_5 loading for maximum month	4100 lb/day
TSS loading for maximum month	4100 lb/day

B. Technology-Based Effluent Limits

Federal and state regulations define technology-based effluent limits for municipal 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 municipal wastewater.

Chapter 173-221 WAC lists the following technology-based limits for pH, fecal coliform, BOD_5, and TSS:

Table 4. Technology-based Limits

Parameter	Limit
pH	The pH must measure within the range of 6.0 to 9.0 standard units.
Fecal Coliform Bacteria	Monthly Geometric Mean = 200 organisms/100 mL Weekly Geometric Mean = 400 organisms/100 mL
BOD_5 (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed fifteen percent (15%) of the average influent concentration Average Weekly Limit = 45 mg/L
TSS (concentration)	Average Monthly Limit is the most stringent of the following: - 30 mg/L - may not exceed fifteen percent (15%) of the average influent concentration Average Weekly Limit = 45 mg/L

The following technology-based mass limits are based on WAC 173-220-130(3)(b) and 173-221-030(11)(b):

Monthly average effluent mass loadings for $BOD_5$and TSS = 1.5 MGD (maximum monthly design flow) x 30 mg/L (concentration limit) x 8.34 (conversion factor) = 376 lbs/day.

Weekly average effluent mass loadings for $BOD_5$and TSS = 1.5 MGD (maximum monthly design flow) x 45 mg/L (concentration limit) x 8.34 (conversion factor) = 563 lbs/day.

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 disease, 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

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.

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.
- Whenever the natural conditions of a water body are of a lower quality than the assigned criteria, the natural conditions constitute the water quality criteria. Where water quality criteria are not met because of natural conditions, human actions are not allowed to further lower the water quality, except where explicitly allowed in chapter 173-201A WAC.

Ecology’s analysis described in this section of the fact sheet demonstrates that the existing and designated uses of the receiving water will be protected under the conditions of the proposed permit.

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 use no more than 25% of the available width of the water body for dilution. 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 10 means the effluent is 10% and the receiving water is 90% 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.

Each aquatic life **acute** criterion is 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. Each aquatic life **chronic** criterion is 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 an 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.

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 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 waterbody'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: http://www.ecy.wa.gov/biblio/92109.html.

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 being discharged.

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 rises through the water column as it mixes; 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 mixing zone.

The authorized 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). Criteria applicable to this facility's discharge are summarized below in Table 5.

- **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 for this receiving water are identified below.

Table 5. 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 uses for this receiving water are identified below.

Table 6. 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. 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 biological oxygen demand (BOD) 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.

Stanwood discharges secondary treated and disinfected effluent from the WWTP into the Old Stillaguamish River at river mile 4.1. The effluent is discharged via a 24-inch 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 (MLLW).

Chronic Mixing Zone

WAC 173-201A-400(7)(b)(i) specifies that the maximum size of the mixing zone in estuaries must not extend in any horizontal direction from the discharge port(s) for a distance greater than 200 feet plus the depth of water over the discharge port(s) as measured during MLLW.

WAC 173-201A-400(7)(b)(ii) specifies that the maximum size of the mixing zone in estuaries must not occupy greater than twenty-five percent of the width of the water body as measured during MLLW.

The phrase “any horizontal direction” suggests a circular mixing zone boundary (when the outfall is a single port), but the “width of the water body” stipulation, coupled with a narrow river channel, mandates a more rectangular channel (*An Analysis of the Effect of Discharged Wastewater on the Stillaguamish River at Stanwood*, Norm Glenn, July 1996, Ecology Publication Number 96-330). The purpose of the study (in late summer 1992) presented in this publication was to assess the impact of Stanwood's wastewater discharge to the Old Stillaguamish River. Ecology estimated a channel width of approximately 100 feet at MLLW during the study.

Based on this study report:

(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 the zone where the acute criteria may be exceeded in estuaries must not extend beyond 10 percent of the distance established in subsection (7)(b) as measured independently from the discharge port(s).

Based on WAC 173-201A-400(8)(b) and the study report discussed above:

(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 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 7. Dilution Factors (DF) for Stanwood WWTP Discharge

Criteria	Acute	Chronic
Aquatic Life	8	36
Human Health, Non-carcinogen		36

The Federal Clean Water Act (Section 303(d)) requires the states to prepare a list of water bodies that do not meet water quality standards. Ecology is required to submit the 303(d) list to EPA for approval. After approval by the EPA, Ecology is required to develop water clean-up plans, also known as Total Maximum Daily Loads (TMDLs) for each of the water bodies on the 303(d) list. The 303(d) list for the year 2008 was approved by EPA on January 29, 2009.

The Old Stillaguamish River (OSR) is listed in the 2008 303(d) list as an impaired water body for temperature and fecal coliform. This was carried forward from the 2004 303(d) list. The monitoring data shows that temperature and fecal coliform in the river exceeded the water quality standards at sampling locations shown in the following table:

Table 8. Parameters listed in 2008 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.
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.

Ecology determined the impacts of dissolved oxygen deficiency, temperature, pH, fecal coliform, and toxics (ammonia, metals and other toxics) as described below, using the dilution factors shown in Table 7 above. 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.

You can obtain more complete information on the TMDL activities in the Stillaguamish at: http://www.ecy.wa.gov/programs/wq/tmdl/TMDLsbyWria/tmdl-wria05.html
DO—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 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 finalize the model calibration and 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 below in Table 9 and in Condition S1.A of the proposed 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.

Ecology Publication 96-330*, An Analysis of the Effect of Discharged Wastewater on the Stillaguamish River at Stanwood,* July 1996, presented the results of the September 1992 study of the impacts of Stanwood's discharge on the river. The report states that the OSR is a tidal bay during low flow periods. Due to a diversion placed in the main stem of the Stillaguamish River many years ago, it now flows through Hatt Slough except during high flow periods when some of it flows into the OSR.

Based on this study report, it appears that the temperature in the OSR is primarily influenced by tides from Port Susan during dry weather low flow periods. Ecology's long-term marine water quality monitoring data shows surface water temperature of 20.11^{o}C in Port Susan at Kayak Point (Station SUZ 001) in August 2006. This value is close to the maximum temperature of 19.6^{o}C measured on September 4, 1992, during Ecology's study of the impacts of Stanwood's discharge on the river. Therefore, 19.6^{o}C was selected as the background temperature in the temperature reasonable potential analysis (see *Appendix E*). As stated earlier, Ecology plans to finalize the OSRC model calibration and develop a TMDL followed by WLA in the future.

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.

Stanwood WWTP staffs measure effluent temperature daily between 2 pm and 4 pm. Ecology analyzed the effluent temperature data for the months of July, August and September from 2006 through 2010. Ecology used the 95th percentile effluent temperature for this time period of 24.5^{o}C in the temperature reasonable potential analysis (see *Appendix E*).

Based on the chronic dilution factor of 36, ambient temperature of 19.6°C and effluent temperature of 24.5°C, Ecology determined there is no reasonable potential to exceed temperature standards, and effluent temperature limit is not required (see *Appendix E*).

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—As shown in Table 8 above, the OSR is listed as Category 4A for fecal coliform (FC) in the 2008 303(d) list. Ecology has not developed or proposed WLA for FC for Stanwood WWTP. Therefore, the proposed permit includes technology-based fecal coliform limits of 200/100 mL monthly average and 400/100 mL weekly average.

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.

Based on the effluent monitoring data submitted by the City, the toxic pollutants present in the discharge are: ammonia, arsenic, nickel, zinc, phenolic compounds and Toluene. Ecology conducted a reasonable potential analysis (See *Appendix E*) for these parameters to determine whether it would require effluent limits in this permit.

Valid ambient background data was available only for ammonia. Ecology used zero for background for the other toxic compounds.

Ecology determined that the toxic chemicals present in Stanwood WWTP effluent have no reasonable potential to exceed the water quality criteria at the critical condition using procedures given in EPA, 1991 (see *Appendix E*).

F. Whole Effluent Toxicity

The water quality standards for surface waters forbid discharge of effluent that causes 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 with 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 retarded growth or reduced 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.

Ecology-accredited WET testing laboratories use the proper WET testing protocols, fulfill the data requirements, and submit results in the correct reporting format. Accredited laboratory staff knows about WET testing and how to calculate an NOEC, LC_{50}, EC_{50}, IC_{25}, 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* (http://www.ecy.wa.gov/biblio/9580.html), which is referenced in the permit. Ecology recommends that the City send a copy of the acute or chronic toxicity sections(s) of its NPDES permit to the laboratory.

WET testing conducted during effluent characterization showed no reasonable potential for Stanwood WWTP discharge to cause receiving water acute or chronic toxicity. The proposed permit will not impose WET limit(s). The City must retest the effluent before submitting an application for permit renewal.

- If the City 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. The City may demonstrate to Ecology that effluent toxicity has not increased by performing additional WET testing after the process or material changes have been made.

G. 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 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 E*) showed that the discharge has no reasonable potential to cause a violation of water quality standards, and an effluent limit is not needed.

H. 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, Ecology determined that this discharge has no reasonable potential to violate the sediment management standards.

I. Ground Water Quality Limits

The WWTP does not discharge wastewater to the ground. No permit limits are required to protect ground water.

J. Comparison of Proposed Effluent Limits with the Existing Effluent Limits

As shown in the following table, the proposed effluent limits for BOD_5, TSS, fecal coliform bacteria and pH are identical to the existing effluent limits.

Table 9. Comparison of Effluent Limits

Parameter	Basis of Limit	Existing Effluent Limits Outfall # 001		Proposed Effluent Limits Outfall # 001	
		Average Monthly	**Average Weekly**	**Average Monthly**	**Average Weekly**
BOD_5	Technology	30 mg/L	45 mg/L	30 mg/L	45 mg/L
TSS	Technology	30 mg/L	45 mg/L	30 mg/L	45 mg/L
Fecal Coliform Bacteria	Technology	200/100 mL	400/100 mL	200/100 mL	400/100 mL
pH	Technology	6.0 to 9.0		6.0 to 9.0	
Parameter		**Average Monthly**	**Maximum Daily**	**Average Monthly**	**Maximum Daily**
Total Ammonia	Water Quality	10 mg/L	17 mg/L	--------	--------

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.

The monitoring schedule is detailed in the proposed permit under Condition S2. 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 92-09) for activated sludge plants with less than 2 million gallons per day (MGD) average design flow.

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.

A. 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 this facility for all the parameters shown in Condition S1.A of the permit.

V. OTHER PERMIT CONDITIONS

A. Reporting and Record Keeping

Ecology based permit Condition S3 on our 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 to take the actions detailed in proposed permit requirement S4 to plan expansions or modifications before existing capacity is reached and to report and correct conditions that could result in new or increased discharges of pollutants.

C. Operation and Maintenance (O&M)

The proposed permit contains Condition S5 as authorized under RCW 90.48.110, WAC 173-220-150, WAC 173-230 and WAC 173-240-080. Ecology included it to ensure proper operation and regular maintenance of equipment, and to ensure that the City takes adequate safeguards so that it uses constructed facilities to their optimum potential in terms of pollutant capture and treatment.

Under the proposed permit Condition S5.C, the plant effluent will be diverted to the emergency storage lagoon when the effluent turbidity exceeds a preset limit (35 NTU), or intensity and/or dosage are lower than preset limits. This requirement is to protect the DOH approved shellfish beds downstream, in Skagit Bay.

Based on the quality of the (diverted) effluent in the emergency storage lagoon, it may be pumped to the headworks and re-treated through the main (oxidation ditch) plant, or it may be discharged directly by blending it with the main plant effluent upstream of the UV disinfection system. In order to protect the biota in the oxidation ditch, if the blended (main plant and lagoon) effluent can comply with the permitted effluent limits, the diverted effluent in the lagoon should be discharged by blending it with the main plant effluent upstream of the UV disinfection system.

D. Pretreatment

Primary sources of wastewater tributary to the facility are domestic sewage from residential and light commercial activities in the service area. Since the pretreatment program has not been delegated to the City, the pretreatment condition S8 in the permit is a standard condition derived from the Federal Regulation 40 CFR 403.5.

E. Solid Waste Control

To prevent water quality problems the facility is required in permit Condition S7 to store and handle all residual solids (grit, screenings, scum, 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 local county health department.

F. General Conditions

Ecology bases the standardized General Conditions on state and federal law and regulations. They are included in all individual municipal 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 ground waters, 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 five years.

VII. REFERENCES FOR TEXT AND APPENDICES

Environmental Protection Agency (EPA)

1992. *National Toxics Rule.* Federal Register, V. 57, No. 246, Tuesday, December 22, 1992.

1991. *Technical Support Document for Water Quality-based Toxics Control*. EPA/505/2-90-001.

Washington State Department of Ecology

2007. *(Draft) Total Maximum Daily Load Analysis of the Old Stillaguamish River Channel – Interim Model Calibration Report*, S. A. Breithaupt and T. Khangaonkar, Battelle – Pacific Northwest Division, Prepared for WA State Department of Ecology.

2006. *Permit Writer's Manual.* Publication Number 92-109 (http://www.ecy.wa.gov/biblio/92109.html)

2004. *Old Stillaguamish River Channel Diel Surveys*, July and September 2004, Publication Number 05-03-035 (http://www.ecy.wa.gov/biblio/0503035.html)

1996. *An Analysis of the Effect of Discharged Wastewater on the Stillaguamish River at Stanwood*, Publication Number 96-330 (http://www.ecy.wa.gov/pubs/96330.pdf)

Laws and Regulations (http://www.ecy.wa.gov/laws-rules/index.html)

Permit and Wastewater Related Information (http://www.ecy.wa.gov/programs/wq/wastewater/index.html)

City of Stanwood

2010. *City of Stanwood Comprehensive Sewer System Plan*, RH2 Engineering

2003. *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 reissue a permit to the City of Stanwood. 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 Application on December 15 and 22, 2010, in the *Everett Herald* to inform the public about the submitted application and to invite comment on the reissuance of this permit.

Ecology placed a Public Notice of Draft in the *Everett Herald* on September 9, 2011, 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 http://www.ecy.wa.gov/biblio/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
Attn.: Ms. Tricia Miller
Department of Ecology
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452

The primary author of this permit and fact sheet is Mike Dawda.

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 **Pollution Control Hearings Board** 1111 Israel RD SW STE 301 Tumwater, WA 98501	**Department of Ecology** Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608 **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 period of time, 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).

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 Discharge Limit—The average of the measured values obtained over a calendar month's time.

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.

BOD_5—Determining the 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 BOD_5 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 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.

Chlorine—Chlorine is 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 visits 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 visits 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.

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%.

Engineering Report—A document which 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.

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 storm water and, also, leachate from solid waste facilities.

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)—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.

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 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)—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.

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.

Quantitation Level (QL)—The smallest detectable concentration of analyte greater than the Method Detection Limit (MDL) where the accuracy (precision &bias) achieves the objectives of the intended purpose.

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).

Technology-based Effluent Limit—A permit limit that is based on the ability of a treatment method to reduce the pollutant.

Total Suspended Solids (TSS)—Total suspended solids is the particulate material in an effluent. Large quantities of TSS discharged to receiving waters 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.

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.

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.

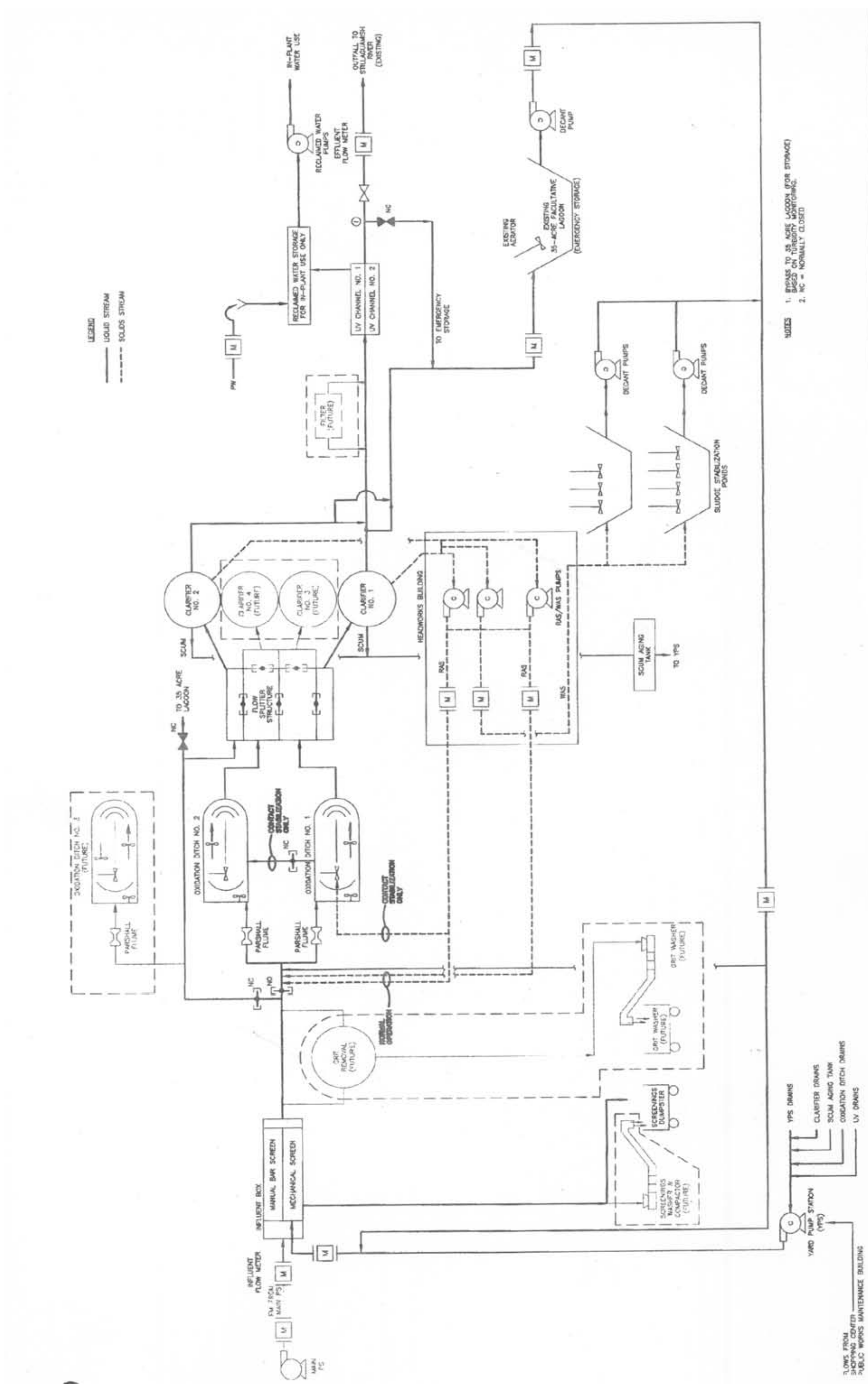
Stormwater—That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility.

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.

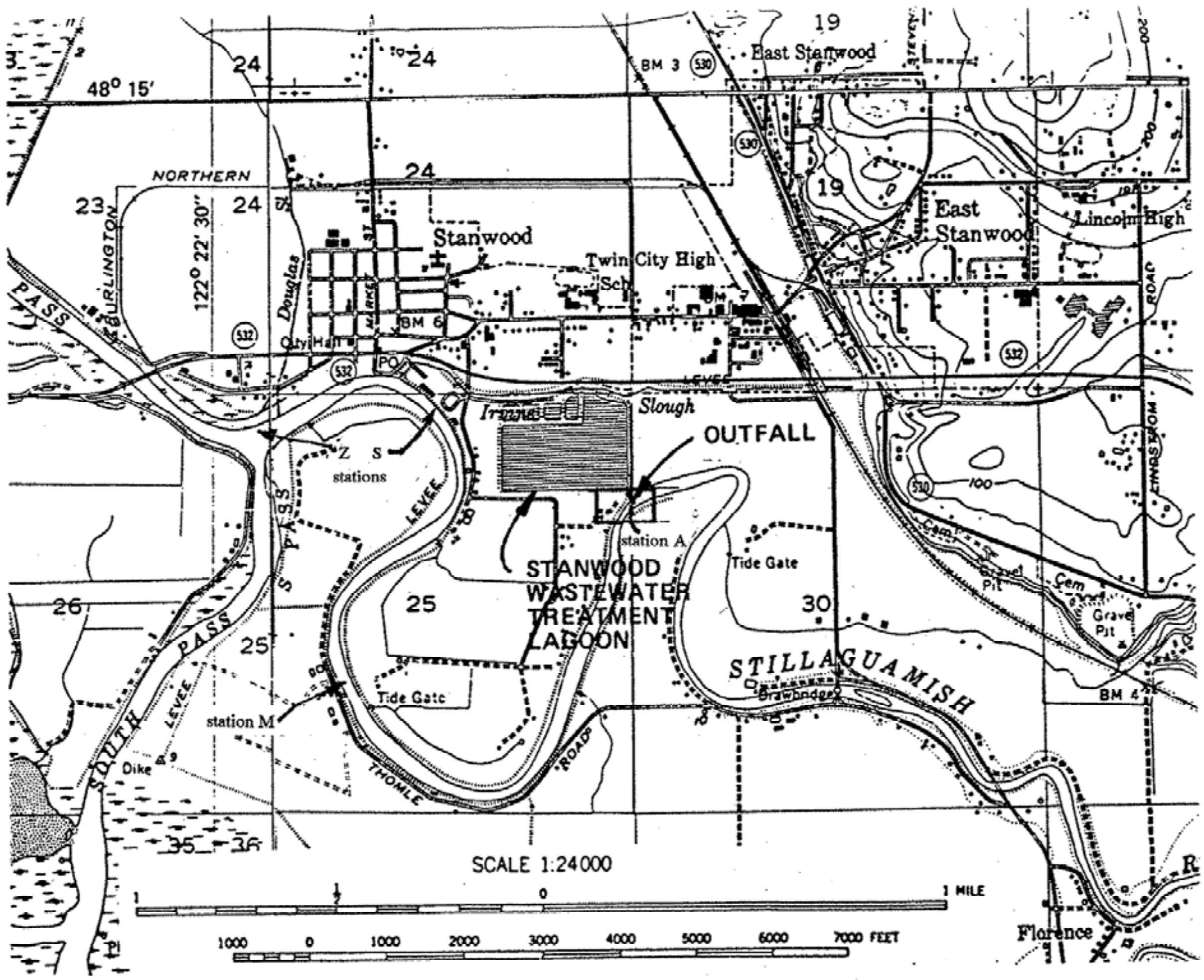
Water Quality-based Effluent Limit—A limit on the concentration of an effluent parameter that is intended to prevent the concentration of that parameter from exceeding its water quality criterion after it is discharged into receiving waters.

APPENDIX D—TREATMENT FACILITY LAYOUT AND OUTFALL LOCATION

Facility Layout



Outfall Location



APPENDIX E—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 on Ecology's homepage at http://www.ecy.wa.gov/programs/eap/pwspread/pwspread.html.

Determination of Background and Effluent Ammonia Concentrations
Used in Reasonable Potential Analysis

Ammonia's toxicity depends on that portion which is available in the unionized form. The amount of unionized ammonia present in a marine water-body depends on the temperature, pH, and salinity of the receiving water.

Background ammonia concentration was determined from the study presented in *(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. During this study, samples of the Old Stillaguamish River (OSR) and the Stanwood WWTP effluent were collected on August 23 and 24, 2006, and September 12 and 13, 2006. Sample locations and the maximum ammonium concentrations are shown in the following table:

Sample Location	Maximum Ammonium Concentration (as N mg/L)
TOC 1 – OSR near Irvine Slough	0.1
TOC 2 – OSR near Stanwood WWTP	0.045
TOC 3 – OSR north of Florence	0.175
TOC 4 – OSR at Norman Road Bridge	0.035
Stanwood WWTP Effluent	0.13

The ambient water sampling station TOC 4 is the farthest station (upstream) away from Stanwood WWTP's discharge and outside its influence. Therefore, background concentration is estimated at 0.035 mg/L of ammonium as N.

The approved dilution study in Stanwood's engineering report for the WWTP upgrade used ambient temperature and pH of 19.27^{o} C and 7.8 respectively, for calculating the total ammonia criteria. At this temperature and pH, approximately 2.5% of total ammonia is in the form of unionized ammonia and the rest (97.5%) is in the form of ammonium ion. Therefore, the maximum total ammonia concentration at sampling station TOC 4 is estimated at 0.0359 mg/L as N (35.9 ug/L NH3-N). Due to insufficient data, Ecology used the maximum (instead of the 90th percentile) ambient ammonia concentration in the RP analysis.

Stanwood staff collected weekly effluent samples for ammonia analysis for the past five years, and reported the results to Ecology as monthly average and monthly maximum. Ecology used the 95th percentile value (3,500 ug/L NH3-N) of monthly maximum results in the RP analysis.

Ammonia Criteria Calculation

Marine Total 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-93.

INPUT	
1. Receiving Water Temperature, deg C (90th percentile):	19.27
2. Receiving Water pH, (90th percentile):	7.8
3. Receiving Water Salinity, g/Kg (90th percentile):	14.5
4. Pressure (atm; EPA criteria assumes 1 atm):	1.0
5. Unionized ammonia criteria (mg un-ionized NH3 per liter)	
from EPA 440/5-88-004	
Acute:	0.233
Chronic:	0.035
OUTPUT	
1. Molal Ionic Strength (not valid if >0.85):	0.293
2. pKa8 at 25 deg C (Whitfield model "B"):	9.279
3. Percent of Total Ammonia Present as Unionized:	2.1%
4. Total Ammonia Criteria (mg/L as NH3)	
Acute:	10.88
Chronic:	1.63
RESULTS	
Total Ammonia Criteria (mg/L as NH3-N)	**0.82**
Acute:	**8.9498**
Chronic:	**1.3444**

Reasonable Potential Calculations for Water Quality and Humane-Health Criteria

STANWOOD WASTEWATER TREATMENT PLANT
NPDES PERMIT NUMBER WA-0020290
RECEIVING WATER: OLD STILLAGUAMISH RIVER

Reasonable Potential Calculation

Water Body Type: **Marine**

Dilution Factors:	**Acute**	**Chronic**		
Aquatic Life	8	36	**Amb. Temperature, °C**	**19.27**
Human Health Carcinogenic			**Amb. pH**	**7.8**
Human Health Non-Carcinogenic		36	**Amb. Salinity, psu**	**14.5**

Pollutant, CAS No. & NPDES Application Ref. No.			**AMMONIA, Criteria as Total NH3**	**ARSENIC (dissolved) 7440382 2M**	**NICKEL - 7440020 9M - Dependent on hardness**	**ZINC- 7440666 13M hardness dependent**	**PHENOL 108952 10A**	**TOLUENE 108883 25V**
Effluent Data	# of Samples (n)		58	3	3	3	3	3
	Coeff of Variation (Cv)		2.43	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)		3,500.00	4	4	64	52	0.6
	Calculated 50th percentile Effluent Conc. (when n>10)							
Ambient Data	90th Percentile Conc., ug/L		35.9	0	0	0		
	Geo Mean, ug/L							
Water Quality Criteria	Aquatic Life Criteria, ug/L	Acute	8,950	69	74	90	-	-
		Chronic	1,344	36	8.2	81	-	-
	WQ Criteria for Protection of Human Health, ug/L		-	-	4600	-	5E+06	2E+05
	Metal Criteria Translator, decimal	Acute		1	0.99	0.946	-	-
		Chronic		-	0.99	0.946	-	-
	Carcinogen?			Y	N	N	N	N
Aquatic Life Reasonable Potential								
s			1.3900	0.555	0.555	0.555	0.555	0.555
Pn			0.9497	0.368	0.368	0.368		
Multiplier			1.00	3.00	3.00	3.00	3.00	3.00
Max concentration (ug/L) at edge of...		Acute	469	1.500	1.485	22.702		
		Chronic	132	0.3333	0.3300	5.0450		
Reasonable Potential? Limit Required?			**NO**	**NO**	**NO**	**NO**	n/a	n/a
Human Health Reasonable Potential								
s					0.555		0.555	0.555
Pn			0.950	0.368	0.368	0.368	0.368	0.368
Multiplier					1.205		1.205	1.205
Dilution Factor			0	0	36	36	36	36
Max Conc. at edge of Chronic Zone, ug/L					0.134		1.74	0.02
Reasonable Potential? Limit Required?			n/a	n/a	**NO**	n/a	**NO**	**NO**

Marine Temperature Reasonable Potential 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	July-Sep
1. Chronic Dilution Factor at Mixing Zone Boundary	36
2. Annual max 1DADMax Ambient Temperature (Background 90th percentile)	19.6 °C
3. 1DADMax Effluent Temperature (95th percentile)	24.5 °C
4. Aquatic Life Temperature WQ Criterion	16.0 °C
OUTPUT	
5. Temperature at Chronic Mixing Zone Boundary:	19.74 °C
6. Incremental Temperature Increase or decrease:	0.14 °C
7. Incremental Temperature Increase 12/(T-2) if T$\leq$ crit:	---
8. Maximum Allowable Temperature at Mixing Zone Boundary:	19.90 °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**

NOTE: (i) The ambient temperature of 19.6ºC was the maximum tempearture measured (on September 4, 1992) in the river during the 1992 Ecology Study (see Ecology Publication Number 96-330). (ii) The effluent temperature of 24.5ºC is the 95th percentile value of the effluent temperature measurements in July, August and September during the years 2006 through 2010.

APPENDIX F—RESPONSE TO COMMENTS

Ecology did not receive any comments during the public notice period.

APPENDIX C

SEPA CHECKLIST

CITY OF STANWOOD
ENVIRONMENTAL CHECKLIST

Purpose of checklist:

The State Environmental Policy Act (SEPA), chapter 43.21C RCW, requires all governmental agencies to consider the environmental impacts of a proposal before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse impacts on the quality of the environment. The purpose of this checklist is to provide information to help you and the agency identify impacts from your proposal (and to reduce or avoid impacts from the proposal, if it can be done) and to help the agency decide whether an EIS is required.

Instructions for applicants:

This environmental checklist asks you to describe some basic information about your proposal. Governmental agencies use this checklist to determine whether the environmental impacts of your proposal are significant, requiring preparation of an EIS. Answer the questions briefly, with the most precise information known, or give the best description you can.

You must answer each question accurately and carefully, to the best of your knowledge. In most cases, you should be able to answer the questions from your own observations or project plans without the need to hire experts. If you really do not know the answer, or if a question does not apply to your proposal, write "do not know" or "does not apply." Complete answers to the questions now may avoid unnecessary delays later.

Some questions ask about governmental regulations, such as zoning, shoreline, and landmark designations. Answer these questions if you can. If you have problems, the governmental agencies can assist you.

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.

Use of checklist for nonproject proposals:

Complete this checklist for nonproject proposals, even though questions may be answered "does not apply." in addition, complete the supplemental sheet for nonproject actions (part D).

For nonproject actions, the references in the checklist to the words "project," "applicant," and "property or site" should be read as "proposal," "proposer," and "affected geographic area," respectively.

A. BACKGROUND

1. Name of proposed project, if applicable:

   City of Stanwood Comprehensive Sewer System Plan

2. Name of applicant:

   City of Stanwood

3. Address and phone number of applicant and contact person:

   Mr. Kevin Hushagen, Public Works Director
   City of Stanwood
   10220 270th Street NW
   Stanwood, WA 98292
   (360) 629-9782

4. Date checklist prepared:

   October 31st, 2014

5. Agency requesting checklist:

   City of Stanwood

6. Proposed timing or schedule (including phasing, if applicable):

   The City of Stanwood (City) Comprehensive Sewer System Plan (Plan) proposes projects that will rehabilitate and replace aging gravity sewer main and lift stations, as well as construct new facilities to accommodate future growth. The Plan details three categories of proposed projects in a 20-year planning period: 1) improvements to the existing system; 2) developer funded projects proposed for completion by 2021 (6 years); and 3) developer funded projects proposed for completion between 2021 and 2035 (14 years).

   Developer funded improvement projects are planned to begin within the next six years, but are dependent on when growth occurs within the City's Urban Growth Area (UGA). The City will identify and schedule the repair or replacement of existing system components during the annual budget process, which provides the City with flexibility to coordinate and combine the capital improvement projects with other City projects in the same vicinity. **Table 1** details the estimated schedule for Plan improvements.

Table 1. Proposed Improvements Implementation Schedule

No.	Description	Estimated Cost (2014 $$)	Schedule of Improvements Planned Year of Project and Estimated Cost in 2014 $$ 2014	2015	2016	2017	2018	2019	2020	2021	2022-2028	2029-2035
Pipeline Improvements												
EX1	Sewer Drainage Basin 1 Pipe Replacement Program	$5,763K		$274K	$274K	$274K	$274K	$274K	$274K	$274K	$1,921K	$1,921K
EX2	Collector/Interceptor System Flow Monitoring and Video	$353K		$40K		$40K		$40K		$40K	$193K	
EX3	270th Street NW Pipe Construction	$100K		$100K								
EX4	272nd Street NW and 76th Drive NW Gravity Main Replacement	$643K					$96K	$547K				
EX5A	Church Creek Collection System Construction	$1,025K									$1,025K	
EX5B	Cedarhome Collection System Construction	$175K										$175K
EX13	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	$236K					$47K	$189K				
EX14	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	$1,690K		$169K	$761K	$761K						
EX15	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	$271K							$41K	$230K		
EX16	Upper Pioneer Highway Interceptor Existing Deficiencies	$572K					$86K	$486K				
EX17	Pioneer Highway Interceptor Existing Deficiencies	$559K									$559K	
EX18	Lower Pioneer Highway Interceptor Existing Deficiencies	$569K									$85K	$484K
EX19	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	$717K								$108K	$609K	
EX20	265th Street NW Gravity Main Existing Deficiencies	$145K									$145K	
Facility Improvements												
EX6	Miscellaneous Improvements	$665K		$35K	$35K	$35K	$35K	$35K	$35K	$35K	$210K	$210K
EX7	Telemetry System Upgrades	$275K	$40K	$10K	$50K	$15K					$80K	$80K
EX8A	Long-term Biosolids Utilization Study	$110K		$110K								
EX8B	Long-term Biosolids Utilization Modifications	$1,925K			$289K	$545K	$545K	$545K				
EX8C	Biosolids Removal and Utilization	$500K							$500K			
EX9	Grit Removal Unit Installation	$203K					$51K	$76K	$76K			
EX10	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	$48K				$48K						
EX11	Sheet Pile Installation	$4,900K					$200K		$250K	$250K	$4,200K	
EX12	Main Lift Station (Lift Station 4) Force Main Upgrades	$486K		$73K	$413K							
Planning and Wastewater Treatment Plant Improvements												
M1	Inflow and Infiltration Study	$100K			$50K					$50K		
M2	Comprehensive Sewer System Plan Update	$232K	$101K	$15K								$116K
M3	Sewer Rate Study	$50K				$50K						
M4	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates[1]	$200K								$67K	$133K	
M5	Wastewater Treatment Plant Update and Expansion[2,3]	$11,498K										$11,498K
Total Estimated Project Costs of City Funded Improvements		**$34,010,000**	**$141K**	**$826K**	**$1,872K**	**$1,768K**	**$1,335K**	**$2,193K**	**$1,176K**	**$1,054K**	**$9,161K**	**$14,484K**
Developer Funded Improvements - Prior to 2021												
DF1A	Main Lift Station (Lift Station 4) Alternatives Analysis	$54K	Timing of Project Based on Timing of Future Developments									
DF1B	Main Lift Station (Lift Station 4) Rehabilitation	$1,544K	Timing of Project Based on Timing of Future Developments									
DF2	72nd Avenue NW Gravity Main Replacement	$193K	Timing of Project Based on Timing of Future Developments									
DF3	Church Creek Loop NW Main Replacement	$423K	Timing of Project Based on Timing of Future Developments									
DF4	68th Avenue NW Gravity Main Replacement	$321K	Timing of Project Based on Timing of Future Developments									
DF5	90th Avenue NW and Viking Way Pipe Construction	$514K	Timing of Project Based on Timing of Future Developments									
DF6	Lift Station 8 Construction	$1,842K	Timing of Project Based on Timing of Future Developments									
DF7	Lift Station 9 Construction	$1,769K	Timing of Project Based on Timing of Future Developments									
DF8A	Lift Station 10 Construction	$1,927K	Timing of Project Based on Timing of Future Developments									
DF8B	Taylor's Landing Lift Station (Lift Station 5) Pipe Construction	$481K	Timing of Project Based on Timing of Future Developments									
DF9	Lift Station 11 Construction	$1,875K	Timing of Project Based on Timing of Future Developments									
DF10A	Lift Station 12 Construction	$2,099K	Timing of Project Based on Timing of Future Developments									
DF10B	Lindstrom Lift Station (Lift Station 7) Pipe Construction	$420K	Timing of Project Based on Timing of Future Developments									
Developer Funded Improvements - Prior to 2035												
DF11	271st Street NW Monitoring and Potential Pipe Replacement	$1,397K	Timing of Project Based on Timing of Future Developments									
DF12	274th Street NW Gravity Main Replacement	$130K	Timing of Project Based on Timing of Future Developments									
DF13	Lift Station 13 Construction	$2,099K	Timing of Project Based on Timing of Future Developments									
Total Estimated Project Costs of Developer Funded Improvements		**$17,088,000**										

NOTES:
1 - Time scheduled is based on projected maximum month average flow reaching 85 percent of the capacity of the wastewater treatment plant.
2 - Price is dependent on wastewater treatment system requirements in the future. Time scheduled is based on projected maximum month average flow reaching the capacity of the wastewater treatment plant.
3 - Price is dependent on plan update conducted in M4.

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

The Plan is intended to propose future additions, expansions and improvements to the City's sewer system. In this regard, the Plan addresses improvements that are required to accommodate growth through the year 2035. Some of the identified improvements are necessary to serve residential areas in the expanded UGA that are currently undeveloped. Impacts of future facility expansion will be evaluated based on future growth projections, water quality requirements and the annual budget process.

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

None known.

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 known.

10. List any government approvals or permits that will be needed for your proposal, if known.

Approval of the preliminary Plan is needed from the Washington State Department of Ecology (Ecology) prior to finalization by the City. No other permits or approvals are required for the adoption of this Plan. Specific improvement projects may require an individual SEPA review, as well as local and State approvals, which will be identified and procured as part of the project implementation.

11. Give 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.)

The City's Plan proposes various improvements that are necessary to resolve existing system deficiencies and accommodate the projected growth of sewer customers. Some improvements are necessary to serve currently undeveloped areas in the City's UGA. In these areas, the majority of proposed pipe and facility improvements are considered developer funded projects. Planned improvements are organized into three primary categories: 1) existing system improvements; 2) developer funded system improvements to be accomplished by 2021; and 3) developer funded system improvements to be accomplished by 2035. Within each of these categories, improvements address gravity collection piping, lift stations, force mains, the wastewater treatment plant, and miscellaneous sewer projects.

For planning purposes, the proposed improvement projects described in the Plan are based on one alternative route or conventional concept to provide the necessary improvement. Other methods of achieving the same result should be considered during predesign to ensure the most efficient and lowest cost alternative is selected. A variety of alternatives for improving the Church Creek, Cedarhome, Lindstrom and Taylor's Landing Lift Stations and the pipe construction along Pioneer Highway, 72nd Avenue NW, 271st Street NW, Church Creek Loop NW, 68th Avenue NW, and 274th Street NW are plausible. Further evaluation should be performed when more information is available regarding when and where new developments will occur.

Each proposed improvement is assigned a Capital Improvement Plan (CIP) number. Prefix "EX" stands for "existing" system improvement project and "DF" stands for "developer funded" project. The following improvements to the existing system were identified by City staff and the system analyses results.

1) CIP EX1: Sewer Drainage Basin 1 Pipe Replacement Program
2) CIP EX2: Collector/Interceptor System Flow Monitoring and Video
3) CIP EX3: 270th Street NW Pipe Construction
4) CIP EX4: 272nd Street NW and 76th Drive NW Gravity Main Replacement
5) CIP EX5A: Church Creek Collection System Construction
6) CIP EX5B: Cedarhome Collection System Construction
7) CIP EX6: Miscellaneous Improvements
8) CIP EX7: Telemetry System Upgrades
9) CIP EX8: Long Term Biosolids Utilization Study
10) CIP EX9: Long Term Biosolids Utilization Modifications
11) CIP EX10: Biosolids Removal and Utilization
12) CIP EX11: Sheet Pile Installation
13) CIP EX12: Main Lift Station Force Main Upgrades
14) CIP EX13: 271st Street NW, 99th Avenue NW, and 272nd Street NW Gravity Main Existing Deficiencies
15) CIP EX14: 94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies
16) CIP EX15: Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies
17) CIP EX16: Upper Pioneer Highway Existing Deficiencies
18) CIP EX17: Pioneer Highway Existing Deficiencies
19) CIP EX18: Lower Pioneer Highway Existing Deficiencies
20) CIP EX19: 72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies
21) CIP EX20: 265th Street NW Gravity Main Existing Deficiencies
22) CIP M1: Inflow and Infiltration Study
23) CIP M2: Comprehensive Sewer System Plan Update

Improvements planned by the year 2021 were identified from the system analyses results. These improvements are necessary to serve currently undeveloped areas of the City's UGA expansion. The pipe size upgrades for the 2021 flow projections are scheduled based on the capacity of the existing pipes being reached at the 2021 flow rate; however, the proposed size of the pipe is based on the ultimate flow projection for 2035. The proposed 2021 projects are listed below.

1) CIP DF1A: Main Lift Station (Lift Station 4) Alternatives Analysis
2) CIP DF1B: Main Lift Station (Lift Station 4) Rehabilitation
3) CIP DF2: 72nd Avenue NW Gravity Main Replacement
4) CIP DF3: Church Creek Loop NW Main Replacement
5) CIP DF4: 68th Avenue NW Gravity Main Replacement
6) CIP DF5: 90th Avenue NW and Viking Way Pipe Construction
7) CIP DF6: Lift Station 8 Construction
8) CIP DF7: Lift Station 9 Construction
9) CIP DF8A: Lift Station 10 Construction
10) CIP DF8B: Taylor's Landing Lift Station (Lift Station 5) Pipe Construction
11) CIP DF9: Lift Station 11 Construction
12) CIP DF10A: Lift Station 12 Construction
13) CIP DF10B: Lindstrom Lift Station (Lift Station 7) Pipe Construction
14) CIP M3: Sewer Rate Study

Improvements planned by the year 2035 were also identified from the system analyses results and are necessary to serve the remaining undeveloped areas of the City's UGA. The improvements include the major pipeline upgrades that will be required to properly serve the system. The following improvements are contingent on completion of the 2021 improvements and are based on the 2035 flow rate projections.

1) CIP DF11: 271st Street NW Monitoring and Potential Pipe Replacement
2) CIP DF12: 274th Street NW Gravity Main Replacement
3) CIP DF13: Lift Station 13 Construction
4) CIP M4: Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates
5) CIP M5: Wastewater Treatment Plant Update and Expansion

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.

This SEPA Checklist is an update to the City's Plan, which proposes sewer projects that are City-wide. Specific project locations are detailed in the City's preliminary Plan.

B. ENVIRONMENTAL ELEMENTS

1. Earth

a. General description of the site (circle one): Flat, rolling, hilly, steep slopes, mountainous, other.

Ground slopes in the project area vary from generally flat in the western portion of the City to as much as 25-to-65 percent in steep slope areas located adjacent to Church Creek in the uplands.

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 prime farmland.

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 Pastik silt loam, 0-to-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.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

According to the Geologic Hazards Map (Figure NF-7a) in the City's *2004 Comprehensive Plan Update*, 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 low landslide risk and are associated with slight slopes and slight erosion potential. According to the Geologic Hazards Map, 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. Slopes, erosion and landslide risks reflect U.S. Department of Agriculture (USDA) data. The incidence of landslide hazards reflects U.S. Geological Survey (USGS) data. Seismic hazards data was gathered from the Washington State Department of Natural Resources (DNR).

e. Describe the purpose, type, and approximate quantities of any filling or grading proposed. Indicate source of fill.

No excavations will occur at this stage of plan adoption. The purpose, type and approximate quantities of filling and grading will be identified in individual project design and permitting.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Some erosion could potentially occur during the construction of the proposed projects.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Lift station projects may result in an increase in impervious surfaces. Gravity main projects will not likely result in new impervious surfaces. Future gravity main projects will likely be completed in conjunction with new road projects, but will not specifically result in new impervious surfaces. Exact dimensions of lift station projects and associated increases in impervious surfaces will be addressed with individual project permitting.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Lift station projects are best situated on or near the lowest ground contour possible, which often means locating projects adjacent to waterways. Five future lift station projects are proposed to be sited near Church Creek and the Stillaguamish River, both of which are salmon and trout-bearing waterways. Work performed near these water features would require strict erosion and sedimentation control measures to prevent adverse impacts.

Construction performed during dry periods (between May 1st and September 30th), followed by landscaping and restoration of existing ground contours, features and substrates, will significantly reduce potential erosion impacts. Temporary Erosion and Sedimentation Control (TESC) plans will need to be developed using the City-adopted 2012 Washington State Department of Ecology's *Stormwater Management Manual for Western Washington* and approved by the City prior to any construction project.

The provisions set forth in Stanwood Municipal Code Chapter 17.115 Critical Areas shall be met for any projects occurring within designated critical areas.

2. Air

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke, etc.) during construction and 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.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

None known.

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.

3. Water

a. Surface:

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 flows through the eastern portion of the City's UGA, from north to south. Church Creek flows into Jorgenson Slough and is tributary to the Stillaguamish River, which flows along the southern edge of the UGA. Douglas Creek flows through the northern portion of the City's UGA, from east to west. Douglas Creek flows into Douglas Slough. Douglas Slough flows through the western portion of the City's UGA, from east to west. Douglas Slough flows into Skagit Bay. Irvine Slough flow through the western portion of the City's UGA, from east to west. Irvine Slough flows into the Stillaguamish River. Palustrine wetlands exist throughout the UGA. Similarly, the Stillaguamish River is associated with estuarine wetlands below the Jorgenson Slough confluence. The western portion of the City is also within the 100-year floodplain.

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.

New construction or improvements to existing lift stations are planned for within 100 feet of Church Creek, Douglas Creek, Douglas Slough, and Irvine Slough.

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 is anticipated.

4) Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.

No surface water withdrawals or diversions are anticipated.

5) Does the proposal lie within a 100–year floodplain? If so, note location on the site plan.

The proposed improvements in the western portion of the planning area are located within the 100-year floodplain. The eastern portion of the City's UGA is outside of the 100-year floodplain.

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 these pollutants currently allowed by the Wastewater Treatment Plant's NPDES permit.

b. Ground:

1) Will ground water be withdrawn, or will water be discharged to ground water? Give general description, purpose, and approximate quantities if known.

Groundwater should not be affected by this project, except in localized areas where dewatering may be necessary for excavation during construction. The construction will take place near City drinking water wells and within wellhead protection zones.

2) Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: 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.

2) Could waste materials enter ground or surface waters? If so, generally describe.

No.

d. Proposed measures to reduce or control surface, ground, and runoff water impacts, if any:

- In all areas of special flood hazard, the provisions set forth in the Stanwood Municipal Code 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 Stanwood Municipal Code 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 Stanwood Municipal Code 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 Stanwood Municipal Code Chapter 17.140 Stormwater Management Performance Standards shall be met.

4. Plants

a. Check or circle types of vegetation found on the site:

_x_ deciduous tree: alder, maple, aspen, other
_x_ evergreen tree: fir, cedar, pine, other
_x_ shrubs
_x_ grass
_x_ pasture
__ crop or grain

_x_ wet soil plants: cattail, buttercup, bull rush, skunk cabbage, other
__ water plants: water lily, eelgrass, milfoil, other
__ other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

Trees, shrubs and grasses could potentially be removed with the replacement and rehabilitation of the proposed lift stations. Species and amount will be further assessed with each individual construction project.

c. List threatened or endangered species known to be on or near the site.

According to the DNR Natural Heritage Program (NHP), a Natural Heritage Feature is recorded for Section 25, Township 32, Range 03E. This section contains part of the Stillaguamish River, and the City's Wastewater Treatment Plant. NHP's List of Known Occurrences of Rare Plants in Washington for Snohomish County contains one Federal Species of Concern, stalked moonwort, *Botrychium pedunculosum,* but no listed threatened or endangered species. NHP's Snohomish County list does contain three State-threatened plant species. They are: Smoky Mountain sedge, *Carex proposita,* water lobelia, *Lobelia dortmanna,* and Choris' bog-orchid, *Platanthera chorisiana.* This list is county-wide and does not necessarily reflect occurrence of these species in the City.

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 the lift station projects. Any necessary landscaping shall utilize native plants when appropriate.

5. Animals

a. Circle any birds and animals which have been observed on or near the site or are known to be on or near the site:

birds: hawk, heron, eagle, songbirds, other:
mammals: deer, bear, elk, beaver, other:
fish: bass, salmon, trout, herring
other: rainbow trout.

b. List any threatened or endangered species known to be on or near the site.

The Washington State Department of Fish and Wildlife (WDFW) Salmonid Stock Inventory (SaSI) indicated the following threatened species presence and status within Church Creek/Jorgenson Slough and the Stillaguamish River.

Church Creek/Jorgenson Slough

- Winter steelhead (*Oncorhyncus mykiss*) – depressed status

Stillaguamish River

- Winter steelhead (*O. mykiss*) – depressed status
- Summer steelhead (*O. mykiss*) – depressed status
- Bull trout (*Salvelinus confluentus*) – Designated Critical Habitat

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 (not federally listed, but still 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 migration and spawning of listed salmonids and nesting bald eagles. Construction activities must meet the provisions set forth in Stanwood Municipal Code Chapter 17.130 Critical Areas – Fish and Wildlife Habitat Conservation Areas – Specific Standards.

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 the lift stations in the collection system will require electricity and backup diesel or gas-run generators may be located on-site in the event of power outages.

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:

None proposed at this time. Energy conservation shall be addressed on an individual project basis during the design phase.

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 as a result of this proposal? If so, describe.

Wastewater would need to be routed around any active construction zone in temporary above-ground piping.

1) Describe special emergency services that might be required.

None are anticipated. Local police, fire and aid should suffice during construction.

2) Proposed measures to reduce or control environmental health hazards, if any:

Each individual project will need to identify applicable measures to reduce or control environmental health hazards, such as containment for potential sewage spills.

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

None.

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. Some noise will be generated by electric motors and pumps at the new lift stations.

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. Lift station pumps will be enclosed in a building or other structure to minimize noise impacts.

8. Land and Shoreline Use

a. What is the current use of the site and adjacent properties?

Land use in the City of Stanwood UGA is a mixture of residential, commercial, industrial, agricultural and public facilities.

b. Has the site been used for agriculture? If so, describe.

Portions of the planning area have been and continue to be used for agriculture. Some of the proposed lift station projects may be situated adjacent to agricultural lands.

c. Describe any structures on the site.

A variety of typical residential, business, commercial and industrial structures exist in the City's UGA.

d. Will any structures be demolished? If so, what?

None anticipated.

e. What is the current zoning classification of the site?

The zoning in the City's UGA is a mixture of residential, business, commercial and industrial zones.

f. What is the current comprehensive plan designation of the site?

The current comprehensive plan designations are consistent with the mixed uses in the City's UGA.

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.

h. Has any part of the site been classified as an "environmentally sensitive" area? If so, specify.

The City maintains Critical Areas regulations and maps that specifically identify such areas within the City limits (Stanwood Municipal Code Chapters 17.114 through 17.135).

i. Approximately how many people would reside or work in the completed project?

The projects will provide essential wastewater facilities for the City of Stanwood, which is projected to have a resident population of 11,085 by 2035. No one will reside or work in the proposed projects themselves, but the construction of these projects will allow further development of the City's UGA. Public works employees and City engineering consultants are anticipated to occasionally visit the finished projects primarily for maintenance purposes.

j. Approximately how many people would the completed project displace?

None.

k. Proposed measures to avoid or reduce displacement impacts, if any:

Not applicable.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

The proposed Plan is being developed to be improve-upon and ensure compatibility with the City's other long-range planning efforts.

9. Housing

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low–income housing.

The indirect effect of new housing and other structures is not known as a result of the proposed Plan. No housing is expected to directly occur as a result of these projects; however, the proposed projects will allow for continued residential growth.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low–income housing.

The indirect effect of new or eliminated housing and other structures is not known as a result of the proposed Plan. No housing is expected to be eliminated as a result of the proposed projects.

c. Proposed measures to reduce or control housing impacts, if any:

Not applicable.

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?

The tallest proposed structures in the Plan are the rehabilitated and replacement lift stations, which would likely be small, one-story buildings, typically measuring about 10 feet tall.

b. What views in the immediate vicinity would be altered or obstructed?

No views are anticipated to be altered significantly by the Plan's proposed projects. Subsequent development of the UGA after the sewer projects are built will alter the aesthetic of those portions of the landscape.

c. Proposed measures to reduce or control aesthetic impacts, if any:

No specific measures are proposed at this time. Specific measures may be proposed with individual projects as needed.

11. Light and Glare

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

The proposed projects would generate no light or glare.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

No.

c. What existing off–site sources of light or glare may affect your proposal?

None known.

d. Proposed measures to reduce or control light and glare impacts, if any:

None.

12. Recreation

a. What designated and informal recreational opportunities are in the immediate vicinity?

The proposed projects would allow for the continued passive recreational opportunities that are consistent with the commercial and residential character of the City's UGA.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No recreational uses will be displaced.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

None.

13. Historic and Cultural Preservation

a. Are there any places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or next to the site? If so, generally describe.

According to the Washington Heritage Register (WHR), the Stanwood International Order of Odd Fellows (IOOF) Public Hall, located at 27128 102nd Avenue NW was registered as a WHR and National Register Historic Site in 1973. Also, the house of D.O. Pearson, located at 27108 102nd Avenue was registered as a WHR and National Register Historic Site in 2002. Both sites are located in the western portion of the City. The D.O. Pearson house was registered for Architectural significance, and the IOOF Hall was registered for Social History significance.

b. Generally describe any landmarks or evidence of historic, archaeological, scientific, or cultural importance known to be on or next to the site.

See above.

c. Proposed measures to reduce or control impacts, if any:

If cultural artifacts or historic resources are uncovered during construction, project work should be suspended immediately. Appropriate authorities at the County and State levels would be notified and appropriate measures would be taken to protect these resources.

14. Transportation

a. Identify public streets and highways serving the site, and describe proposed access to the existing street system. Show on site plans, if any.

The major highway running through Stanwood is SR 532. Gravity main projects are proposed for Pioneer Highway and 271st Street NW (downtown Stanwood), as well as other short sections of residential collectors in the City's UGA. These construction projects would likely not require full-closure of these streets, and the City will make the effort to keep two-way traffic open where possible. If traffic impacts are anticipated, traffic planning may be necessary and would be completed in coordination with the City. The construction of lift station projects will likely not affect public streets or highways.

b. Is site currently served by public transit? If not, what is the approximate distance to the nearest transit stop?

The City's UGA is served by Community Transit, with stops throughout the area.

c. How many parking spaces would the completed project have? How many would the project eliminate?

No parking spaces will be constructed as a part of the proposed Plan unless the sewer projects are done in conjunction with road or parking projects. Assessment of impacts to parking will occur on an individual project basis.

d. Will the proposal require any new roads or streets, or improvements to existing roads or streets, not including driveways? If so, generally describe (indicate whether public or private).

Some of the anticipated gravity main work may allow opportunities for roadway improvements.

e. Will the project use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

A few of the proposed gravity main projects will require installation of sewer line within Pioneer Highway, which parallels to the Burlington Northern Railroad tracks. Lift Station 10 may be constructed adjacent to the railroad tracks. The proposed projects will not use water, rail or air transportation, and will generally not occur in the immediate vicinity of water or air transportation features.

f. How many vehicular trips per day would be generated by the completed project? If known, indicate when peak volumes would occur.

The proposed projects should not measurably, directly increase vehicular traffic in the planning area, with the exception that indirectly, growth can occur as planned in the City's UGA.

g. Proposed measures to reduce or control transportation impacts, if any:

Construction would take place in a timely manner to minimize obstructions and alterations of local traffic flow. Approved traffic control will be provided during construction if needed.

15. Public Services

a. Would the project result in an increased need for public services (for example: fire protection, police protection, health care, schools, other)? If so, generally describe.

The Plan includes recommendations that will improve the current level of public services and accommodate future service needs. Proposed improvements will help ensure adequate and responsive sewer service for the residential and commercial growth projected in the City.

b. Proposed measures to reduce or control direct impacts on public services, if any.

None.

16. Utilities

a. Circle utilities currently available at the site:

Electricity, water, natural gas, refuse service, telephone, sanitary sewer, septic, cable and curbside recycling are available throughout the City's UGA.

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.

The Plan describes the expansion and improvement of the City's existing wastewater conveyance and treatment 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.

Signature: K Hushagen

Date Submitted: 2/24/15

D. SUPPLEMENTAL SHEET FOR NONPROJECT ACTIONS

(Do not use this sheet 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 gravity main and lift station projects, discharge of turbid water could occur. There is a potential risk of sewage spills during the replacement of gravity main. After the projects are constructed and in use, development in the City's UGA will be directed to expand 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 population will produce more wastewater to be treated. Increased impervious surfaces will increase discharge of stormwater to local water bodies (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. After the projects are constructed and in use, residential and commercial construction may expand into designated areas of the UGA, resulting in temporary construction emissions to the air of exhaust from machinery and vehicles, and dust. Personal vehicles belonging to the new homes built as a result of the improved and expanded 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 projects in the Plan 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.
- Re-routing sewage will take place during construction projects to avoid sewage spills, and a clean-up response plan will be utilized if necessary.

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 (e.g., sweeping, watering, etc.) 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 within construction of the proposed projects when plausible.

Reducing the Production, Storage, and Release of Toxic or Hazardous Substances

- The purpose of the Plan and proposed associated projects is to reduce the release of toxic and hazardous substances by increasing the efficiency of sewage collection and conveyance in the City.

Reducing the Production of Noise

- Limit construction work 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 gravity main projects will be fully buried within 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.

The lift station projects could have some localized effects on plants, animals and fish. Lift station projects could require clearing of existing vegetation, which could in turn affect wildlife that utilizes that vegetation for food or shelter. Clearing and grading for lift stations may result in discharge of turbid water to streams, which could disrupt migration or rearing of salmonids.

Proposed measures to protect or conserve plants, animals, fish, or marine life are:

- TESC plans for each construction project will create means to protect water bodies from turbid water discharge and runoff.
- Working during the summer month work-window presents less of a 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?

The goal of a sewer system is to operate using primarily gravity to avoid high energy use. That is why wastewater treatment plants are often sited at the lowest point in the landscape. However, the natural landscape of peaks and valleys requires lift stations to keep sewage flowing to the treatment plant. Lift stations require electricity for their pumps. Back-up gas or diesel generators may be installed at lift stations.

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:

- Locating lift station projects to take advantage of gravity collection.

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?

The proposal should have no direct effect on parks, wilderness, wild and scenic rivers, floodplains or prime farmlands. The project could directly affect sensitive areas such as federally-listed threatened species habitat, cultural sites and wetlands. In most cases, the locations of the proposed lift station projects are adjacent to Church Creek/Jorgenson Slough or the Stillaguamish River. As discussed above, construction of these projects could potentially 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 improved sewer 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:

- TESC plans for each construction project will create means to protect water bodies from turbid water discharge and runoff.
- Working during the summer month work-window presents less of a 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 projects in the Plan would allow for an expansion of residential and commercial uses within the City's UGA. The UGA was defined specifically to accommodate population growth in the City.

Proposed measures to avoid or reduce shoreline and land use impacts are:

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 Plan could be temporary loss of sidewalks, on-street parking, lane closures or detours near gravity 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 population may result in increased ridership of community transit and expanded service route frequency and stops. The expansion and improvement of the sewer system will result in the ability to handle more sewage from 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 alterations of local traffic flow.
- City-approved traffic control 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 gravity main and lift station 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).

<u>Federal</u>

- 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.

CITY OF STANWOOD
DETERMINATION OF NONSIGNIFICANCE (DNS)

PROJECT: City of Stanwood 2015 Sewer System Comprehensive Plan (SSP)

PROPONENT: City of Stanwood
Public Works Department
Kevin Hushagen, Director
26729 98th Ave NW
Stanwood, WA 98292

DATE OF ISSUANCE: March 3, 2015

LEAD AGENCY: City of Stanwood

DESCRIPTION OF PROPOSAL: The proposed non-project action is the development of a Sewer System Comprehensive Plan (SSP) to serve the sewage needs of the City of Stanwood and its associated growth areas as identified in the Stanwood Land Use Element of the Comprehensive Plan. The City's Plan proposes various improvements that are necessary to resolve existing system deficiencies and accommodate the projected growth of sewer customers. Some improvements are necessary to serve currently undeveloped areas in the City's UGA. Planned improvements are organized into three primary categories: 1) existing system improvements; 2) developer funded system improvements to be accomplished by 2021; and 3) developer funded system improvements to be accomplished by 2035. Within each of these categories, improvements address gravity collection piping, lift stations, force mains, the wastewater treatment plant, and miscellaneous sewer projects. The SSP details the service area, existing facilities and sewage usage, as well as the construction, operation, financing, and maintenance requirements for the sewer system.

LOCATION OF PROPOSAL: Applies to all properties within the incorporated City of Stanwood and Stanwood's UGA.

THRESHOLD DETERMINATION: The lead agency for this proposal has determined that it 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.

WRITTEN COMMENTS AND APPEALS: This Determination of Nonsignificance is issued under WAC 197-11-340(2) with a 14-day comment period and the lead agency will not act on this proposal for 14 days from the date of issuance. Written comments or appeals may be submitted to the lead agency at the address below. Comments or appeals must be submitted by **March 17, 2015 at 5:00pm.** Appeals must provide specific reasons for the appeal and be accompanied by a $500 non-refundable filing fee. ..

RESPONSIBLE OFFICIAL: Ryan C. Larsen, Community Development Director

CONTACT PERSON: Ryan C. Larsen (360-629-2181) ryan.larsen@ci.stanwood.wa.us

MAILING ADDRESS: 10220 - 270th St. NW
Stanwood, WA 98292

SIGNATURE: Ryan C. L

DATE: 2/27/15

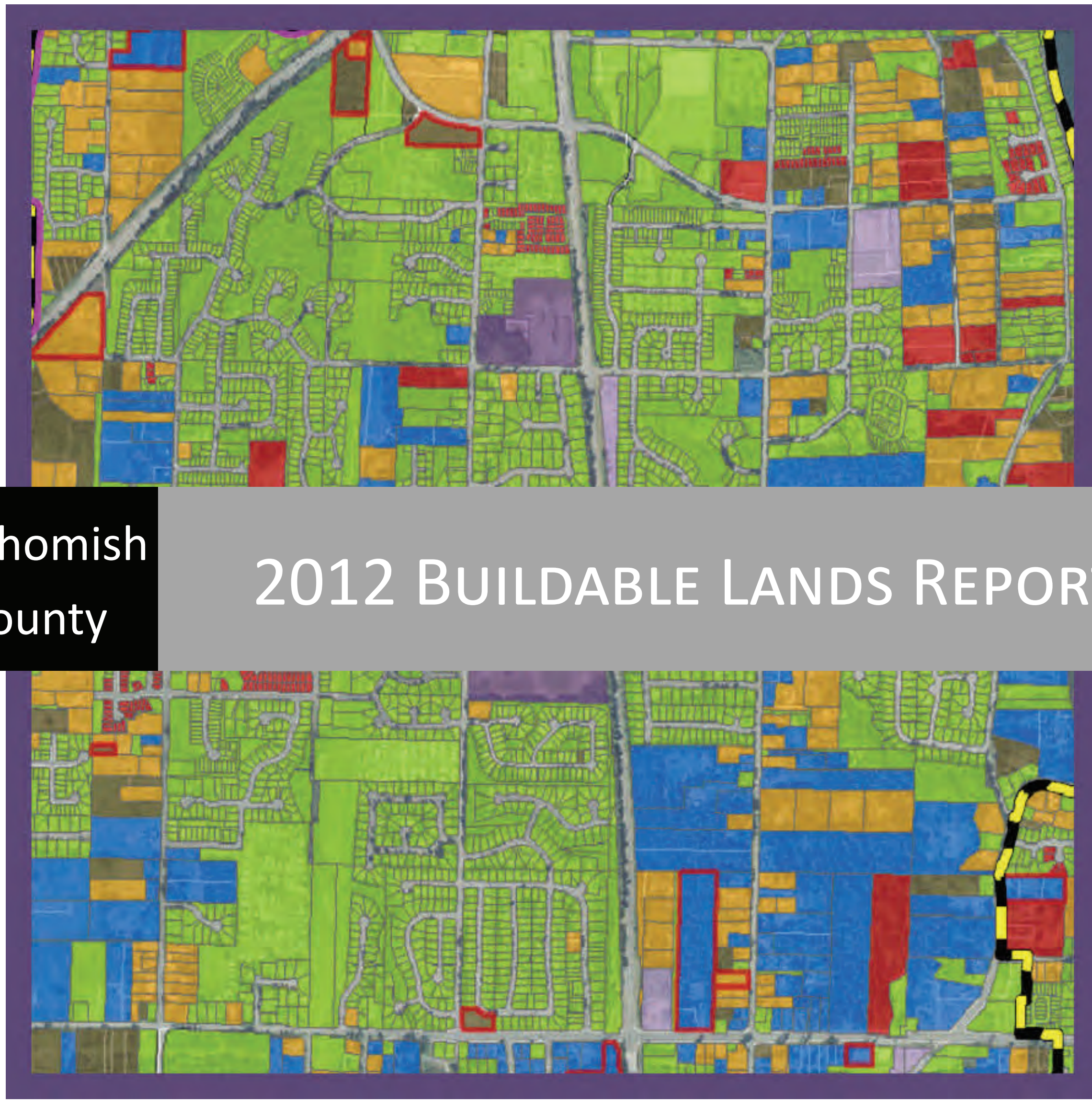
APPENDIX D

2012 BUILDABLE LANDS REPORT FOR SNOHOMISH COUNTY

Snohomish County

Snohomish County Tomorrow

A GROWTH MANAGEMENT ADVISORY COUNCIL



Snohomish County

2012 Buildable Lands Report

Adopted by the Snohomish County Council on June 12, 2013

(425) 388-3311
Fax: (425) 388-3670

M/S # 604
3000 Rockefeller Avenue
Everett, WA 98201-4046

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2012 Buildable Lands Report for Snohomish County

Adopted by the Snohomish County Council on June 12, 2013

Executive Summary

The 2012 Buildable Lands Report responds to 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.

This is the third buildable lands review and evaluation report completed by Snohomish County and its cities. It is based on the methods and approaches first developed and used by the county and cities for the two previous buildable lands reports prepared by Snohomish County Tomorrow in 2002 and 2007. 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 2025.

If the results of the buildable lands review and evaluation reveal that planned densities are not being achieved or that deficiencies in buildable land supply exist within UGAs, cities and counties are required to adopt and implement measures, other than adjusting urban growth areas, that are reasonably likely to ensure sufficient buildable lands throughout the remaining portion of the 20-year GMA planning period.

METHODOLOGY:

Using geographic information systems (GIS) technology, the present analysis began with a spring 2011 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, 2011 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 2012 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.

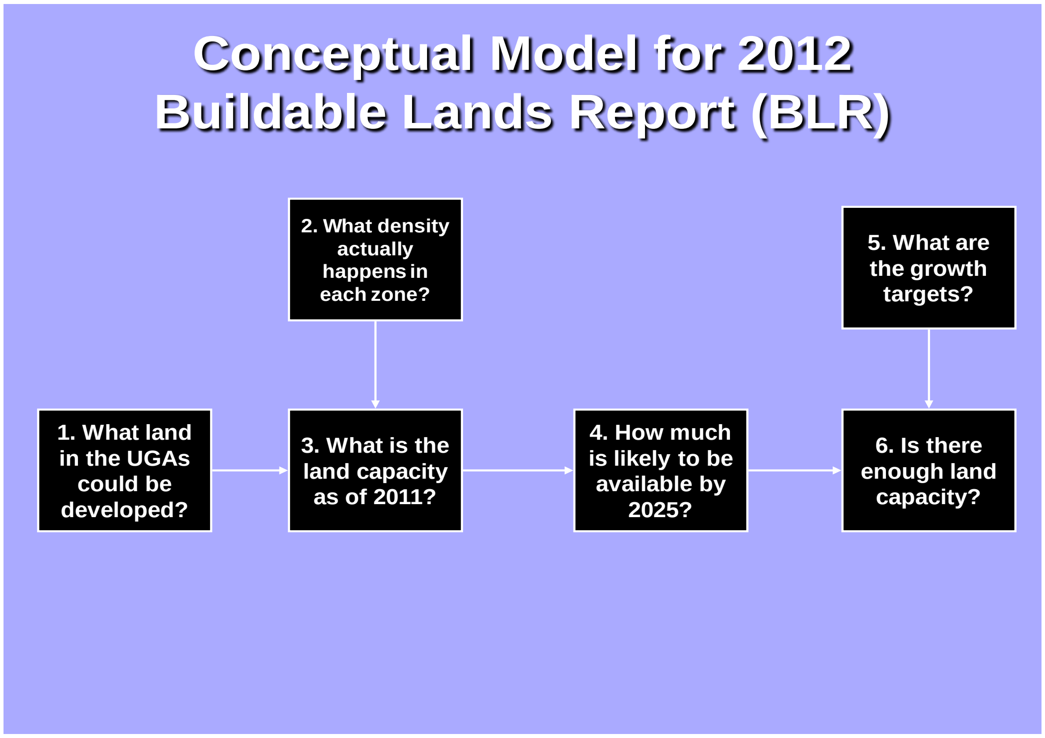
Unbuildable land area in developable parcels was then removed from the buildable lands inventory for parcels affected by: critical areas and buffers (steep slopes, wetlands, streams and lakes, frequently flooded areas); major utility easements; future arterial rights-of-way and land needed for other capital facilities (schools, parks, etc.). The unbuildable land estimate within parcels was further increased by 5% to account for unmapped critical/unbuildable areas.

Observed development densities (represented as housing units and/or jobs per buildable acre), derived from 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 2025 population and employment targets, contained in Appendix B of the Countywide Planning Policies for Snohomish County.

The following flowchart depicts the major steps in conducting the buildable lands analysis:



RESULTS:

Below are the key observations from the 2012 SCT Buildable Lands Report, recommended by the PAC on February 14, 2013. These observations describe the estimated capacity shortfalls (termed "inconsistencies" under the GMA buildable lands statute) and capacity surpluses shown in the 2012 BLR.

- 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 2025 total UGA population and employment growth targets[1].

Population

	2011 Estimated Population	CPP 2025 Population Target	2011-2025 Numeric Change	2025 Total Population Capacity	Additional 2011-2025 Pop Capacity	Pop Capacity Surplus vs. Shortfall (in parentheses)
UGA Total	595,713	759,919	164,206	791,958	196,245	32,039

[1] For the countywide UGA, additional 2011-2025 population capacity exceeds 2011-2025 projected UGA population growth by 32,039 (19.5%). This net overall UGA surplus population capacity results from a combination of UGAs showing excess capacity (totaling 37,928) above projected population growth, and those showing deficits (totaling -5,888), as shown in the UGA-specific table below.

Employment

	2011 Estimated Employment	CPP 2025 Employment Target	2011-2025 Numeric Change	2025 Total Employment Capacity	Additional 2011-2025 Emp Capacity	Emp Capacity Surplus vs. Shortfall (in parentheses)
UGA Total	234,300	340,205	105,905	401,103	166,803	60,898

- UGA- and city-specific observations show:
    - At the individual UGA level, there appear to be 2025 population capacity shortfalls within the Arlington UGA, Gold Bar UGA, Monroe UGA, and Sultan UGA:

UGA Population

	2011 Estimated Population	CPP 2025 Population Targets	2011-2025 Numeric Change	2025 Total Population Capacity	Additional 2011-2025 Pop Capacity	Pop Capacity Surplus vs. Shortfall (in parentheses)
Arlington UGA	18,489	27,000	8,511	25,467	6,978	(1,533)
Darrington UGA	1,420	2,125	705	2,340	920	215
Gold Bar UGA	2,909	3,500	591	3,333	424	(167)
Granite Falls UGA	3,517	6,970	3,453	8,651	5,134	1,681
Index UGA	180	190	10	218	38	28
Lake Stevens UGA	33,218	46,125	12,907	46,634	13,416	509
Marysville UGA	60,869	79,800	18,931	84,829	23,960	5,029
Monroe UGA	18,806	26,590	7,784	24,782	5,976	(1,808)
Snohomish UGA	10,559	14,535	3,976	14,907	4,348	372
Stanwood UGA	6,353	8,840	2,487	11,452	5,099	2,612
Sultan UGA	4,969	11,119	6,150	8,739	3,770	(2,380)
SW County UGA	434,425	533,125	98,700	560,607	126,182	27,482
UGA Total	595,713	759,919	164,206	791,958	196,245	32,039

- At the individual city level[2,3], there appears to be a 2025 population capacity shortfall within the Town of Darrington (although the Darrington UGA as a whole has enough capacity to accommodate the 2025 growth), and the cities of Monroe and Sultan. Within the SWUGA, which has enough overall capacity to accommodate the projected 2025 growth, there appear to be 2025 population capacity shortfalls within the cities of Bothell, Brier, Mill Creek, and Mukilteo:

City Population

	2011 Estimated Population	CPP 2025 Population Targets	2011-2025 Numeric Change	2025 Total Population Capacity	Additional 2011-2025 Pop Capacity	Pop Capacity Surplus vs. Shortfall (in parentheses)
Arlington City	16,620	18,150	1,530	18,965	2,345	815
Bothell City	16,570	22,000	5,430	19,899	3,329	(2,101)

[2] Using April 1, 2002 city boundaries (the date at which city boundaries were used to develop the 2025 targets).
[3] Capacity deficits of less than 100 are not considered to be inconsistencies.

	2011 Estimated Population	CPP 2025 Population Targets	2011-2025 Numeric Change	2025 Total Population Capacity	Additional 2011-2025 Pop Capacity	Pop Capacity Surplus vs. Shortfall (in parentheses)
Brier City	6,100	7,790	1,690	6,788	688	(1,002)
Darrington Town	1,345	1,910	565	1,680	335	(230)
Edmonds City	39,800	44,880	5,080	44,865	5,065	(15)
Everett City	101,148	123,060	21,912	126,987	25,839	3,927
Gold Bar City	2,060	2,497	437	2,406	346	(91)
Granite Falls City	3,317	4,770	1,453	5,532	2,215	762
Index Town	180	190	10	218	38	28
Lake Stevens City	7,644	8,360	716	8,777	1,133	417
Lynnwood City	35,767	43,782	8,015	44,624	8,857	842
Marysville City	32,418	36,737	4,319	38,627	6,209	1,890
Mill Creek City	14,554	16,089	1,535	15,117	563	(972)
Monroe City	17,237	20,540	3,303	19,637	2,400	(903)
Mtlk Terrace City	19,987	22,456	2,469	23,096	3,109	640
Mukilteo City	20,310	22,000	1,690	21,642	1,332	(358)
Snohomish City	8,838	9,981	1,143	10,802	1,964	821
Stanwood City	4,438	5,650	1,212	5,910	1,472	260
Sultan City	4,655	8,190	3,535	7,203	2,548	(987)
Woodway Town	1,305	1,170	(135)	1,385	80	215
City Total	354,294	420,202	65,908	424,161	69,867	3,960

- Within cities overall, there is adequate land capacity to accommodate the adopted 2025 total city population growth targets.
- For all other UGAs and cities not mentioned in the bulleted text above, the BLR determined that there is adequate capacity for accommodating the adopted 2025 population growth targets.
- There are no individual UGAs or cities within UGAs where there is a 2025 employment capacity shortfall.

NOTE: The county and cities are already in the process of updating growth targets and comprehensive plans by 2015, so the inconsistencies identified above may be resolved through that update process.

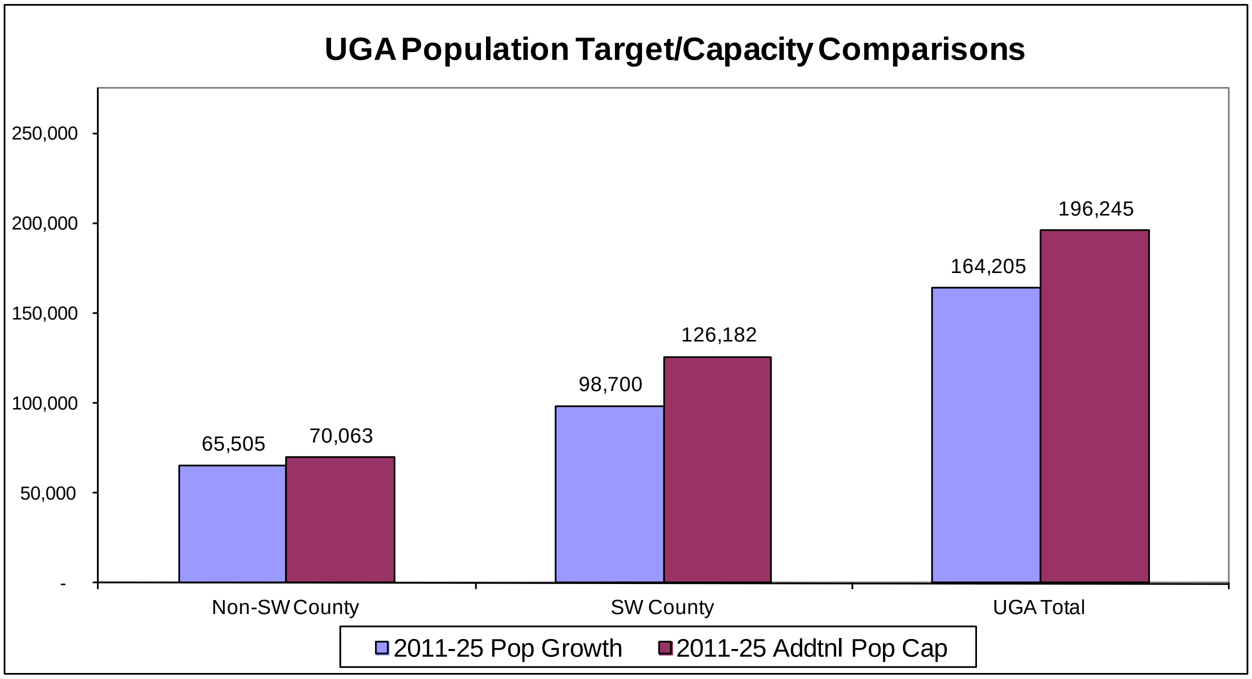
Results Summary

Comparison of 2025 UGA Population Targets with Total Population Capacity Estimates

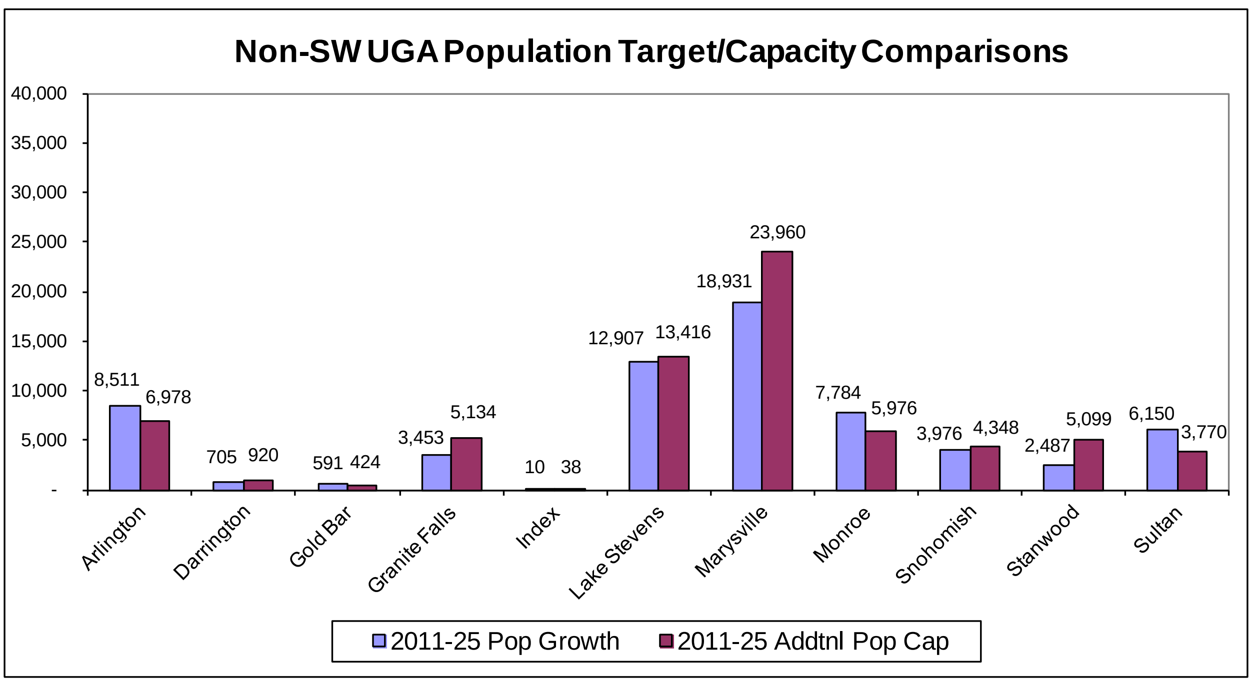
(all estimates, targets and capacity comparisons below are based on April 1, 2002 city boundaries)

Area	2011 Estimated Population	CPP 2025 Population Targets	2011-2025 Numeric Change	2025 Total Population Capacity	Additional 2011-2025 Pop Capacity	Pop Capacity Surplus vs. Shortfall ( )
Non-S.W. County UGA	161,288	226,794	65,506	231,351	70,063	4,557
Arlington UGA	18,489	27,000	8,511	25,467	6,978	(1,533)
Arlington City	16,620	18,150	1,530	18,965	2,345	815
Unincorporated	1,870	8,850	6,980	6,503	4,633	(2,347)
Darrington UGA	1,420	2,125	705	2,340	920	215
Darrington Town	1,345	1,910	565	1,680	335	(230)
Unincorporated	75	215	140	660	585	445
Gold Bar UGA	2,909	3,500	591	3,333	424	(167)
Gold Bar City	2,060	2,497	437	2,406	346	(91)
Unincorporated	849	1,003	155	927	78	(77)
Granite Falls UGA	3,517	6,970	3,453	8,651	5,134	1,681
Granite Falls City	3,317	4,770	1,453	5,532	2,215	762
Unincorporated	200	2,200	2,000	3,119	2,919	919
Index UGA (incorporated)	180	190	10	218	38	28
Lake Stevens UGA	33,218	46,125	12,907	46,634	13,416	509
Lake Stevens City	7,644	8,360	716	8,777	1,133	417
Unincorporated	25,574	37,765	12,191	37,857	12,283	92
Marysville UGA	60,869	79,800	18,931	84,829	23,960	5,029
Marysville City	32,418	36,737	4,319	38,627	6,209	1,890
Unincorporated	28,451	43,063	14,612	46,202	17,751	3,139
Monroe UGA	18,806	26,590	7,784	24,782	5,976	(1,808)
Monroe City	17,237	20,540	3,303	19,637	2,400	(903)
Unincorporated	1,569	6,050	4,481	5,145	3,576	(905)
Snohomish UGA	10,559	14,535	3,976	14,907	4,348	372
Snohomish City	8,838	9,981	1,143	10,802	1,964	821
Unincorporated	1,720	4,554	2,834	4,104	2,384	(450)
Stanwood UGA	6,353	8,840	2,487	11,452	5,099	2,612
Stanwood City	4,438	5,650	1,212	5,910	1,472	260
Unincorporated	1,915	3,190	1,275	5,542	3,627	2,352
Sultan UGA	4,969	11,119	6,150	8,739	3,770	(2,380)
Sultan City	4,655	8,190	3,535	7,203	2,548	(987)
Unincorporated	314	2,929	2,615	1,536	1,222	(1,393)
S.W. County UGA	434,425	533,125	98,700	560,607	126,182	27,482
Incorporated S.W.	255,541	303,227	47,686	304,403	48,862	1,176
Bothell City (part)	16,570	22,000	5,430	19,899	3,329	(2,101)
Brier City	6,100	7,790	1,690	6,788	688	(1,002)
Edmonds City	39,800	44,880	5,080	44,865	5,065	(15)
Everett City	101,148	123,060	21,912	126,987	25,839	3,927
Lynnwood City	35,767	43,782	8,015	44,624	8,857	842
Mill Creek City	14,554	16,089	1,535	15,117	563	(972)
Mtlake Terrace City	19,987	22,456	2,469	23,096	3,109	640
Mukilteo City	20,310	22,000	1,690	21,642	1,332	(358)
Woodway Town	1,305	1,170	(135)	1,385	80	215
Unincorporated S.W.	178,884	229,898	51,014	256,204	77,320	26,306
UGA Total	595,713	759,919	164,206	791,958	196,245	32,039
City Total	354,294	420,202	65,907	424,161	69,867	3,960
Unincorporated UGA Total	241,419	339,717	98,299	367,797	126,378	28,079

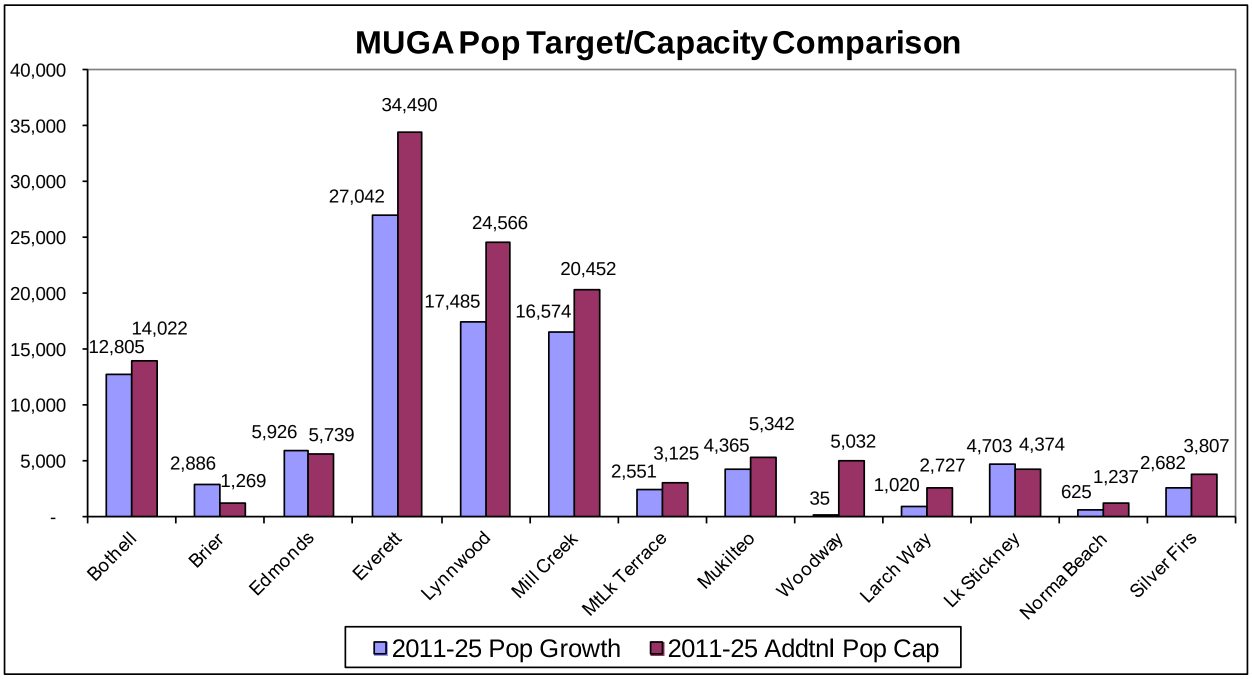
The following graph depicts the relationship between the population growth targets and additional capacity at the large UGA level (includes cities):



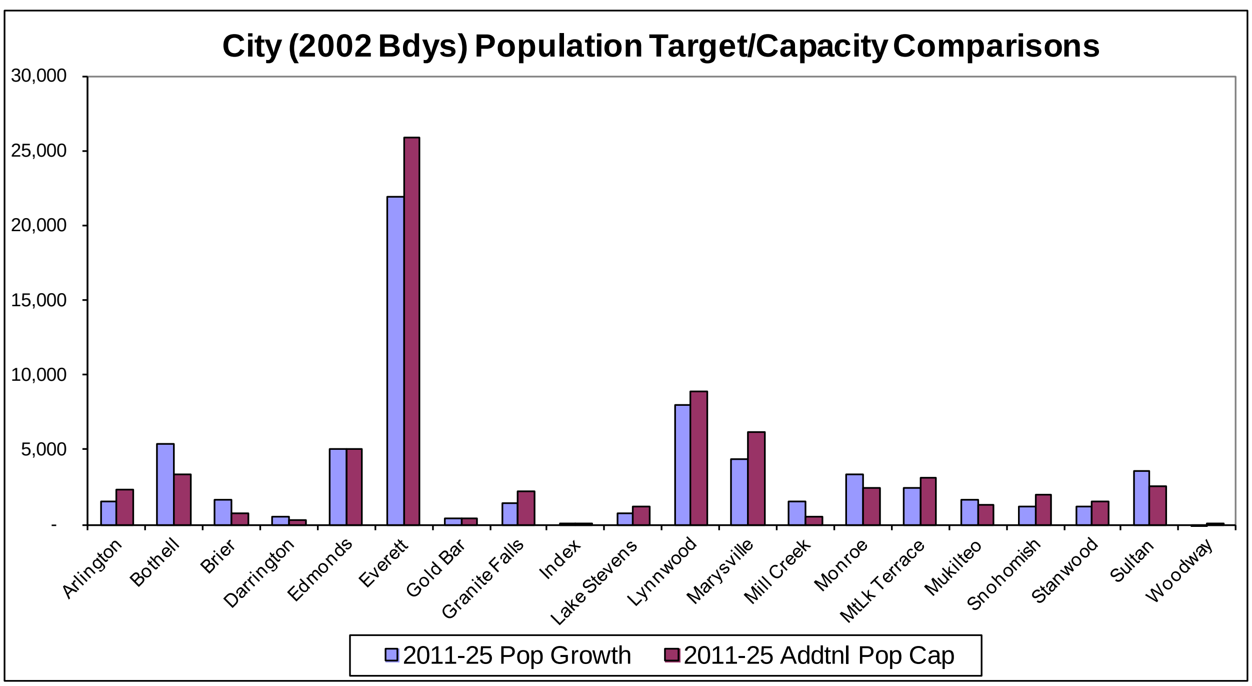
The following graph depicts the relationship between the population growth targets and additional capacity for individual non-SW County UGAs (includes cities):



The following graph depicts the relationship between the population growth targets and additional capacity for individual MUGAs (and gaps and overlaps) within the SW County UGA (includes cities):



The following graph depicts the relationship between the population growth targets and additional capacity for individual cities (using April 2002 city boundaries):



Comparison of 2025 UGA Employment Targets with Total Employment Capacity Estimates
(All estimates, targets and capacity comparisons below are based on April 1, 2002 city boundaries)

Area	2007 Estimated Employment	2011 Estimated Employment	CPP 2025 Employment Targets	2011-2025 Numeric Change	2025 Total Employment Capacity	Additional 2011-2025 Employment Capacity	Employment Capacity Surplus vs. Shortfall ( )
Non-S.W. County UGA	54,227	46,644	80,628	33,984	109,476	62,832	28,848
Arlington UGA	10,178	8,660	15,360	6,700	24,355	15,695	8,995
Arlington City	9,884	8,326	14,350	6,024	19,547	11,221	5,197
Unincorporated	294	334	1,010	676	4,808	4,474	3,798
Darrington UGA	652	500	535	35	4,068	3,568	3,533
Darrington Town	652	498	415	(83)	2,508	2,010	2,093
Unincorporated	-	2	115	113	1,560	1,558	1,445
Gold Bar UGA	194	223	210	(13)	759	536	549
Gold Bar City	193	218	210	(8)	754	536	544
Unincorporated	1	5	-	(5)	5	-	5
Granite Falls UGA	944	760	2,200	1,440	2,592	1,832	392
Granite Falls City	943	757	2,109	1,352	2,565	1,808	456
Unincorporated	1	3	91	88	27	24	(64)
Index UGA (incorporated)	26	20	70	50	26	6	(44)
Lake Stevens UGA	5,031	4,003	6,615	2,612	7,988	3,985	1,373
Lake Stevens City	1,349	1,052	1,805	753	1,900	848	95
Unincorporated	3,682	2,951	4,810	1,859	6,088	3,137	1,278
Maltby UGA (uninc.)	3,917	3,190	4,960	1,770	7,942	4,752	2,982
Marysville UGA	13,075	12,316	24,008	11,692	32,593	20,277	8,585
Marysville City	10,874	9,539	16,851	7,312	19,287	9,748	2,436
Unincorporated	2,201	2,777	7,157	4,380	13,306	10,529	6,149
Monroe UGA	9,939	7,779	12,390	4,611	12,958	5,179	568
Monroe City	9,516	7,666	11,800	4,134	12,316	4,650	516
Unincorporated	423	113	590	477	642	529	52
Snohomish UGA	5,437	4,871	6,730	1,859	7,427	2,556	697
Snohomish City	4,695	3,592	4,900	1,308	5,317	1,725	417
Unincorporated	742	1,279	1,830	551	2,110	831	280
Stanwood UGA	3,802	3,456	5,550	2,094	6,434	2,978	884
Stanwood City	3,526	3,110	4,790	1,680	4,808	1,698	18
Unincorporated	276	346	760	414	1,626	1,280	866
Sultan UGA	1,032	866	2,000	1,134	2,334	1,468	334
Sultan City	1,031	862	1,970	1,108	2,330	1,468	360
Unincorporated	1	4	30	26	4	-	(26)
S.W. County UGA	189,773	187,656	259,577	71,921	291,627	103,971	32,050
Incorporated S.W.	164,561	162,183	219,473	57,290	246,242	84,059	26,769
Bothell City (part)	15,241	13,616	15,840	2,224	19,116	5,500	3,276
Brier City	354	319	430	111	423	104	(7)
Edmonds City	11,770	11,664	12,190	526	14,590	2,926	2,400
Everett City	88,319	92,855	130,340	37,485	141,020	48,165	10,680
Lynnwood City	28,533	24,233	38,550	14,317	44,095	19,862	5,545
Mill Creek City	4,620	4,346	4,544	198	5,941	1,595	1,397
Mountlake Terrace City	7,360	6,725	8,039	1,314	10,204	3,479	2,165
Mukilteo City	8,293	8,369	9,450	1,081	10,782	2,413	1,332
Woodway Town	71	56	90	34	71	15	(19)
Unincorporated S.W.	25,212	25,473	40,104	14,631	45,385	19,912	5,281
UGA Total	244,000	234,300	340,205	105,905	401,103	166,803	60,898
City Total	207,250	197,823	278,743	80,920	317,600	119,777	38,857
Unincorporated UGA Total	36,750	36,477	61,462	24,985	83,503	47,026	22,041

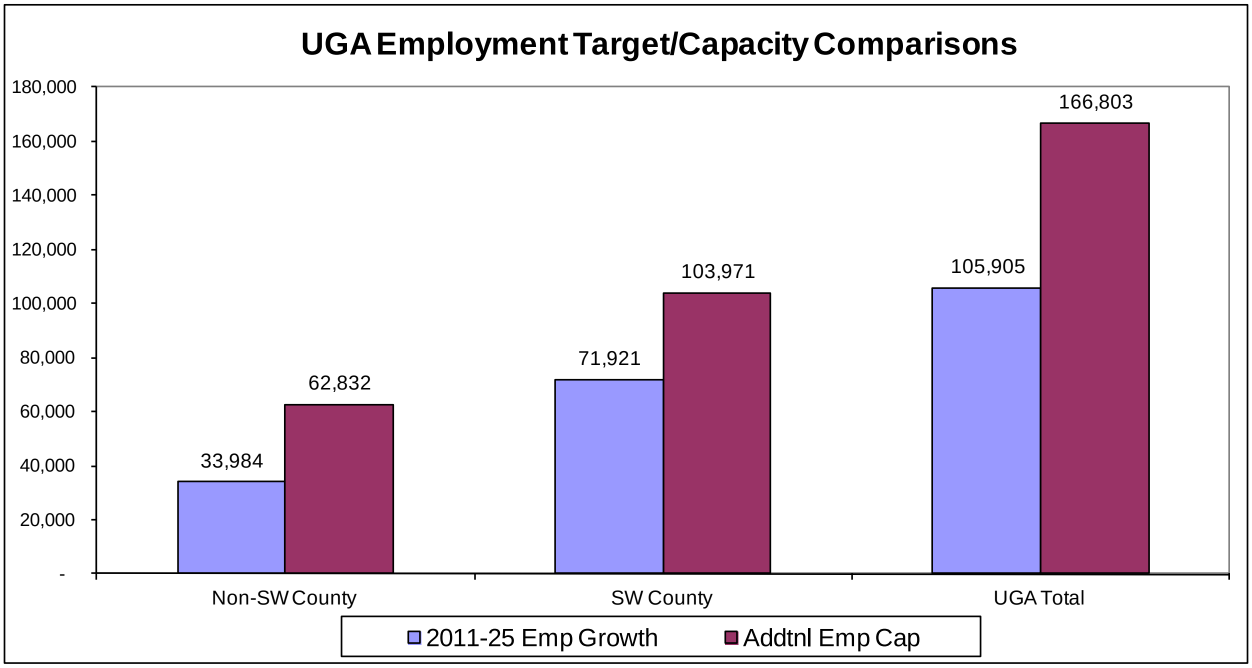
Comparison of 2025 Employment Targets with Total Employment Capacity for SWUGA Cities and Unincorporated MUGAs

(All estimates, targets and capacity comparisons below are based on April 1, 2002 city boundaries)

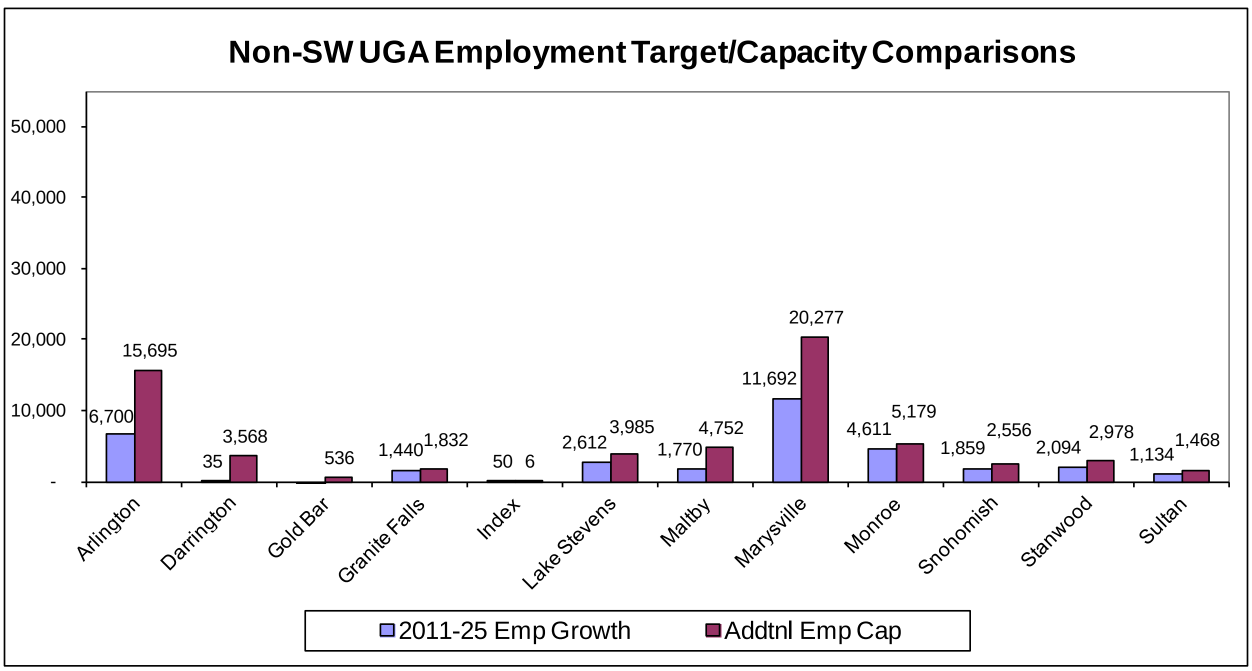
Area	2007 Estimated Employment	2011 Estimated Employment	CPP 2025 Employment Targets	2011-2025 Numeric Change	2025 Total Employment Capacity	Additional 2011-2025 Emp Capacity	Emp Capacity Surplus vs. Shortfall ( )
S.W. County UGA Total	189,773	187,656	259,577	71,921	291,561	103,905	31,984
Incorporated S.W. Total	164,561	162,183	219,473	57,290	246,242	84,059	26,769
Unincorporated S.W. Total	25,175	25,470	40,104	14,634	45,316	19,846	5,212
Bothell Area	16,753	14,996	17,380	2,384	20,967	5,971	3,587
Bothell City (part)	15,241	13,616	15,840	2,224	19,116	5,500	3,276
Unincorporated MUGA	1,512	1,380	1,540	160	1,851	471	311
Brier Area	426	388	564	176	495	107	(69)
Brier City	354	319	430	111	423	104	(7)
Unincorporated MUGA	72	69	134	65	72	3	(62)
Edmonds Area	11,934	11,835	12,604	769	14,812	2,977	2,208
Edmonds City	11,770	11,664	12,190	526	14,590	2,926	2,400
Unincorporated MUGA	164	171	414	243	222	51	(192)
Everett Area	95,200	98,989	137,715	38,726	151,739	52,750	14,024
Everett City	88,319	92,855	130,340	37,485	141,020	48,165	10,680
Unincorporated MUGA	6,881	6,134	7,375	1,241	10,719	4,585	3,344
Lynnwood Area	31,652	27,772	43,950	16,178	51,241	23,469	7,291
Lynnwood City	28,533	24,233	38,550	14,317	44,095	19,862	5,545
Unincorporated MUGA	3,119	3,539	5,400	1,861	7,146	3,607	1,746
Mill Creek Area	8,105	7,372	8,919	1,547	11,358	3,986	2,439
Mill Creek City	4,620	4,346	4,544	198	5,941	1,595	1,397
Unincorporated MUGA	3,485	3,026	4,375	1,349	5,417	2,391	1,042
Mountlake Terrace Area	7,377	6,740	8,059	1,319	10,263	3,523	2,204
Mountlake Terrace City	7,360	6,725	8,039	1,314	10,204	3,479	2,165
Unincorporated MUGA	17	15	20	5	59	44	39
Mukilteo Area	11,571	11,166	14,530	3,364	16,910	5,744	2,380
Mukilteo City	8,293	8,369	9,450	1,081	10,782	2,413	1,332
Unincorporated MUGA	3,278	2,797	5,080	2,283	6,128	3,331	1,048
Woodway Area	88	70	710	640	330	260	(380)
Woodway Town	71	56	90	34	71	15	(19)
Unincorporated MUGA	17	14	620	606	259	245	(361)
Paine Field Area (Uninc.)	3,666	4,622	8,847	4,225	8,246	3,624	(601)
Larch Way Overlap (Uninc.)	1,815	1,630	1,955	325	2,258	628	303
Lake Stickney Gap (Uninc.)	255	694	830	136	694	-	(136)
Norma Beach Gap (Uninc.) *	137	68	90	22			
Silver Firs Gap (Uninc.)	757	1,311	3,424	2,113	2,177	866	(1,247)

* - aka Meadowdale Gap

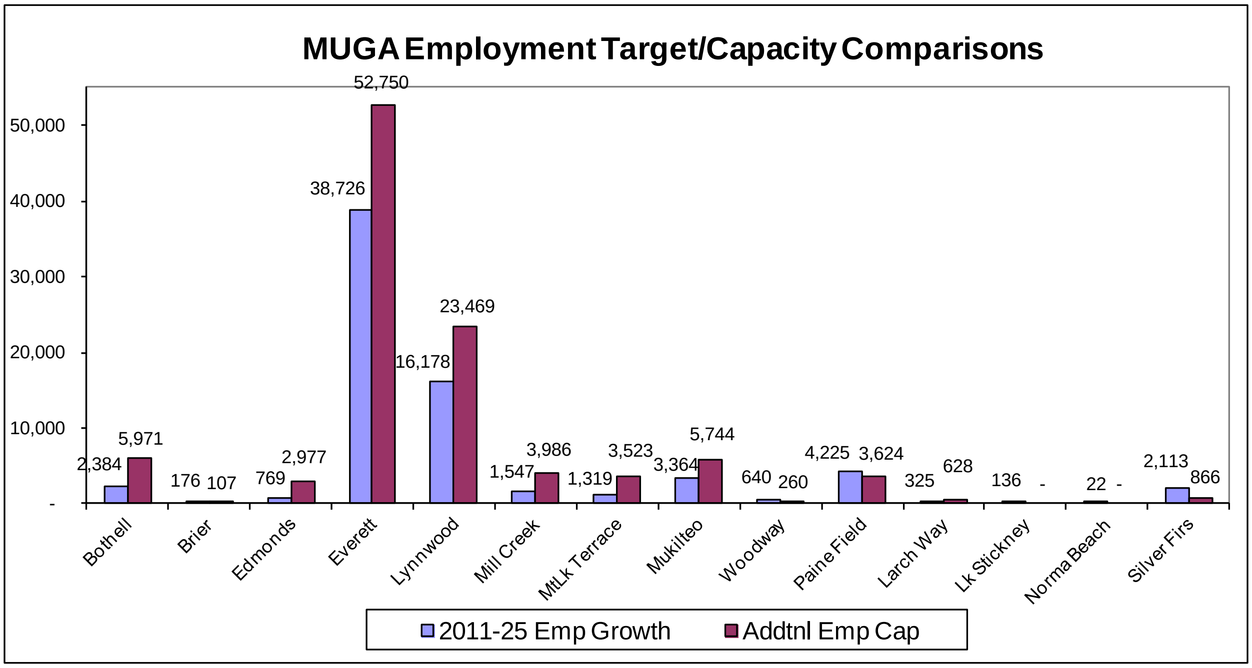
The following graph depicts the relationship between the employment growth targets and additional capacity at the large UGA level (includes cities):



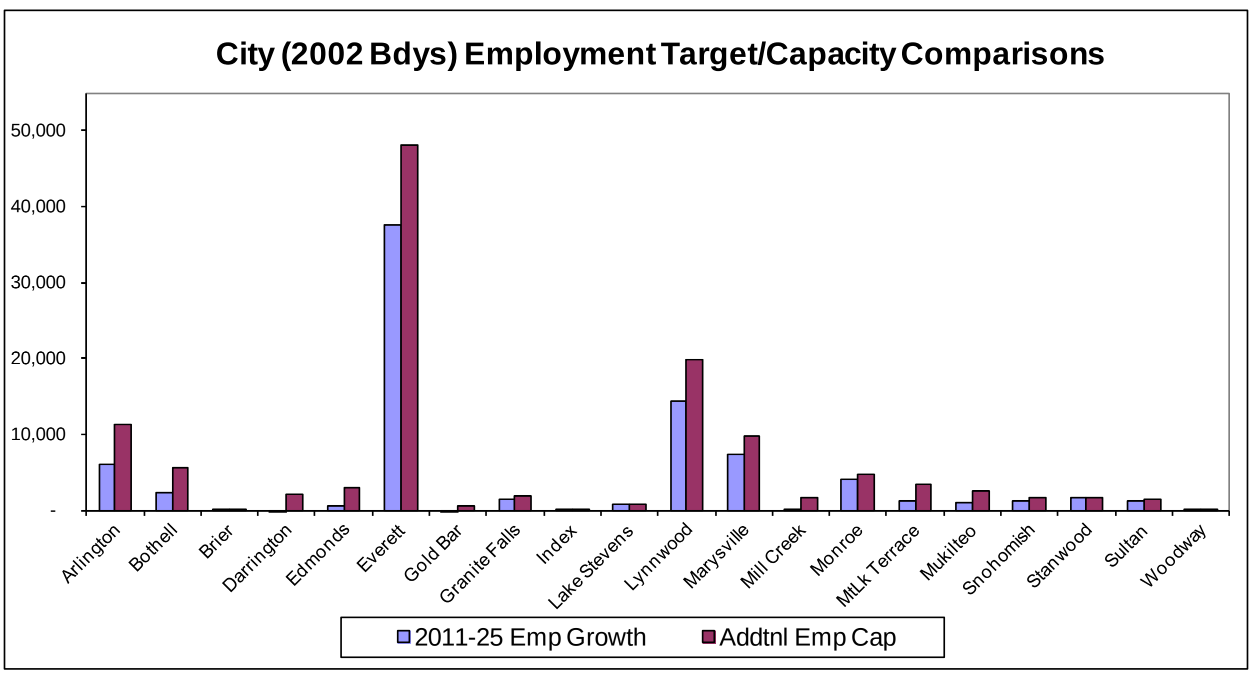
The following graph depicts the relationship between the employment growth targets and additional capacity for individual non-SW County UGAs (includes cities):



The following graph depicts the relationship between the employment growth targets and additional capacity for individual MUGAs (and gaps and overlaps) within the SW County UGA (includes cities):



The following graph depicts the relationship between the employment growth targets and additional capacity for individual cities (using April 2002 city boundaries):



Results by UGA

Figure Pop-J. Stanwood UGA Population

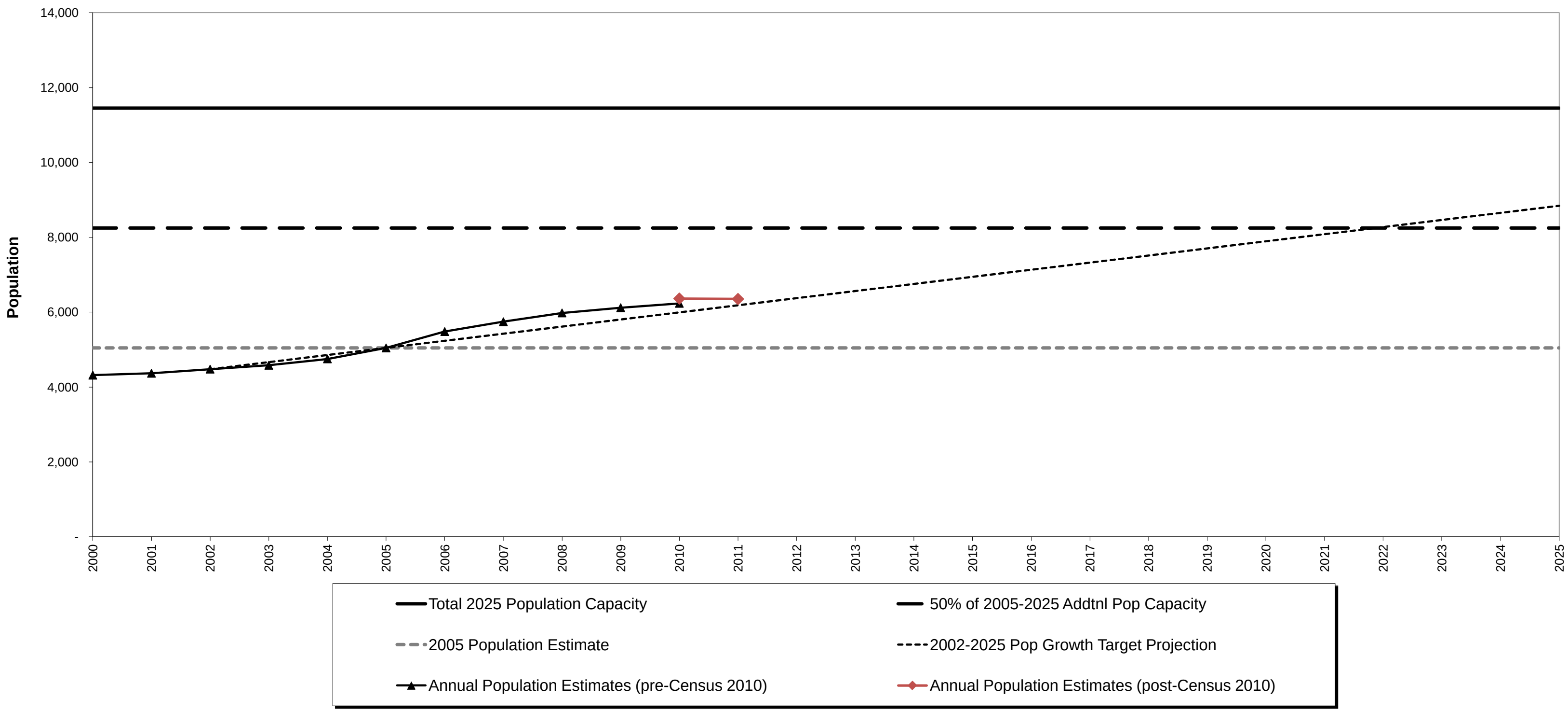


Table Pop-J. Stanwood UGA Population Statistics

	(A) Pre-Census 2010 Population Estimates 2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010 Census Pop	2010 Census Diff. (Census-Est) No.	2010 Census Diff. (Census-Est) Pct.	(B) Post-Census Pop Est 2011	(C) 2005-11 Numeric Change = (B) - (A)	(D) 2025 CPP Pop Target	2005-25 Numeric Change = (D) - (A)	(E) Total 2025 Pop Cap	(F) 2005-25 Addtnl Pop Cap = (E) - (A)	2005-11 Change as % of 2005-25 Addtnl Pop Cap = (C) / (F) *100
Stanwood UGA	4,318	4,369	4,479	4,582	4,753	5,046	5,483	5,746	5,981	6,121	6,237	6,364	127	2.0%	6,353	1,307	8,840	3,794	11,452	6,406	20.4%

Stanwood UGA - Additional Population Capacity

Jurisdiction	Land Status	Market Ready	Zone	Acres Total	Acres Unbuildable	Acres Buildable	Acres Surplus	Additional Housing Unit Capacity (before reductions) SF	(before reductions) MF	(before reductions) Sr. Apts.	(before reductions) Total	Additional Housing Unit Capacity (after reductions) SF	(after reductions) MF	(after reductions) Sr. Apts.	(after reductions) Total	Additional Population Capacity SF	MF	Sr. Apts.	Total
City (as of Apr-02)	(1) PENDING		GC	9.777	0.074	9.702	0	3	100	0	103	3	100	0	103	8	184	0	192
			SR 9.6	3.133	0.294	2.838	0	8	0	0	8	8	0	0	8	22	0	0	22
	Sum			12.909	0.369	12.541	0	11	100	0	111	11	100	0	111	31	184	0	215
	(2) VACANT		MR	6.863	3.015	3.848	0	5	46	11	62	4	37	9	50	11	68	10	90
			SR 12.4	0.776	0.07	0.705	0	3	0	0	3	2	0	0	2	7	0	0	7
			SR 5.0	15.209	0.321	14.888	0	2	143	0	145	2	115	0	117	4	212	0	217
			SR 7.0	3.723	1.554	2.169	0	9	0	0	9	7	0	0	7	20	0	0	20
			SR 9.6	1.138	0.156	0.983	0	5	0	0	5	4	0	0	4	11	0	0	11
		Sum		27.709	5.115	22.594	0	24	189	11	224	19	153	9	181	54	281	10	345
		MARKET-READY	GC	3.855	0.13	3.725	0	0	3	8	11	0	3	8	10	0	5	9	14
			MR	3.939	0.834	3.105	0	5	38	10	53	5	36	10	50	13	66	11	91
			SR 7.0	23.911	10.955	12.956	0	58	0	0	58	55	0	0	55	153	0	0	153
		Sum		31.705	11.919	19.786	0	63	41	18	122	60	39	17	116	167	72	20	258
	Sum			59.414	17.034	42.38	0	87	230	29	346	79	192	26	297	221	352	31	604
	(3) PARTUSE		SR 12.4	0.733	0	0.733	0.577	1	0	0	1	1	0	0	1	2	0	0	2
			SR 5.0	2.432	0	2.432	1.266	0	10	0	10	0	7	0	7	0	12	0	12
			SR 7.0	8.98	0.008	8.973	6.5	24	0	0	24	16	0	0	16	44	0	0	44
			SR 9.6	8.333	0.648	7.685	5.219	14	0	0	14	9	0	0	9	26	0	0	26
	Sum			20.479	0.656	19.823	13.563	39	10	0	49	26	7	0	33	72	12	0	84
	(4) REDEV		GC	2.421	0.536	1.885	0	0	1	4	5	0	1	3	3	0	1	3	4
			MR	10.139	2.572	7.566	0	2	90	23	115	1	60	15	76	4	110	18	132
			SR 5.0	0.826	0.261	0.565	0	-2	5	0	3	-1	3	0	2	-4	6	0	2
			SR 9.6	0.66	0	0.66	0	1	0	0	1	1	0	0	1	2	0	0	2
			TN	27.823	0	27.823	0	139	139	0	278	92	92	0	185	257	170	0	427
		Sum		41.869	3.369	38.499	0	140	235	27	402	93	156	18	267	259	288	21	568
		MARKET-READY	MR	0.387	0.231	0.156	0	0	1	0	1	0	1	0	1	0	2	0	2
		Sum		0.387	0.231	0.156	0	0	1	0	1	0	1	0	1	0	2	0	2
	Sum			42.256	3.6	38.656	0	140	236	27	403	93	157	18	268	259	289	21	570
City (as of Apr-02) Subtotal				**135.058**	**21.659**	**113.4**	**13.563**	**277**	**576**	**56**	**909**	**209**	**455**	**44**	**709**	**583**	**838**	**52**	**1472**
City (as of Dec-12) *	(1) PENDING		MR	1.381	0	1.381	0	0	24	0	24	0	24	0	24	0	44	0	44
			SR 7.0	2.538	0	2.538	0	13	0	0	13	13	0	0	13	36	0	0	36
			SR 9.6	63.702	26.426	37.276	0	242	0	0	242	242	0	0	242	674	0	0	674
	Sum			67.621	26.426	41.195	0	255	24	0	279	255	24	0	279	710	44	0	754
	(2) VACANT		SR 5.0	19.168	10.962	8.206	0	0	80	0	80	0	65	0	65	0	119	0	119
			SR 9.6	16.202	10.073	6.129	0	22	0	0	22	18	0	0	18	49	0	0	49
		Sum		35.37	21.035	14.335	0	22	80	0	102	18	65	0	82	49	119	0	168
		MARKET-READY	MR	5.268	3.203	2.065	0	3	25	7	35	3	24	7	33	8	44	8	59
			SR 9.6	18.017	11.202	6.815	0	25	0	0	25	24	0	0	24	66	0	0	66
		Sum		23.285	14.405	8.88	0	28	25	7	60	27	24	7	57	74	44	8	126
	Sum			58.655	35.44	23.215	0	50	105	7	162	44	88	7	139	124	163	8	294
	(3) PARTUSE		SR 7.0	0.913	0	0.913	0.548	2	0	0	2	1	0	0	1	4	0	0	4
			SR 9.6	70.059	10	60.06	53.23	170	0	0	170	113	0	0	113	315	0	0	315
	Sum			70.972	10	60.972	53.778	172	0	0	172	114	0	0	114	318	0	0	318
	(4) REDEV		MR	11.927	2.306	9.621	0	11	118	31	160	7	78	21	106	20	144	24	189

Stanwood UGA - Additional Population Capacity

Jurisdiction	Land Status	Market Ready	Zone	Acres				Additional Housing Unit Capacity (before reductions)				Additional Housing Unit Capacity (after reductions)				Additional Population Capacity			
				Total	Unbuildable	Buildable	Surplus	SF	MF	Sr. Apts.	Total	SF	MF	Sr. Apts.	Total	SF	MF	Sr. Apts.	Total
			SR 9.6	62.702	11.947	50.755	0	160	0	0	160	106	0	0	106	296	0	0	296
			TN	19.912	0	19.912	0	99	99	0	198	66	66	0	132	183	121	0	304
		Sum		94.541	14.253	80.288	0	270	217	31	518	180	144	21	344	500	266	24	790
		MARKET-READY	MR	3.272	0.379	2.893	0	3	35	8	46	3	33	8	44	8	61	9	78
		Sum		3.272	0.379	2.893	0	3	35	8	46	3	33	8	44	8	61	9	78
	Sum			97.812	14.632	83.181	0	273	252	39	564	182	178	28	388	508	327	33	868
City (as of Dec-12) Subtotal *				**295.06**	**86.496**	**208.564**	**53.778**	**750**	**381**	**46**	**1177**	**596**	**290**	**35**	**921**	**1660**	**533**	**41**	**2234**
* - outside of City Apr-2002 boundaries																			
Unincorporated	(2) VACANT		SR 9.6	68.47	15.428	53.042	0	178	0	0	178	144	0	0	144	400	0	0	400
		Sum		68.47	15.428	53.042	0	178	0	0	178	144	0	0	144	400	0	0	400
		MARKET-READY	MR	7.674	1.506	6.168	0	9	76	20	105	9	72	19	100	24	133	22	179
		Sum		7.674	1.506	6.168	0	9	76	20	105	9	72	19	100	24	133	22	179
	Sum			76.144	16.934	59.21	0	187	76	20	283	152	72	19	243	424	133	22	579
	(3) PARTUSE		SR 9.6	65.615	18.781	46.833	42.399	135	0	0	135	90	0	0	90	250	0	0	250
	Sum			65.615	18.781	46.833	42.399	135	0	0	135	90	0	0	90	250	0	0	250
	(4) REDEV		SR 9.6	118.807	37.387	81.419	0	268	0	0	268	178	0	0	178	496	0	0	496
		Sum		118.807	37.387	81.419	0	268	0	0	268	178	0	0	178	496	0	0	496
		MARKET-READY	GC	13.833	0.527	13.306	0	-1	17	36	52	-1	16	34	49	-3	30	40	67
		Sum		13.833	0.527	13.306	0	-1	17	36	52	-1	16	34	49	-3	30	40	67
	Sum			132.64	37.915	94.726	0	267	17	36	320	177	16	34	228	494	30	40	563
Unincorporated Subtotal				**274.399**	**73.63**	**200.769**	**42.399**	**589**	**93**	**56**	**738**	**419**	**88**	**53**	**561**	**1167**	**163**	**63**	**1393**
UGA Total				**704.517**	**181.785**	**522.733**	**109.74**	**1616**	**1050**	**158**	**2824**	**1224**	**833**	**132**	**2191**	**3410**	**1534**	**156**	**5099**

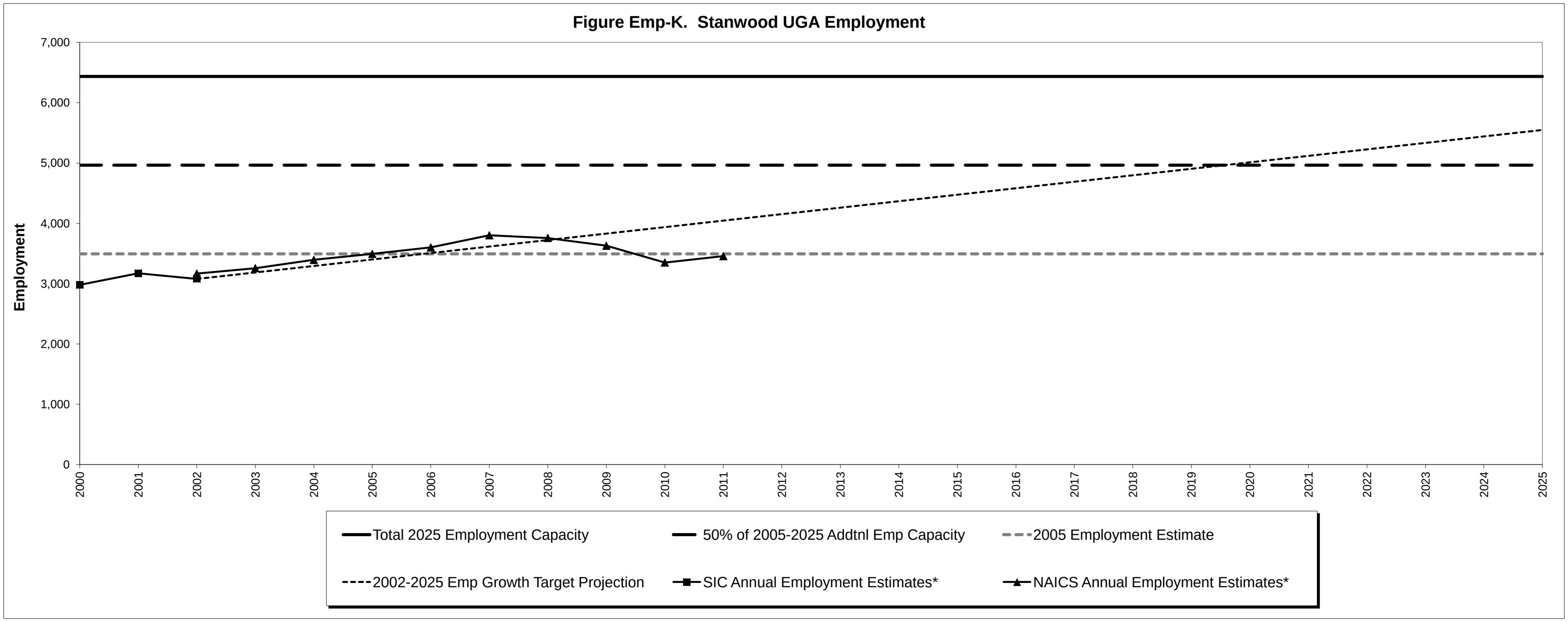


Table Emp-K. Stanwood UGA Employment Statistics

	(A) Employment Estimates 2000	2001	2002 SIC	2002 NAICS	2003	2004	2005	2006	2007	2008	2009	2010	(B) 2011	(C) 2005-11 Numeric Change = (B) - (A)	(D) 2025 CPP Emp Target	2005-25 Numeric Change = (D) - (A)	(E) Total 2025 Emp Cap	(F) 2005-25 Addtnl Emp Cap = (E) - (A)	2005-11 Change as % of 2005-25 Addtnl Emp Cap = (C) / (F) *100
Stanwood UGA	2,980	3,173	3,081	3,167	3,257	3,394	3,493	3,600	3,802	3,758	3,629	3,350	3,456	-37	5,550	2,057	6,434	2,941	-1.3%

* The State of Washington Employment Security Department now uses the NAICS system of classifying jobs to prepare its data, changing the way some jobs are categorized and resulting in slightly different UGA employment estimates than under the old SIC system. Data for 2002 is shown using both systems. In addition, beginning with the 2002 NAICS estimate, temporary workers have been incorporated into the estimates.

Stanwood UGA - Additional Employment Capacity

Jurisdiction	Land Status	Market Ready	Zone	Acres Total	Acres Unbuildable	Acres Buildable	Acres Surplus	Additional Employment Capacity Before Reductions	Additional Employment Capacity After Reductions
City (as of Apr-02)	(1) PENDING		MB2	0.488	0	0.488	0	11	11
		Sum		0.488	0	0.488	0	11	11
		MARKET-READY	MB2	0.679	0	0.679	0	53	53
		Sum		0.679	0	0.679	0	53	53
	Sum			1.167	0	1.167	0	64	64
	(2) VACANT		GI	29.057	10.14	18.916	0	404	326
			LI	15.513	3.79	11.723	0	251	203
			MB1	1.87	0.14	1.73	0	36	29
			MB2	3.579	0	3.579	0	82	66
		Sum		50.019	14.071	35.948	0	773	624
		MARKET-READY	GC	3.855	0.13	3.725	0	69	66
			MB2	5.852	1.119	4.733	0	108	103
		Sum		9.708	1.249	8.458	0	177	168
	Sum			59.726	15.32	44.407	0	950	792
	(3) PARTUSE		GC	2.08	0.029	2.051	0.607	13	9
			LI	14.112	3.675	10.436	2.088	45	30
			MB1	0.724	0	0.724	0.044	1	1
			MB2	0.799	0	0.799	0.505	12	8
	Sum			17.715	3.704	14.01	3.244	71	47
	(4) REDEV		GC	3.66	0.571	3.089	0	55	37
			GI	3.004	0.465	2.539	0	54	36
			LI	9.369	8.543	0.826	0	18	12
			MB1	7.281	0	7.281	0	133	88
			MB2	16.102	0	16.102	0	295	196
		Sum		39.416	9.578	29.837	0	555	369
		MARKET-READY	MB2	0.526	0	0.526	0	10	10
		Sum		0.526	0	0.526	0	10	10
	Sum			39.941	9.578	30.363	0	565	379

Stanwood UGA - Additional Employment Capacity

				Acres				Additional Employment Capacity	
Jurisdiction	Land Status	Market Ready	Zone	Total	Unbuildable	Buildable	Surplus	Before Reductions	After Reductions
City (as of Apr-02) Subtotal				**118.549**	**28.602**	**89.946**	**3.244**	**1650**	**1282**
City (as of Dec-12) *	(4) REDEV		NB	1.32	0	1.32	0	33	22
	Sum			1.32	0	1.32	0	33	22
City (as of Dec-12) Subtotal *				**1.32**	**0**	**1.32**	**0**	**33**	**22**
* - outside of City Apr-2002 boundaries									
Unincorporated	(2) VACANT		LI	14.001	12.335	1.665	0	36	29
	Sum			14.001	12.335	1.665	0	36	29
	(3) PARTUSE		UI	18.705	5.453	13.252	11.874	254	169
	Sum			18.705	5.453	13.252	11.874	254	169
	(4) REDEV		LI	6.812	0.809	6.004	0	122	81
			NB	1.941	0	1.941	0	56	37
			UI	7.582	2.8	4.783	0	102	68
		Sum		16.336	3.609	12.727	0	280	186
		MARKET-READY	GC	13.833	0.527	13.306	0	248	236
			LI	43.533	8.67	34.864	0	745	708
		Sum		57.367	9.197	48.17	0	993	943
	Sum			73.702	12.805	60.897	0	1273	1130
Unincorporated Subtotal				**106.408**	**30.594**	**75.814**	**11.874**	**1563**	**1328**
UGA Total				**226.277**	**59.196**	**167.08**	**15.118**	**3246**	**2632**

Stanwood UGA

Development History (1995 to 2010)

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)*											
SR-12400											
	Single Family	61.88	100%	167	2.70	2.70	-	-	-	-	-
SR-9600 ***(and both ULDR and UMDR)***											
	Single Family	119.31	100%	409	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	-	-	-	-	-
TN (Traditional Neighborhood)											
	Single Family	*New Zone -- No Development Yet*				5.00	-	-	-	-	-
	Multi-Family					5.00	-	-	-	-	-
	Total	**-**	**-**	**-**	**-**	**10.00**	**-**	**-**	**-**	**-**	**-**
MR (Multi-Family Residential)											
	Single Family	2.08	16%	21	1.62	1.62	-	-	-	-	-
	Multi-Family	8.56	66%	161	12.42	12.42	-	-	-	-	-
	Senior Apartments	2.32	18%	44	3.40	3.40	-	-	-	-	-
	Total	**12.96**	**100%**	**226**	**17.44**	**17.44**	**-**	**-**	**-**	**-**	**-**
General Commercial -- New Projects											
	Senior Apartments	4.03	10%	113	2.73	2.73	-	-	-	-	-
	Mixed Use	2.24	5%	54	1.30	1.30	15,290	0.16	37	0.88	0.88
	Non-Residential	35.19	85%	-	-	-	325,291	0.19	736	17.76	17.76
	Total	**41.46**	**100%**	**167**	**4.03**	**4.03**	**340,581**	**0.19**	**773**	**18.64**	**18.64**

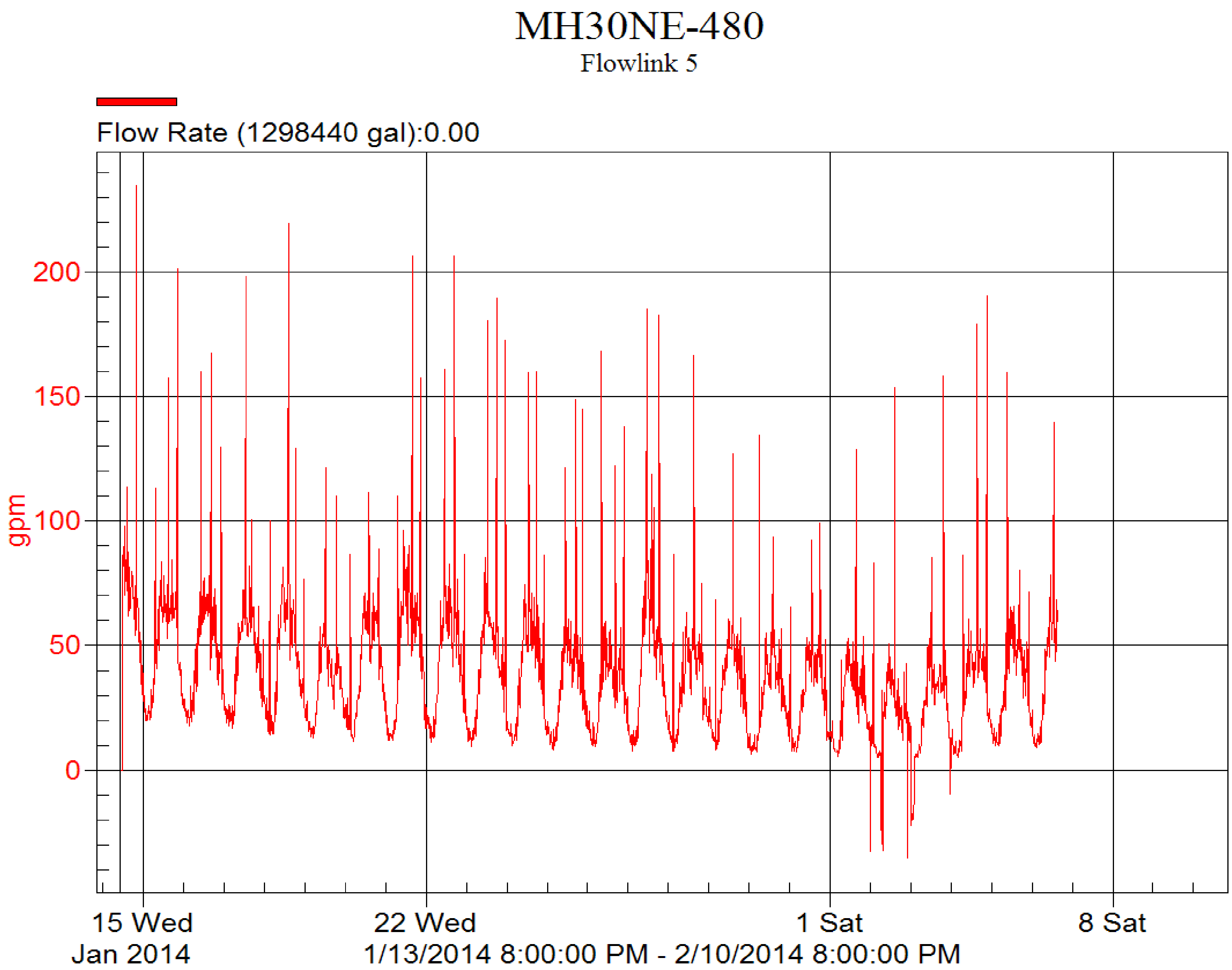
Stanwood UGA

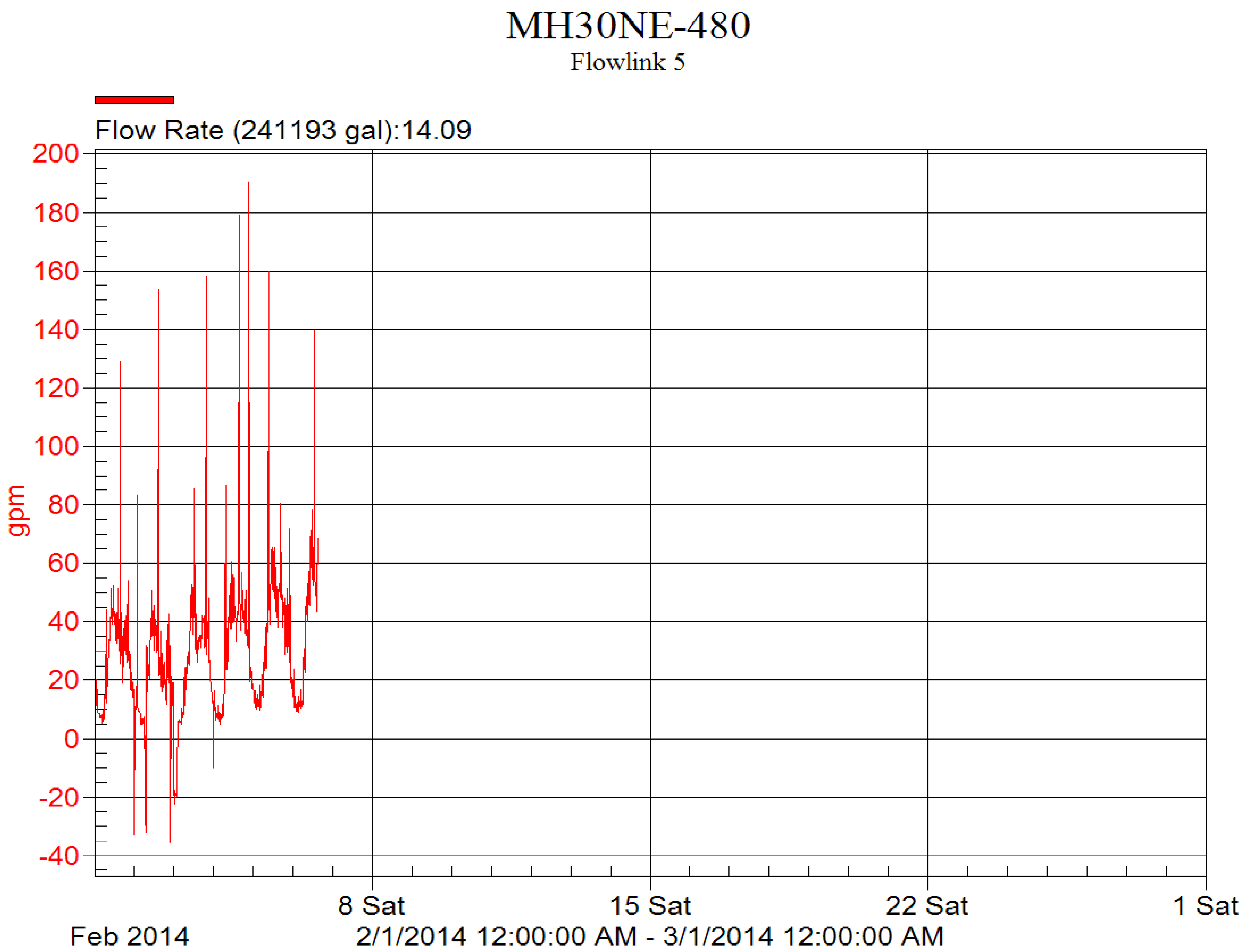
Development History (1995 to 2010)

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
General Commercial -- Infill (Modeled by removing senior apartments and mixed-use projects from the new projects list)											
	Non-Residential	35.19	100%	-	-	-	325,291	0.19	736	20.86	20.86
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									21.38
General Industrial -- (Excluding Twin City Foods Reconstruction)											
	Non-Residential	3.35	100%	-	-	-	37,570	0.26	28	8.25	21.38 (1)
1- 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-II (Mainstreet Business II)											
	Non-Residential	14.91	100%	-	-	-	162,946	0.25	342	22.96	22.96
NB (Neighborhood Business) *(and Urban Commercial)*											
	Non-Residential	1.01	100%	-	-	-	11,515	0.26	29	28.59	28.59

APPENDIX E

SYSTEM-WIDE FLOW MONITORING RESULTS

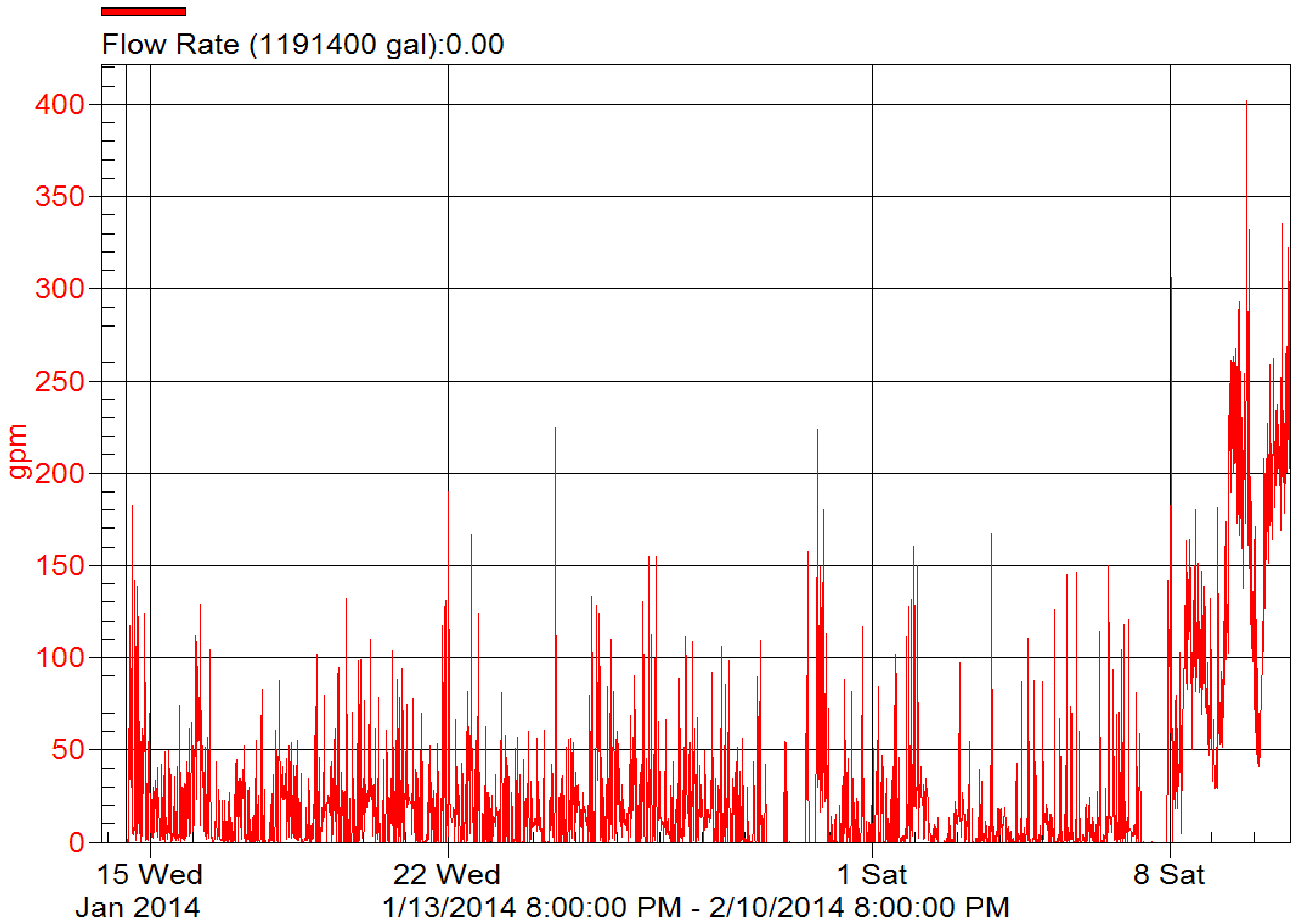

MH30NE-480
Flowlink 5
Flow Rate (1298440 gal):0.00
gpm
200
150
100
50
0
15 Wed
Jan 2014
22 Wed
1 Sat
8 Sat
1/13/2014 8:00:00 PM - 2/10/2014 8:00:00 PM



MH30NE-480
Flowlink 5
Flow Rate (241193 gal):14.09
200
180
160
140
120
100
80
60
40
20
0
-20
-40
gpm
8 Sat
15 Sat
22 Sat
1 Sat
Feb 2014
2/1/2014 12:00:00 AM - 3/1/2014 12:00:00 AM

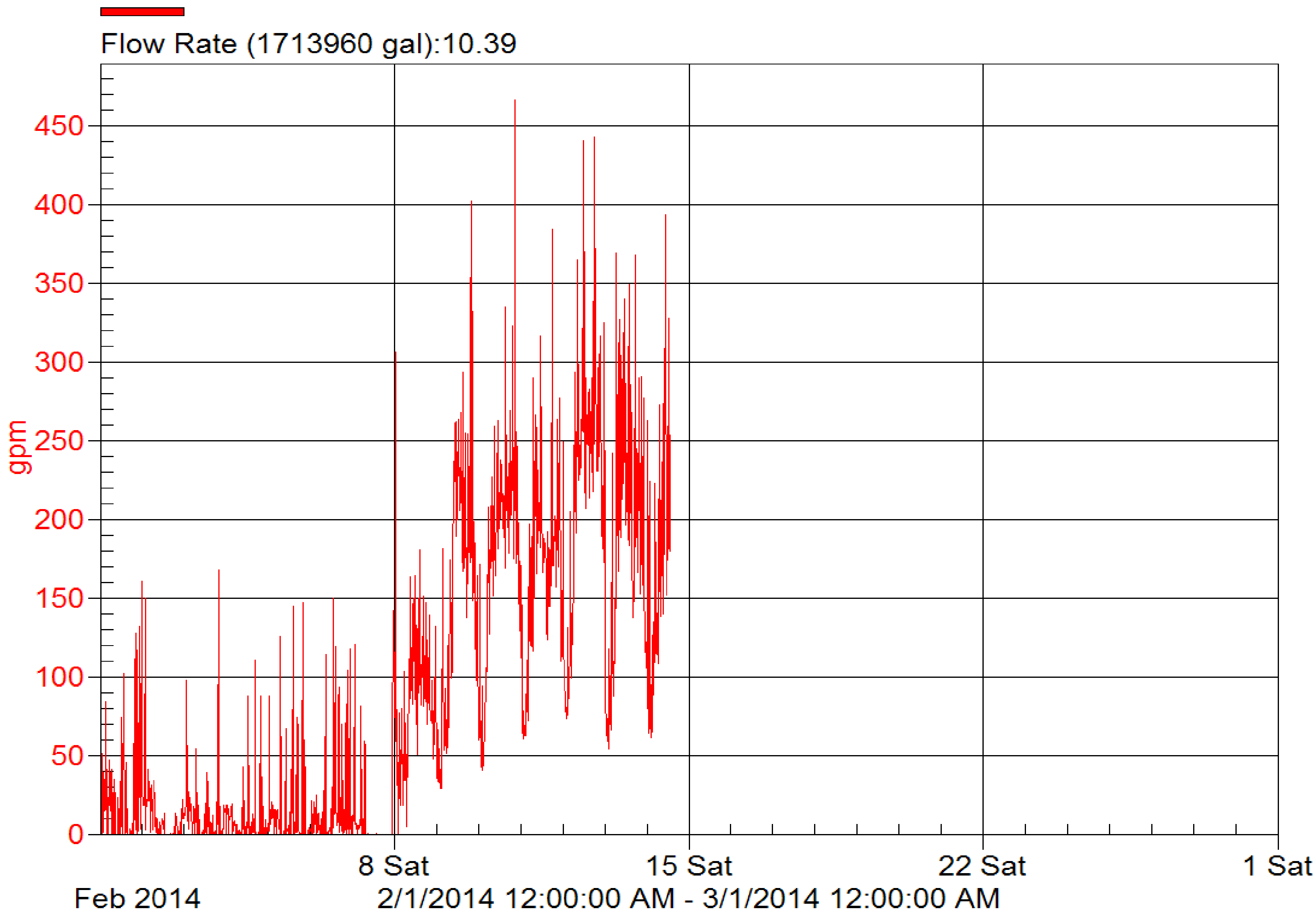
MH 19SW-230

Flowlink 5

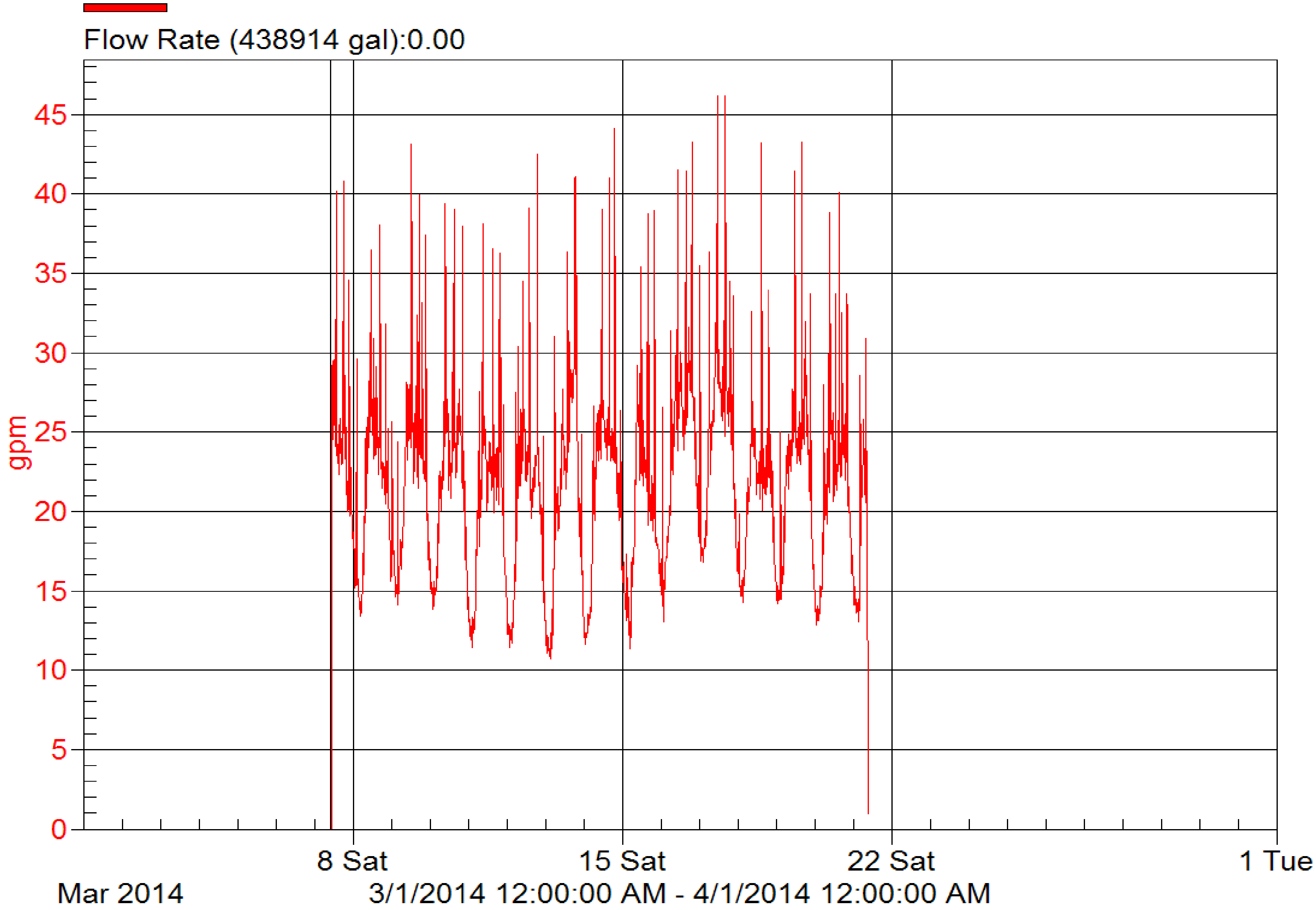


MH 19SW-230

Flowlink 5

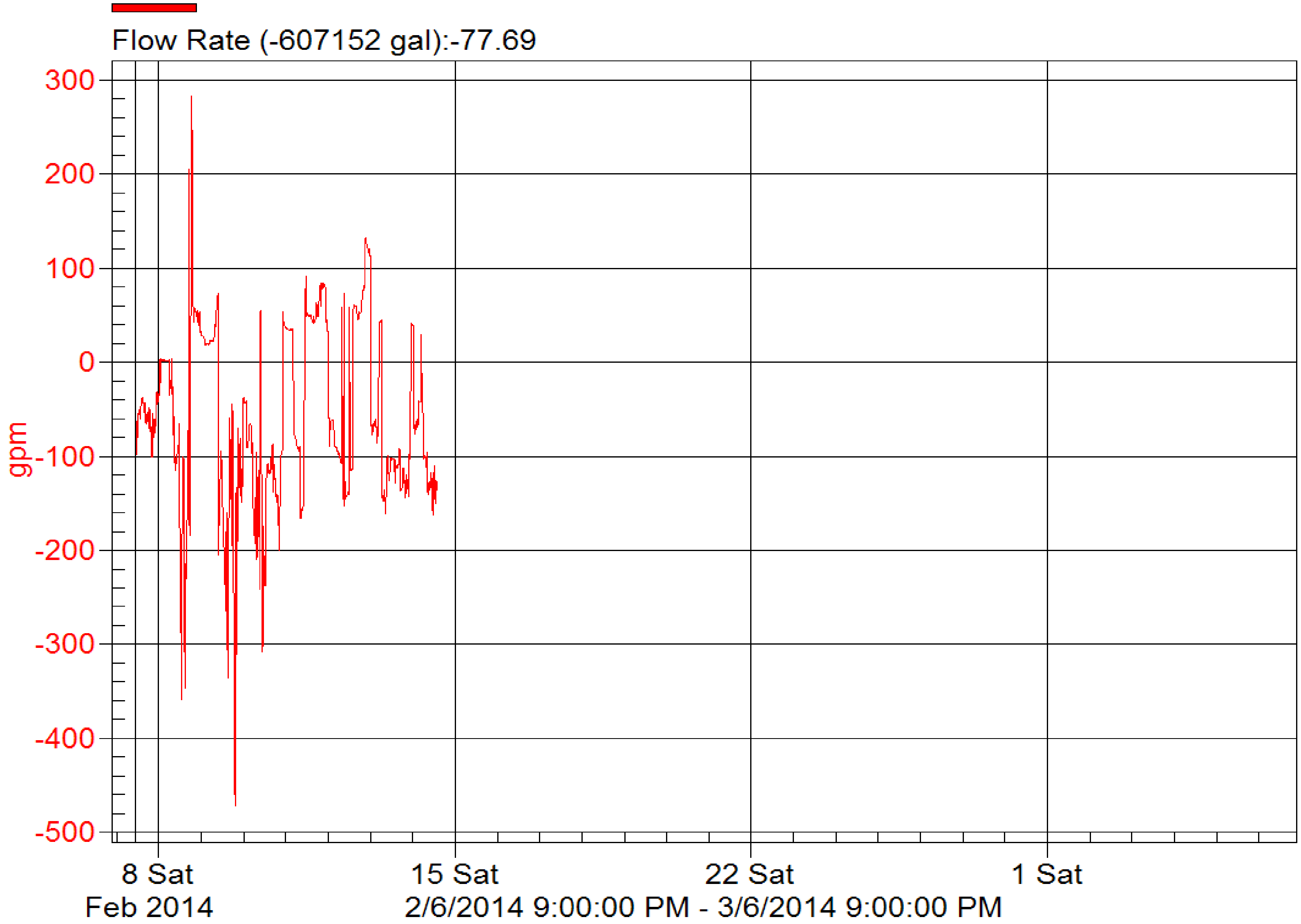


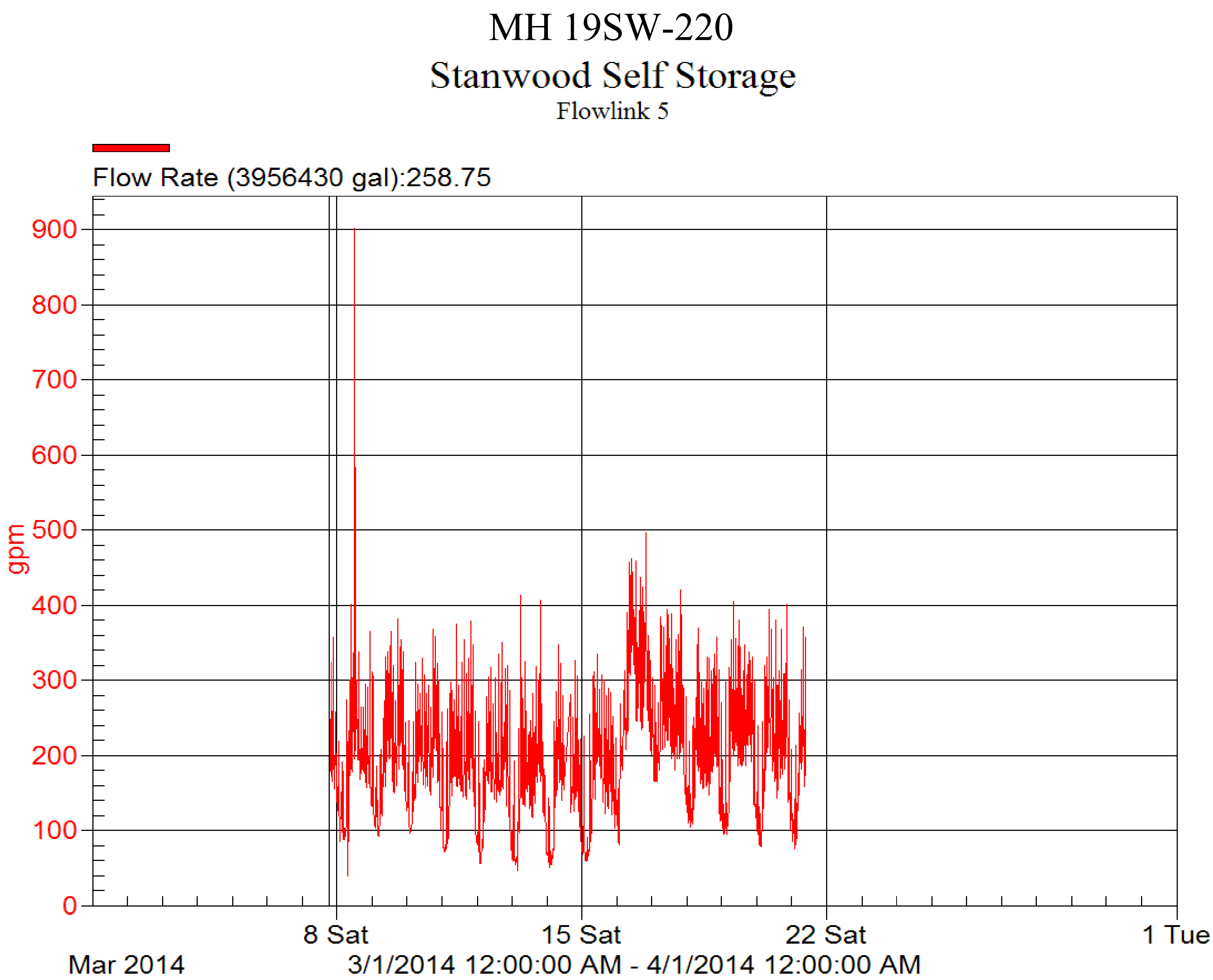
MH 19SW-230
North Star Side
Flowlink 5



MH 20SW-450

Flowlink 5

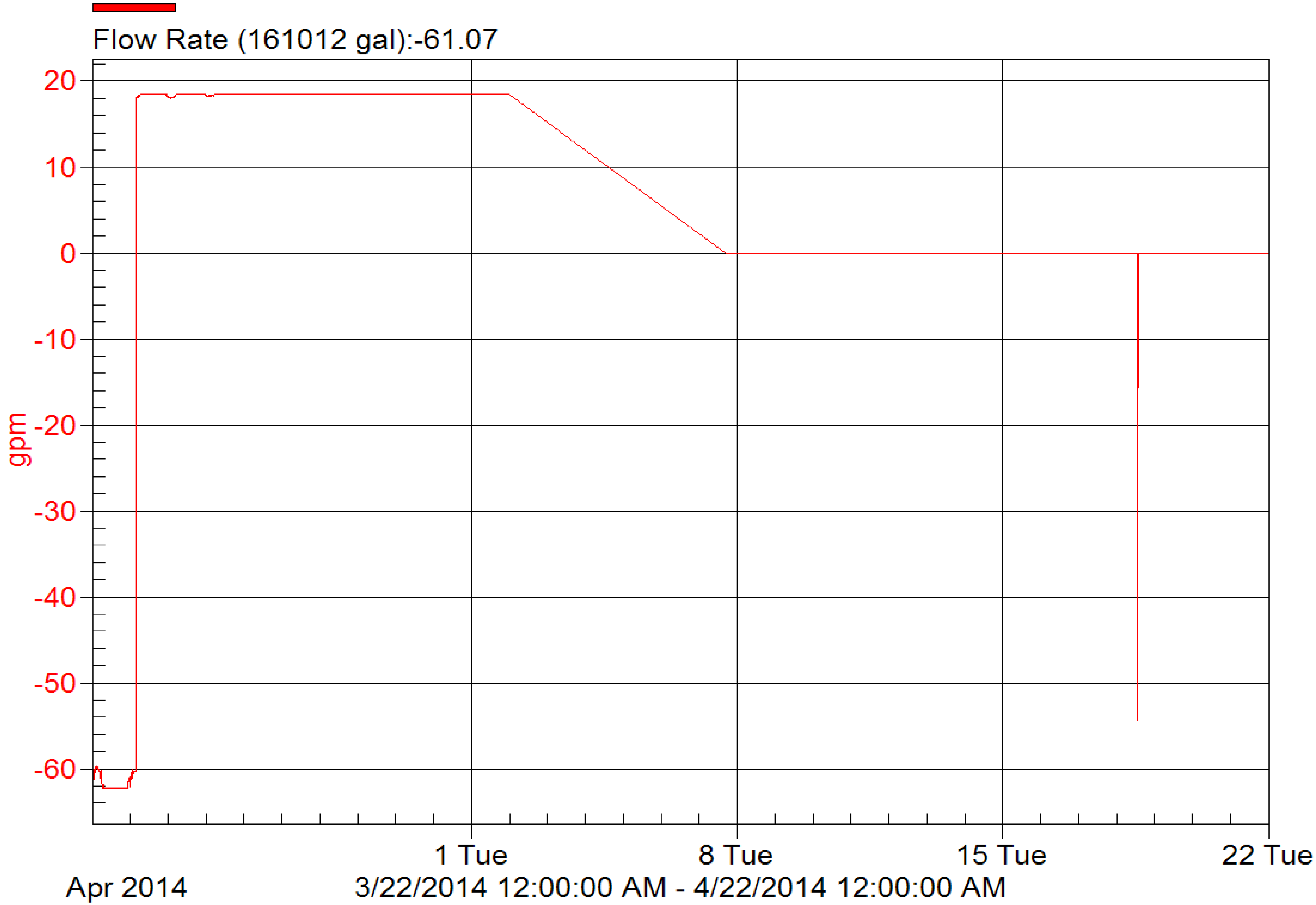




MH 19SW-220
Stanwood Self Storage
Flowlink 5
Flow Rate (3956430 gal):258.75
gpm
900
800
700
600
500
400
300
200
100
0
8 Sat
15 Sat
22 Sat
1 Tue
Mar 2014
3/1/2014 12:00:00 AM - 4/1/2014 12:00:00 AM

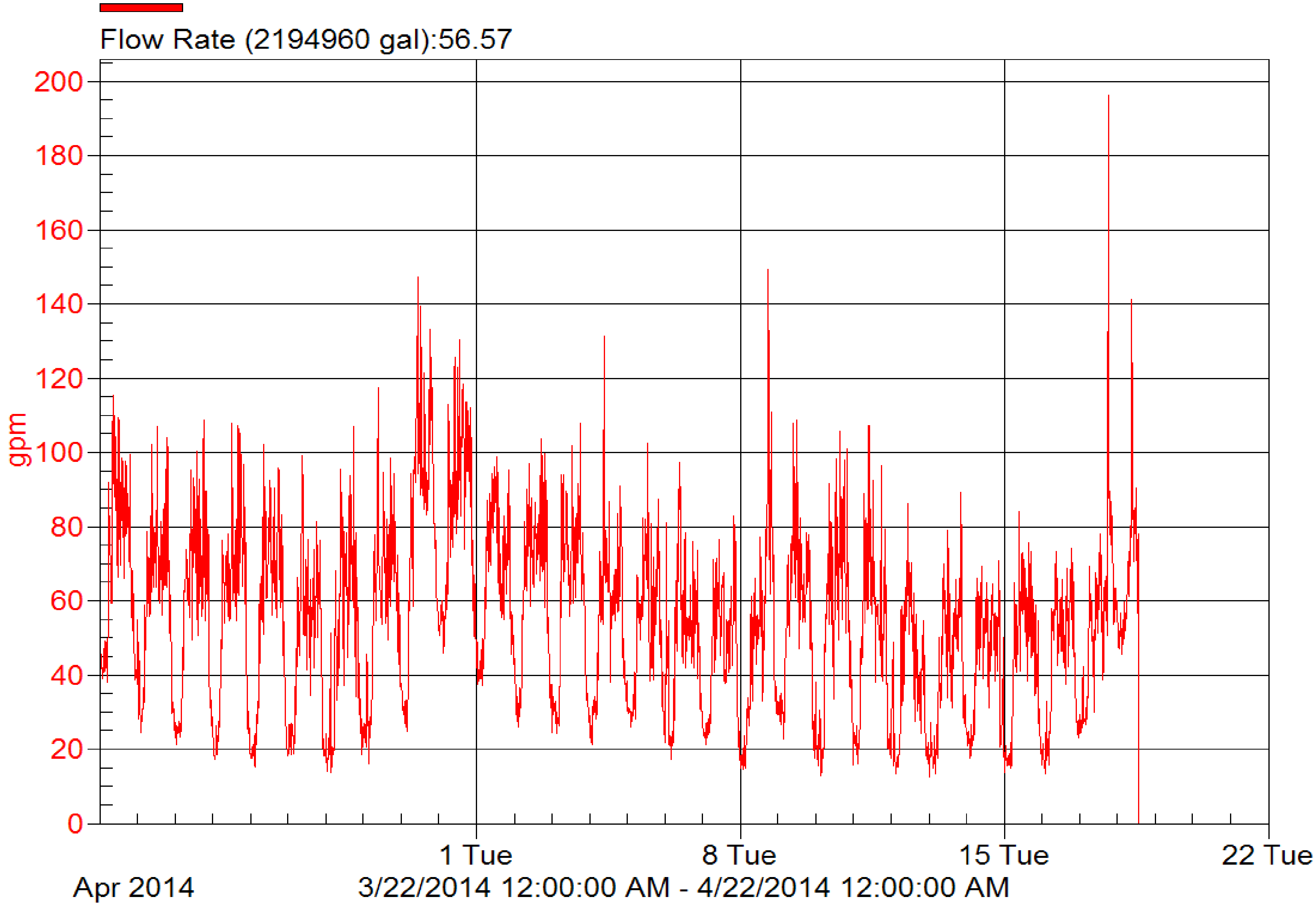
MH 24SE-200

Flowlink 5



MH 24SE-060

Flowlink 5



APPENDIX F

INFLOW AND INFILTRATION DATA

City of Stanwood
2014 Comprehensive Sewer System Plan
Appendix F - Inflow Data and Analyses

2009 population	6,073
2010 population	6,231
2011 population	6,220
2012 population	6,300
2013 population	6,340

(orange)	Max Inflow Day
(green)	Notable Rain Event (> 0.30 in.)

Max. Q_{res} for Inflow (gpcd)
275

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
2009					
1-Jan	0.95	0.20	0.074	0.88	144
2-Jan	0.84	0.04	0.074	0.77	126
3-Jan	0.73	0.00	0.074	0.66	108
4-Jan	0.72	0.00	0.074	0.65	106
5-Jan	0.81	0.28	0.074	0.74	121
6-Jan	1.14	0.24	0.074	1.07	176
7-Jan	1.58	0.98	0.074	1.51	248
8-Jan	1.48	0.41	0.074	1.41	232
9-Jan	1.30	0.15	0.074	1.23	202
10-Jan	1.29	0.10	0.074	1.22	200
11-Jan	1.28	0.76	0.074	1.21	199
12-Jan	1.02	0.16	0.074	0.95	156
13-Jan	0.89	0.08	0.074	0.82	134
14-Jan	0.81	0.00	0.074	0.74	121
15-Jan	0.76	0.00	0.074	0.69	113
16-Jan	0.70	0.00	0.074	0.63	103
17-Jan	0.64	0.00	0.074	0.57	93
18-Jan	0.60	0.00	0.074	0.53	87
19-Jan	0.61	0.00	0.074	0.54	88
20-Jan	0.58	0.00	0.074	0.51	83
21-Jan	0.57	0.00	0.074	0.50	82
22-Jan	0.57	0.00	0.074	0.50	82
23-Jan	0.56	0.00	0.074	0.49	80
24-Jan	0.54	0.00	0.074	0.47	77
25-Jan	0.52	0.07	0.074	0.45	73
26-Jan	0.53	0.01	0.074	0.46	75
27-Jan	0.53	0.00	0.074	0.46	75
28-Jan	0.53	0.01	0.074	0.46	75
29-Jan	0.51	0.01	0.074	0.44	72
30-Jan	0.54	0.00	0.074	0.47	77
31-Jan	0.50	0.01	0.074	0.43	70
1-Feb	0.50	0.00	0.074	0.43	70
2-Feb	0.50	0.01	0.074	0.43	70
3-Feb	0.52	0.00	0.074	0.45	73
4-Feb	0.49	0.00	0.074	0.42	69
5-Feb	0.49	0.00	0.074	0.42	69
6-Feb	0.52	0.05	0.074	0.45	73
7-Feb	0.49	0.08	0.074	0.42	69
8-Feb	0.50	0.00	0.074	0.43	70

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
9-Feb	0.53	0.15	0.074	0.46	75
10-Feb	0.52	0.01	0.074	0.45	73
11-Feb	0.54	0.07	0.074	0.47	77
12-Feb	0.50	0.00	0.074	0.43	70
13-Feb	0.49	0.00	0.074	0.42	69
14-Feb	0.48	0.00	0.074	0.41	67
15-Feb	0.49	0.00	0.074	0.42	69
16-Feb	0.53	0.21	0.074	0.46	75
17-Feb	0.51	0.01	0.074	0.44	72
18-Feb	0.48	0.00	0.074	0.41	67
19-Feb	0.49	0.00	0.074	0.42	69
20-Feb	0.48	0.00	0.074	0.41	67
21-Feb	0.47	0.00	0.074	0.40	65
22-Feb	0.51	0.01	0.074	0.44	72
23-Feb	0.52	0.26	0.074	0.45	73
24-Feb	0.54	0.08	0.074	0.47	77
25-Feb	0.55	0.01	0.074	0.48	78
26-Feb	0.56	0.28	0.074	0.49	80
27-Feb	0.54	0.01	0.074	0.47	77
28-Feb	0.50	0.00	0.074	0.43	70
1-Mar	0.53	0.03	0.074	0.46	75
2-Mar	0.61	0.27	0.074	0.54	88
3-Mar	0.57	0.05	0.074	0.50	82
4-Mar	0.55	0.00	0.074	0.48	78
5-Mar	0.58	0.17	0.074	0.51	83
6-Mar	0.56	0.00	0.074	0.49	80
7-Mar	0.52	0.00	0.074	0.45	73
8-Mar	0.56	0.10	0.074	0.49	80
9-Mar	0.57	0.00	0.074	0.50	82
10-Mar	0.53	0.00	0.074	0.46	75
11-Mar	0.53	0.00	0.074	0.46	75
12-Mar	0.51	0.00	0.074	0.44	72
13-Mar	0.51	0.00	0.074	0.44	72
14-Mar	0.53	0.02	0.074	0.46	75
15-Mar	0.55	0.18	0.074	0.48	78
16-Mar	0.52	0.03	0.074	0.45	73
17-Mar	0.51	0.00	0.074	0.44	72
18-Mar	0.52	0.00	0.074	0.45	73
19-Mar	0.54	0.09	0.074	0.47	77
20-Mar	0.52	0.06	0.074	0.45	73
21-Mar	0.51	0.00	0.074	0.44	72
22-Mar	0.49	0.00	0.074	0.42	69
23-Mar	0.52	0.08	0.074	0.45	73
24-Mar	0.51	0.07	0.074	0.44	72
25-Mar	0.59	0.18	0.074	0.52	85
26-Mar	0.55	0.08	0.074	0.48	78
27-Mar	0.52	0.05	0.074	0.45	73
28-Mar	0.57	0.02	0.074	0.50	82
29-Mar	0.60	0.36	0.074	0.53	87

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
30-Mar	0.58	0.00	0.074	0.51	83
31-Mar	0.64	0.28	0.074	0.57	93
1-Apr	0.78	0.04	0.074	0.71	116
2-Apr	0.95	0.83	0.074	0.88	144
3-Apr	0.82	0.22	0.074	0.75	123
4-Apr	0.68	0.00	0.074	0.61	100
5-Apr	0.60	0.00	0.074	0.53	87
6-Apr	0.57	0.00	0.074	0.50	82
7-Apr	0.55	0.00	0.074	0.48	78
8-Apr	0.53	0.00	0.074	0.46	75
9-Apr	0.52	0.00	0.074	0.45	73
10-Apr	0.52	0.00	0.074	0.45	73
11-Apr	0.52	0.00	0.074	0.45	73
12-Apr	0.55	0.08	0.074	0.48	78
13-Apr	0.59	0.21	0.074	0.52	85
14-Apr	0.56	0.06	0.074	0.49	80
15-Apr	0.54	0.00	0.074	0.47	77
16-Apr	0.54	0.00	0.074	0.47	77
17-Apr	0.64	0.29	0.074	0.57	93
18-Apr	0.55	0.08	0.074	0.48	78
19-Apr	0.54	0.00	0.074	0.47	77
20-Apr	0.54	0.00	0.074	0.47	77
21-Apr	0.52	0.00	0.074	0.45	73
22-Apr	0.52	0.03	0.074	0.45	73
23-Apr	0.50	0.00	0.074	0.43	70
24-Apr	0.50	0.00	0.074	0.43	70
25-Apr	0.49	0.00	0.074	0.42	69
26-Apr	0.50	0.10	0.074	0.43	70
27-Apr	0.51	0.00	0.074	0.44	72
28-Apr	0.49	0.02	0.074	0.42	69
29-Apr	0.49	0.00	0.074	0.42	69
30-Apr	0.49	0.00	0.074	0.42	69
1-May	0.49	0.00	0.074	0.42	69
2-May	0.48	0.00	0.074	0.41	67
3-May	0.47	0.11	0.074	0.40	65
4-May	0.50	0.00	0.074	0.43	70
5-May	0.58	0.14	0.074	0.51	83
6-May	0.60	0.46	0.074	0.53	87
7-May	0.66	0.58	0.074	0.59	97
8-May	0.57	0.00	0.074	0.50	82
9-May	0.52	0.00	0.074	0.45	73
10-May	0.50	0.00	0.074	0.43	70
11-May	0.55	0.10	0.074	0.48	78
12-May	0.67	0.42	0.074	0.60	98
13-May	0.59	0.02	0.074	0.52	85
14-May	0.60	0.25	0.074	0.53	87
15-May	0.55	0.00	0.074	0.48	78
16-May	0.51	0.00	0.074	0.44	72
17-May	0.52	0.00	0.074	0.45	73

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
18-May	0.55	0.00	0.074	0.48	78
19-May	0.68	0.57	0.074	0.61	100
20-May	0.59	0.09	0.074	0.52	85
21-May	0.58	0.01	0.074	0.51	83
22-May	0.54	0.00	0.074	0.47	77
23-May	0.50	0.00	0.074	0.43	70
24-May	0.47	0.00	0.074	0.40	65
25-May	0.53	0.00	0.074	0.46	75
26-May	0.51	0.00	0.074	0.44	72
27-May	0.51	0.00	0.074	0.44	72
28-May	0.49	0.00	0.074	0.42	69
29-May	0.48	0.00	0.074	0.41	67
30-May	0.47	0.00	0.074	0.40	65
31-May	0.47	0.00	0.074	0.40	65
1-Jun	0.49	0.00	0.074	0.42	69
2-Jun	0.47	0.00	0.074	0.40	65
3-Jun	0.49	0.00	0.074	0.42	69
4-Jun	0.49	0.00	0.074	0.42	69
5-Jun	0.47	0.00	0.074	0.40	65
6-Jun	0.45	0.00	0.074	0.38	62
7-Jun	0.47	0.00	0.074	0.40	65
8-Jun	0.47	0.00	0.074	0.40	65
9-Jun	0.47	0.00	0.074	0.40	65
10-Jun	0.48	0.00	0.074	0.41	67
11-Jun	0.46	0.00	0.074	0.39	64
12-Jun	0.47	0.00	0.074	0.40	65
13-Jun	0.44	0.00	0.074	0.37	60
14-Jun	0.44	0.00	0.074	0.37	60
15-Jun	0.48	0.00	0.074	0.41	67
16-Jun	0.46	0.00	0.074	0.39	64
17-Jun	0.45	0.00	0.074	0.38	62
18-Jun	0.44	0.00	0.074	0.37	60
19-Jun	0.44	0.03	0.074	0.37	60
20-Jun	0.43	0.06	0.074	0.36	59
21-Jun	0.42	0.02	0.074	0.35	57
22-Jun	0.43	0.00	0.074	0.36	59
23-Jun	0.44	0.00	0.074	0.37	60
24-Jun	0.43	0.00	0.074	0.36	59
25-Jun	0.43	0.02	0.074	0.36	59
26-Jun	0.42	0.01	0.074	0.35	57
27-Jun	0.41	0.00	0.074	0.34	55
28-Jun	0.42	0.00	0.074	0.35	57
29-Jun	0.44	0.00	0.074	0.37	60
30-Jun	0.44	0.00	0.074	0.37	60
1-Jul	0.44	0.00	0.074	0.37	60
2-Jul	0.43	0.00	0.074	0.36	59
3-Jul	0.42	0.00	0.074	0.35	57
4-Jul	0.37	0.00	0.074	0.30	49
5-Jul	0.41	0.00	0.074	0.34	55

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
6-Jul	0.42	0.00	0.074	0.35	57
7-Jul	0.44	0.03	0.074	0.37	60
8-Jul	0.43	0.00	0.074	0.36	59
9-Jul	0.44	0.00	0.074	0.37	60
10-Jul	0.43	0.00	0.074	0.36	59
11-Jul	0.42	0.00	0.074	0.35	57
12-Jul	0.43	0.02	0.074	0.36	59
13-Jul	0.46	0.06	0.074	0.39	64
14-Jul	0.43	0.00	0.074	0.36	59
15-Jul	0.43	0.00	0.074	0.36	59
16-Jul	0.45	0.00	0.074	0.38	62
17-Jul	0.42	0.00	0.074	0.35	57
18-Jul	0.42	0.00	0.074	0.35	57
19-Jul	0.42	0.00	0.074	0.35	57
20-Jul	0.44	0.00	0.074	0.37	60
21-Jul	0.43	0.00	0.074	0.36	59
22-Jul	0.44	0.00	0.074	0.37	60
23-Jul	0.42	0.00	0.074	0.35	57
24-Jul	0.44	0.00	0.074	0.37	60
25-Jul	0.44	0.04	0.074	0.37	60
26-Jul	0.42	0.01	0.074	0.35	57
27-Jul	0.47	0.00	0.074	0.40	65
28-Jul	0.46	0.00	0.074	0.39	64
29-Jul	0.44	0.00	0.074	0.37	60
30-Jul	0.44	0.00	0.074	0.37	60
31-Jul	0.44	0.00	0.074	0.37	60
1-Aug	0.43	0.00	0.074	0.36	59
2-Aug	0.44	0.00	0.074	0.37	60
3-Aug	0.44	0.00	0.074	0.37	60
4-Aug	0.44	0.00	0.074	0.37	60
5-Aug	0.43	0.00	0.074	0.36	59
6-Aug	0.43	0.00	0.074	0.36	59
7-Aug	0.42	0.00	0.074	0.35	57
8-Aug	0.42	0.01	0.074	0.35	57
9-Aug	0.44	0.00	0.074	0.37	60
10-Aug	0.43	0.00	0.074	0.36	59
11-Aug	0.46	0.21	0.074	0.39	64
12-Aug	0.45	0.15	0.074	0.38	62
13-Aug	0.45	0.00	0.074	0.38	62
14-Aug	0.42	0.01	0.074	0.35	57
15-Aug	0.41	0.00	0.074	0.34	55
16-Aug	0.42	0.00	0.074	0.35	57
17-Aug	0.48	0.00	0.074	0.41	67
18-Aug	0.42	0.00	0.074	0.35	57
19-Aug	0.43	0.00	0.074	0.36	59
20-Aug	0.43	0.00	0.074	0.36	59
21-Aug	0.41	0.00	0.074	0.34	55
22-Aug	0.42	0.00	0.074	0.35	57
23-Aug	0.42	0.00	0.074	0.35	57

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
24-Aug	0.43	0.00	0.074	0.36	59
25-Aug	0.43	0.00	0.074	0.36	59
26-Aug	0.44	0.00	0.074	0.37	60
27-Aug	0.44	0.00	0.074	0.37	60
28-Aug	0.44	0.00	0.074	0.37	60
29-Aug	0.42	0.00	0.074	0.35	57
30-Aug	0.44	0.00	0.074	0.37	60
31-Aug	0.45	0.00	0.074	0.38	62
1-Sep	0.45	0.00	0.074	0.38	62
2-Sep	0.46	0.05	0.074	0.39	64
3-Sep	0.45	0.16	0.074	0.38	62
4-Sep	0.44	0.00	0.074	0.37	60
5-Sep	0.43	0.06	0.074	0.36	59
6-Sep	0.48	0.16	0.074	0.41	67
7-Sep	0.46	0.39	0.074	0.39	64
8-Sep	0.45	0.00	0.074	0.38	62
9-Sep	0.45	0.01	0.074	0.38	62
10-Sep	0.45	0.00	0.074	0.38	62
11-Sep	0.43	0.00	0.074	0.36	59
12-Sep	0.40	0.00	0.074	0.33	54
13-Sep	0.43	0.00	0.074	0.36	59
14-Sep	0.44	0.00	0.074	0.37	60
15-Sep	0.44	0.00	0.074	0.37	60
16-Sep	0.44	0.00	0.074	0.37	60
17-Sep	0.45	0.00	0.074	0.38	62
18-Sep	0.43	0.00	0.074	0.36	59
19-Sep	0.50	0.55	0.074	0.43	70
20-Sep	0.46	0.06	0.074	0.39	64
21-Sep	0.46	0.00	0.074	0.39	64
22-Sep	0.43	0.00	0.074	0.36	59
23-Sep	0.44	0.00	0.074	0.37	60
24-Sep	0.44	0.00	0.074	0.37	60
25-Sep	0.42	0.00	0.074	0.35	57
26-Sep	0.42	0.00	0.074	0.35	57
27-Sep	0.43	0.00	0.074	0.36	59
28-Sep	0.46	0.00	0.074	0.39	64
29-Sep	0.48	0.71	0.074	0.41	67
30-Sep	0.49	0.32	0.074	0.42	69
1-Oct	0.45	0.00	0.074	0.38	62
2-Oct	0.46	0.23	0.074	0.39	64
3-Oct	0.44	0.00	0.074	0.37	60
4-Oct	0.43	0.00	0.074	0.36	59
5-Oct	0.44	0.00	0.074	0.37	60
6-Oct	0.46	0.00	0.074	0.39	64
7-Oct	0.44	0.00	0.074	0.37	60
8-Oct	0.45	0.00	0.074	0.38	62
9-Oct	0.44	0.00	0.074	0.37	60
10-Oct	0.44	0.00	0.074	0.37	60
11-Oct	0.42	0.00	0.074	0.35	57

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
12-Oct	0.48	0.00	0.074	0.41	67
13-Oct	0.46	0.00	0.074	0.39	64
14-Oct	0.49	0.14	0.074	0.42	69
15-Oct	0.45	0.24	0.074	0.38	62
16-Oct	0.50	0.08	0.074	0.43	70
17-Oct	1.34	2.50	0.074	1.27	208
18-Oct	0.65	0.46	0.074	0.58	95
19-Oct	0.57	0.05	0.074	0.50	82
20-Oct	0.54	0.00	0.074	0.47	77
21-Oct	0.53	0.05	0.074	0.46	75
22-Oct	0.50	0.11	0.074	0.43	70
23-Oct	0.76	0.58	0.074	0.69	113
24-Oct	1.15	0.12	0.074	1.08	177
25-Oct	0.59	0.00	0.074	0.52	85
26-Oct	1.22	1.23	0.074	1.15	189
27-Oct	0.77	0.22	0.074	0.70	115
28-Oct	0.66	0.00	0.074	0.59	97
29-Oct	0.75	0.22	0.074	0.68	111
30-Oct	0.75	0.32	0.074	0.68	111
31-Oct	0.81	0.42	0.074	0.74	121
1-Nov	0.67	0.03	0.074	0.60	98
2-Nov	0.62	0.00	0.074	0.55	90
3-Nov	0.58	0.02	0.074	0.51	83
4-Nov	0.55	0.00	0.074	0.48	78
5-Nov	0.57	0.00	0.074	0.50	82
6-Nov	0.56	0.19	0.074	0.49	80
7-Nov	0.55	0.03	0.074	0.48	78
8-Nov	0.54	0.13	0.074	0.47	77
9-Nov	0.66	0.02	0.074	0.59	97
10-Nov	0.62	0.34	0.074	0.55	90
11-Nov	0.69	0.20	0.074	0.62	101
12-Nov	0.57	0.00	0.074	0.50	82
13-Nov	0.59	0.04	0.074	0.52	85
14-Nov	0.53	0.08	0.074	0.46	75
15-Nov	0.56	0.13	0.074	0.49	80
16-Nov	0.91	0.01	0.074	0.84	138
17-Nov	0.96	1.10	0.074	0.89	146
18-Nov	0.78	0.06	0.074	0.71	116
19-Nov	0.87	0.27	0.074	0.80	131
20-Nov	0.80	0.22	0.074	0.73	120
21-Nov	0.82	0.23	0.074	0.75	123
22-Nov	1.13	0.43	0.074	1.06	174
23-Nov	0.89	0.37	0.074	0.82	134
24-Nov	0.76	0.04	0.074	0.69	113
25-Nov	0.72	0.01	0.074	0.65	106
26-Nov	1.28	0.95	0.074	1.21	199
27-Nov	0.84	0.04	0.074	0.77	126
28-Nov	0.71	0.01	0.074	0.64	105
29-Nov	0.66	0.03	0.074	0.59	97

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
30-Nov	0.67	0.02	0.074	0.60	98
1-Dec	0.62	0.09	0.074	0.55	90
2-Dec	0.62	0.00	0.074	0.55	90
3-Dec	0.59	0.00	0.074	0.52	85
4-Dec	0.59	0.00	0.074	0.52	85
5-Dec	0.56	0.00	0.074	0.49	80
6-Dec	0.58	0.00	0.074	0.51	83
7-Dec	0.55	0.00	0.074	0.48	78
8-Dec	0.54	0.00	0.074	0.47	77
9-Dec	0.54	0.00	0.074	0.47	77
10-Dec	0.52	0.00	0.074	0.45	73
11-Dec	0.50	0.00	0.074	0.43	70
12-Dec	0.48	0.00	0.074	0.41	67
13-Dec	0.47	0.00	0.074	0.40	65
14-Dec	0.52	0.22	0.074	0.45	73
15-Dec	0.55	0.10	0.074	0.48	78
16-Dec	0.56	0.11	0.074	0.49	80
17-Dec	0.55	0.03	0.074	0.48	78
18-Dec	0.53	0.00	0.074	0.46	75
19-Dec	0.63	0.25	0.074	0.56	92
20-Dec	0.68	0.25	0.074	0.61	100
21-Dec	0.89	0.05	0.074	0.82	134
22-Dec	0.97	0.84	0.074	0.90	148
23-Dec	0.74	0.00	0.074	0.67	110
24-Dec	0.66	0.00	0.074	0.59	97
25-Dec	0.55	0.00	0.074	0.48	78
26-Dec	0.56	0.00	0.074	0.49	80
27-Dec	0.53	0.00	0.074	0.46	75
28-Dec	0.53	0.02	0.074	0.46	75
29-Dec	0.53	0.00	0.074	0.46	75
30-Dec	0.52	0.04	0.074	0.45	73
31-Dec	0.53	0.00	0.074	0.46	75
2010					
1-Jan	0.51	0.14	0.074	0.44	70
2-Jan	0.50	0.01	0.074	0.43	68
3-Jan	0.54	0.01	0.074	0.47	75
4-Jan	0.90	0.36	0.074	0.83	133
5-Jan	1.26	0.95	0.074	1.19	190
6-Jan	0.93	0.29	0.074	0.86	137
7-Jan	0.76	0.00	0.074	0.69	110
8-Jan	0.87	0.27	0.074	0.80	128
9-Jan	0.81	0.25	0.074	0.74	118
10-Jan	0.71	0.00	0.074	0.64	102
11-Jan	0.70	0.01	0.074	0.63	100
12-Jan	0.75	0.25	0.074	0.68	109
13-Jan	0.70	0.03	0.074	0.63	100
14-Jan	0.70	0.13	0.074	0.63	100
15-Jan	0.70	0.00	0.074	0.63	100
16-Jan	0.63	0.12	0.074	0.56	89

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
17-Jan	0.66	0.13	0.074	0.59	94
18-Jan	0.68	0.09	0.074	0.61	97
19-Jan	0.64	0.00	0.074	0.57	91
20-Jan	0.60	0.00	0.074	0.53	84
21-Jan	0.59	0.00	0.074	0.52	83
22-Jan	0.56	0.00	0.074	0.49	78
23-Jan	0.52	0.00	0.074	0.45	72
24-Jan	0.51	0.00	0.074	0.44	70
25-Jan	0.55	0.10	0.074	0.48	76
26-Jan	0.52	0.00	0.074	0.45	72
27-Jan	0.52	0.00	0.074	0.45	72
28-Jan	0.53	0.00	0.074	0.46	73
29-Jan	0.51	0.00	0.074	0.44	70
30-Jan	0.56	0.21	0.074	0.49	78
31-Jan	0.55	0.14	0.074	0.48	76
1-Feb	0.55	0.02	0.074	0.48	76
2-Feb	0.56	0.08	0.074	0.49	78
3-Feb	0.55	0.00	0.074	0.48	76
4-Feb	0.54	0.05	0.074	0.47	75
5-Feb	0.55	0.07	0.074	0.48	76
6-Feb	0.53	0.00	0.074	0.46	73
7-Feb	0.55	0.07	0.074	0.48	76
8-Feb	0.58	0.14	0.074	0.51	81
9-Feb	0.55	0.01	0.074	0.48	76
10-Feb	0.53	0.00	0.074	0.46	73
11-Feb	0.56	0.09	0.074	0.49	78
12-Feb	0.58	0.07	0.074	0.51	81
13-Feb	0.54	0.09	0.074	0.47	75
14-Feb	0.70	0.24	0.074	0.63	100
15-Feb	0.67	0.28	0.074	0.60	96
16-Feb	0.62	0.13	0.074	0.55	88
17-Feb	0.62	0.03	0.074	0.55	88
18-Feb	0.58	0.00	0.074	0.51	81
19-Feb	0.57	0.00	0.074	0.50	80
20-Feb	0.53	0.00	0.074	0.46	73
21-Feb	0.52	0.00	0.074	0.45	72
22-Feb	0.52	0.00	0.074	0.45	72
23-Feb	0.52	0.00	0.074	0.45	72
24-Feb	0.57	0.19	0.074	0.50	80
25-Feb	0.52	0.02	0.074	0.45	72
26-Feb	0.52	0.00	0.074	0.45	72
27-Feb	0.54	0.17	0.074	0.47	75
28-Feb	0.50	0.03	0.074	0.43	68
1-Mar	0.51	0.00	0.074	0.44	70
2-Mar	0.52	0.00	0.074	0.45	72
3-Mar	0.50	0.03	0.074	0.43	68
4-Mar	0.50	0.00	0.074	0.43	68
5-Mar	0.47	0.00	0.074	0.40	64
6-Mar	0.49	0.00	0.074	0.42	67

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
7-Mar	0.50	0.00	0.074	0.43	68
8-Mar	0.52	0.17	0.074	0.45	72
9-Mar	0.49	0.00	0.074	0.42	67
10-Mar	0.48	0.03	0.074	0.41	65
11-Mar	0.48	0.07	0.074	0.41	65
12-Mar	0.64	0.34	0.074	0.57	91
13-Mar	0.54	0.00	0.074	0.47	75
14-Mar	0.52	0.04	0.074	0.45	72
15-Mar	0.54	0.03	0.074	0.47	75
16-Mar	0.52	0.00	0.074	0.45	72
17-Mar	0.57	0.03	0.074	0.50	80
18-Mar	0.51	0.00	0.074	0.44	70
19-Mar	0.51	0.00	0.074	0.44	70
20-Mar	0.50	0.00	0.074	0.43	68
21-Mar	0.50	0.08	0.074	0.43	68
22-Mar	0.57	0.13	0.074	0.50	80
23-Mar	0.54	0.00	0.074	0.47	75
24-Mar	0.49	0.00	0.074	0.42	67
25-Mar	0.56	0.20	0.074	0.49	78
26-Mar	0.72	0.15	0.074	0.65	104
27-Mar	0.57	0.00	0.074	0.50	80
28-Mar	0.61	0.07	0.074	0.54	86
29-Mar	0.57	0.09	0.074	0.50	80
30-Mar	0.57	0.13	0.074	0.50	80
31-Mar	0.57	0.01	0.074	0.50	80
1-Apr	0.54	0.00	0.074	0.47	75
2-Apr	0.59	0.01	0.074	0.52	83
3-Apr	0.58	0.24	0.074	0.51	81
4-Apr	0.52	0.01	0.074	0.45	72
5-Apr	0.56	0.02	0.074	0.49	78
6-Apr	0.64	0.29	0.074	0.57	91
7-Apr	0.63	0.18	0.074	0.56	89
8-Apr	0.73	0.31	0.074	0.66	105
9-Apr	0.64	0.02	0.074	0.57	91
10-Apr	0.58	0.00	0.074	0.51	81
11-Apr	0.56	0.00	0.074	0.49	78
12-Apr	0.55	0.00	0.074	0.48	76
13-Apr	0.54	0.04	0.074	0.47	75
14-Apr	0.52	0.02	0.074	0.45	72
15-Apr	0.52	0.00	0.074	0.45	72
16-Apr	0.52	0.00	0.074	0.45	72
17-Apr	0.48	0.00	0.074	0.41	65
18-Apr	0.50	0.03	0.074	0.43	68
19-Apr	0.51	0.00	0.074	0.44	70
20-Apr	0.51	0.07	0.074	0.44	70
21-Apr	0.89	0.88	0.074	0.82	131
22-Apr	0.68	0.27	0.074	0.61	97
23-Apr	0.61	0.00	0.074	0.54	86
24-Apr	0.57	0.08	0.074	0.50	80

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
25-Apr	0.59	0.12	0.074	0.52	83
26-Apr	0.61	0.42	0.074	0.54	86
27-Apr	0.71	0.10	0.074	0.64	102
28-Apr	0.63	0.06	0.074	0.56	89
29-Apr	0.58	0.00	0.074	0.51	81
30-Apr	0.56	0.10	0.074	0.49	78
1-May	0.55	0.08	0.074	0.48	76
2-May	0.59	0.22	0.074	0.52	83
3-May	0.67	0.00	0.074	0.60	96
4-May	0.59	0.00	0.074	0.52	83
5-May	0.57	0.00	0.074	0.50	80
6-May	0.54	0.00	0.074	0.47	75
7-May	0.53	0.00	0.074	0.46	73
8-May	0.50	0.00	0.074	0.43	68
9-May	0.49	0.00	0.074	0.42	67
10-May	0.51	0.00	0.074	0.44	70
11-May	0.49	0.00	0.074	0.42	67
12-May	0.48	0.00	0.074	0.41	65
13-May	0.48	0.00	0.074	0.41	65
14-May	0.48	0.00	0.074	0.41	65
15-May	0.45	0.00	0.074	0.38	60
16-May	0.46	0.00	0.074	0.39	62
17-May	0.47	0.00	0.074	0.40	64
18-May	0.48	0.04	0.074	0.41	65
19-May	0.52	0.06	0.074	0.45	72
20-May	0.50	0.35	0.074	0.43	68
21-May	0.48	0.00	0.074	0.41	65
22-May	0.45	0.00	0.074	0.38	60
23-May	0.48	0.21	0.074	0.41	65
24-May	0.49	0.00	0.074	0.42	67
25-May	0.47	0.00	0.074	0.40	64
26-May	0.49	0.30	0.074	0.42	67
27-May	0.54	0.03	0.074	0.47	75
28-May	1.28	1.46	0.074	1.21	194
29-May	0.98	0.46	0.074	0.91	145
30-May	0.76	0.17	0.074	0.69	110
31-May	0.75	0.14	0.074	0.68	109
1-Jun	0.73	0.19	0.074	0.66	105
2-Jun	0.83	0.38	0.074	0.76	121
3-Jun	0.70	0.02	0.074	0.63	100
4-Jun	0.70	0.16	0.074	0.63	100
5-Jun	0.62	0.02	0.074	0.55	88
6-Jun	0.63	0.05	0.074	0.56	89
7-Jun	0.63	0.24	0.074	0.56	89
8-Jun	0.59	0.01	0.074	0.52	83
9-Jun	0.89	0.72	0.074	0.82	131
10-Jun	0.70	0.01	0.074	0.63	100
11-Jun	0.63	0.06	0.074	0.56	89
12-Jun	0.58	0.00	0.074	0.51	81

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
13-Jun	0.55	0.00	0.074	0.48	76
14-Jun	0.54	0.00	0.074	0.47	75
15-Jun	0.52	0.01	0.074	0.45	72
16-Jun	0.56	0.19	0.074	0.49	78
17-Jun	0.53	0.02	0.074	0.46	73
18-Jun	0.50	0.00	0.074	0.43	68
19-Jun	0.48	0.00	0.074	0.41	65
20-Jun	0.50	0.01	0.074	0.43	68
21-Jun	0.52	0.13	0.074	0.45	72
22-Jun	0.52	0.00	0.074	0.45	72
23-Jun	0.51	0.00	0.074	0.44	70
24-Jun	0.51	0.00	0.074	0.44	70
25-Jun	0.48	0.00	0.074	0.41	65
26-Jun	0.46	0.00	0.074	0.39	62
27-Jun	0.47	0.00	0.074	0.40	64
28-Jun	0.50	0.01	0.074	0.43	68
29-Jun	0.46	0.00	0.074	0.39	62
30-Jun	0.47	0.12	0.074	0.40	64
1-Jul	0.45	0.00	0.074	0.38	60
2-Jul	0.45	0.02	0.074	0.38	60
3-Jul	0.43	0.00	0.074	0.36	57
4-Jul	0.39	0.00	0.074	0.32	51
5-Jul	0.45	0.00	0.074	0.38	60
6-Jul	0.44	0.01	0.074	0.37	59
7-Jul	0.44	0.00	0.074	0.37	59
8-Jul	0.43	0.00	0.074	0.36	57
9-Jul	0.43	0.00	0.074	0.36	57
10-Jul	0.45	0.00	0.074	0.38	60
11-Jul	0.44	0.00	0.074	0.37	59
12-Jul	0.46	0.00	0.074	0.39	62
13-Jul	0.45	0.01	0.074	0.38	60
14-Jul	0.43	0.00	0.074	0.36	57
15-Jul	0.43	0.00	0.074	0.36	57
16-Jul	0.43	0.00	0.074	0.36	57
17-Jul	0.40	0.00	0.074	0.33	52
18-Jul	0.42	0.00	0.074	0.35	56
19-Jul	0.43	0.00	0.074	0.36	57
20-Jul	0.42	0.00	0.074	0.35	56
21-Jul	0.41	0.00	0.074	0.34	54
22-Jul	0.42	0.00	0.074	0.35	56
23-Jul	0.43	0.00	0.074	0.36	57
24-Jul	0.41	0.00	0.074	0.34	54
25-Jul	0.41	0.00	0.074	0.34	54
26-Jul	0.43	0.00	0.074	0.36	57
27-Jul	0.43	0.00	0.074	0.36	57
28-Jul	0.43	0.00	0.074	0.36	57
29-Jul	0.42	0.00	0.074	0.35	56
30-Jul	0.43	0.00	0.074	0.36	57
31-Jul	0.41	0.00	0.074	0.34	54

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
1-Aug	0.41	0.00	0.074	0.34	54
2-Aug	0.42	0.00	0.074	0.35	56
3-Aug	0.41	0.00	0.074	0.34	54
4-Aug	0.41	0.00	0.074	0.34	54
5-Aug	0.41	0.00	0.074	0.34	54
6-Aug	0.41	0.00	0.074	0.34	54
7-Aug	0.43	0.00	0.074	0.36	57
8-Aug	0.46	0.55	0.074	0.39	62
9-Aug	0.42	0.00	0.074	0.35	56
10-Aug	0.42	0.05	0.074	0.35	56
11-Aug	0.42	0.00	0.074	0.35	56
12-Aug	0.42	0.00	0.074	0.35	56
13-Aug	0.41	0.00	0.074	0.34	54
14-Aug	0.39	0.00	0.074	0.32	51
15-Aug	0.41	0.00	0.074	0.34	54
16-Aug	0.43	0.00	0.074	0.36	57
17-Aug	0.43	0.00	0.074	0.36	57
18-Aug	0.43	0.00	0.074	0.36	57
19-Aug	0.43	0.00	0.074	0.36	57
20-Aug	0.43	0.00	0.074	0.36	57
21-Aug	0.41	0.00	0.074	0.34	54
22-Aug	0.42	0.07	0.074	0.35	56
23-Aug	0.44	0.00	0.074	0.37	59
24-Aug	0.43	0.00	0.074	0.36	57
25-Aug	0.44	0.00	0.074	0.37	59
26-Aug	0.44	0.00	0.074	0.37	59
27-Aug	0.44	0.17	0.074	0.37	59
28-Aug	0.41	0.00	0.074	0.34	54
29-Aug	0.41	0.00	0.074	0.34	54
30-Aug	0.43	0.00	0.074	0.36	57
31-Aug	0.55	0.06	0.074	0.48	76
1-Sep	0.52	0.94	0.074	0.45	72
2-Sep	0.48	0.00	0.074	0.41	65
3-Sep	0.47	0.00	0.074	0.40	64
4-Sep	0.43	0.00	0.074	0.36	57
5-Sep	0.40	0.00	0.074	0.33	52
6-Sep	0.52	0.08	0.074	0.45	72
7-Sep	0.56	0.68	0.074	0.49	78
8-Sep	0.49	0.01	0.074	0.42	67
9-Sep	0.47	0.00	0.074	0.40	64
10-Sep	0.46	0.02	0.074	0.39	62
11-Sep	0.43	0.01	0.074	0.36	57
12-Sep	0.44	0.01	0.074	0.37	59
13-Sep	0.45	0.03	0.074	0.38	60
14-Sep	0.46	0.00	0.074	0.39	62
15-Sep	0.45	0.00	0.074	0.38	60
16-Sep	0.48	0.06	0.074	0.41	65
17-Sep	0.47	0.27	0.074	0.40	64
18-Sep	0.52	0.34	0.074	0.45	72

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
19-Sep	0.58	0.49	0.074	0.51	81
20-Sep	0.57	0.02	0.074	0.50	80
21-Sep	0.54	0.33	0.074	0.47	75
22-Sep	0.49	0.01	0.074	0.42	67
23-Sep	0.47	0.05	0.074	0.40	64
24-Sep	0.49	0.10	0.074	0.42	67
25-Sep	0.44	0.00	0.074	0.37	59
26-Sep	0.51	0.33	0.074	0.44	70
27-Sep	0.48	0.00	0.074	0.41	65
28-Sep	0.48	0.07	0.074	0.41	65
29-Sep	0.48	0.02	0.074	0.41	65
30-Sep	0.47	0.01	0.074	0.40	64
1-Oct	0.46	0.00	0.074	0.39	62
2-Oct	0.43	0.00	0.074	0.36	57
3-Oct	0.44	0.00	0.074	0.37	59
4-Oct	0.46	0.00	0.074	0.39	62
5-Oct	0.47	0.00	0.074	0.40	64
6-Oct	0.44	0.00	0.074	0.37	59
7-Oct	0.46	0.00	0.074	0.39	62
8-Oct	0.46	0.00	0.074	0.39	62
9-Oct	0.49	0.16	0.074	0.42	67
10-Oct	0.55	0.62	0.074	0.48	76
11-Oct	0.49	0.00	0.074	0.42	67
12-Oct	0.48	0.00	0.074	0.41	65
13-Oct	0.45	0.00	0.074	0.38	60
14-Oct	0.45	0.00	0.074	0.38	60
15-Oct	0.44	0.00	0.074	0.37	59
16-Oct	0.43	0.00	0.074	0.36	57
17-Oct	0.46	0.00	0.074	0.39	62
18-Oct	0.45	0.00	0.074	0.38	60
19-Oct	0.46	0.00	0.074	0.39	62
20-Oct	0.45	0.00	0.074	0.38	60
21-Oct	0.44	0.00	0.074	0.37	59
22-Oct	0.43	0.02	0.074	0.36	57
23-Oct	0.44	0.00	0.074	0.37	59
24-Oct	0.51	0.35	0.074	0.44	70
25-Oct	0.51	0.23	0.074	0.44	70
26-Oct	0.48	0.12	0.074	0.41	65
27-Oct	0.47	0.03	0.074	0.40	64
28-Oct	0.46	0.00	0.074	0.39	62
29-Oct	0.46	0.02	0.074	0.39	62
30-Oct	0.46	0.00	0.074	0.39	62
31-Oct	0.50	0.18	0.074	0.43	68
1-Nov	0.57	0.18	0.074	0.50	80
2-Nov	0.50	0.25	0.074	0.43	68
3-Nov	0.48	0.01	0.074	0.41	65
4-Nov	0.48	0.00	0.074	0.41	65
5-Nov	0.48	0.00	0.074	0.41	65
6-Nov	0.47	0.08	0.074	0.40	64

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
7-Nov	0.68	0.45	0.074	0.61	97
8-Nov	0.74	1.14	0.074	0.67	107
9-Nov	0.66	0.11	0.074	0.59	94
10-Nov	0.58	0.00	0.074	0.51	81
11-Nov	0.57	0.00	0.074	0.50	80
12-Nov	0.56	0.25	0.074	0.49	78
13-Nov	0.54	0.04	0.074	0.47	75
14-Nov	0.63	0.30	0.074	0.56	89
15-Nov	0.75	0.10	0.074	0.68	109
16-Nov	0.71	0.40	0.074	0.64	102
17-Nov	0.83	0.03	0.074	0.76	121
18-Nov	0.82	0.58	0.074	0.75	120
19-Nov	0.71	0.03	0.074	0.64	102
20-Nov	0.67	0.17	0.074	0.60	96
21-Nov	0.61	0.00	0.074	0.54	86
22-Nov	0.58	0.00	0.074	0.51	81
23-Nov	0.56	0.21	0.074	0.49	78
24-Nov	0.57	0.00	0.074	0.50	80
25-Nov	0.56	0.09	0.074	0.49	78
26-Nov	0.68	0.12	0.074	0.61	97
27-Nov	0.64	0.03	0.074	0.57	91
28-Nov	0.64	0.16	0.074	0.57	91
29-Nov	0.61	0.00	0.074	0.54	86
30-Nov	0.61	0.04	0.074	0.54	86
1-Dec	0.64	0.26	0.074	0.57	91
2-Dec	0.61	0.00	0.074	0.54	86
3-Dec	0.57	0.00	0.074	0.50	80
4-Dec	0.53	0.00	0.074	0.46	73
5-Dec	0.52	0.00	0.074	0.45	72
6-Dec	0.52	0.01	0.074	0.45	72
7-Dec	0.51	0.00	0.074	0.44	70
8-Dec	0.59	0.22	0.074	0.52	83
9-Dec	0.62	0.13	0.074	0.55	88
10-Dec	0.68	0.36	0.074	0.61	97
11-Dec	0.72	0.01	0.074	0.65	104
12-Dec	0.89	0.59	0.074	0.82	131
13-Dec	1.03	0.41	0.074	0.96	153
14-Dec	1.23	0.45	0.074	1.16	186
15-Dec	0.89	0.03	0.074	0.82	131
16-Dec	0.73	0.02	0.074	0.66	105
17-Dec	0.70	0.00	0.074	0.63	100
18-Dec	0.67	0.00	0.074	0.60	96
19-Dec	0.68	0.13	0.074	0.61	97
20-Dec	0.62	0.01	0.074	0.55	88
21-Dec	0.61	0.08	0.074	0.54	86
22-Dec	0.58	0.05	0.074	0.51	81
23-Dec	0.59	0.00	0.074	0.52	83
24-Dec	0.56	0.05	0.074	0.49	78
25-Dec	0.51	0.12	0.074	0.44	70

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
26-Dec	0.55	0.04	0.074	0.48	76
27-Dec	0.53	0.07	0.074	0.46	73
28-Dec	0.55	0.00	0.074	0.48	76
29-Dec	0.52	0.01	0.074	0.45	72
30-Dec	0.51	0.05	0.074	0.44	70
31-Dec	0.51	0.00	0.074	0.44	70
2011					
1-Jan	0.51	0.00	0.074	0.44	70
2-Jan	0.52	0.00	0.074	0.45	72
3-Jan	0.54	0.00	0.074	0.47	75
4-Jan	0.54	0.00	0.074	0.47	75
5-Jan	0.62	0.23	0.074	0.55	88
6-Jan	0.69	0.12	0.074	0.62	99
7-Jan	0.92	0.49	0.074	0.85	136
8-Jan	0.86	0.29	0.074	0.79	126
9-Jan	0.84	0.40	0.074	0.77	123
10-Jan	0.73	0.00	0.074	0.66	105
11-Jan	0.68	0.00	0.074	0.61	97
12-Jan	0.70	0.14	0.074	0.63	101
13-Jan	0.81	0.38	0.074	0.74	118
14-Jan	0.72	0.05	0.074	0.65	104
15-Jan	0.69	0.00	0.074	0.62	99
16-Jan	1.02	0.71	0.074	0.95	152
17-Jan	1.61	1.24	0.074	1.54	247
18-Jan	1.01	0.08	0.074	0.94	151
19-Jan	0.84	0.15	0.074	0.77	123
20-Jan	0.82	0.00	0.074	0.75	120
21-Jan	1.54	0.90	0.074	1.47	236
22-Jan	1.02	0.42	0.074	0.95	152
23-Jan	0.88	0.09	0.074	0.81	130
24-Jan	0.98	0.21	0.074	0.91	146
25-Jan	0.88	0.21	0.074	0.81	130
26-Jan	0.77	0.01	0.074	0.70	112
27-Jan	0.71	0.01	0.074	0.64	102
28-Jan	0.67	0.00	0.074	0.60	96
29-Jan	0.66	0.02	0.074	0.59	94
30-Jan	0.66	0.17	0.074	0.59	94
31-Jan	0.63	0.00	0.074	0.56	89
1-Feb	0.61	0.00	0.074	0.54	86
2-Feb	0.59	0.00	0.074	0.52	83
3-Feb	0.63	0.00	0.074	0.56	90
4-Feb	0.65	0.36	0.074	0.58	93
5-Feb	0.65	0.12	0.074	0.58	93
6-Feb	0.67	0.14	0.074	0.60	96
7-Feb	0.66	0.09	0.074	0.59	94
8-Feb	0.63	0.02	0.074	0.56	89
9-Feb	0.61	0.00	0.074	0.54	86
10-Feb	0.58	0.00	0.074	0.51	81
11-Feb	0.56	0.00	0.074	0.49	78

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
12-Feb	0.55	0.01	0.074	0.48	77
13-Feb	0.57	0.19	0.074	0.50	80
14-Feb	0.65	0.06	0.074	0.58	93
15-Feb	0.63	0.50	0.074	0.56	89
16-Feb	0.60	0.10	0.074	0.53	85
17-Feb	0.61	0.21	0.074	0.54	86
18-Feb	0.57	0.03	0.074	0.50	80
19-Feb	0.55	0.00	0.074	0.48	77
20-Feb	0.53	0.00	0.074	0.46	73
21-Feb	0.55	0.00	0.074	0.48	77
22-Feb	0.64	0.21	0.074	0.57	91
23-Feb	0.70	0.22	0.074	0.63	101
24-Feb	0.71	0.54	0.074	0.64	102
25-Feb	0.67	0.02	0.074	0.60	96
26-Feb	0.60	0.00	0.074	0.53	85
27-Feb	0.71	0.13	0.074	0.64	102
28-Feb	0.97	0.24	0.074	0.90	144
1-Mar	0.81	0.04	0.074	0.74	118
2-Mar	0.74	0.09	0.074	0.67	107
3-Mar	0.67	0.01	0.074	0.60	96
4-Mar	0.66	0.07	0.074	0.59	94
5-Mar	0.67	0.20	0.074	0.60	96
6-Mar	0.63	0.02	0.074	0.56	89
7-Mar	0.61	0.00	0.074	0.54	86
8-Mar	0.59	0.10	0.074	0.52	83
9-Mar	0.61	0.04	0.074	0.54	86
10-Mar	0.69	0.26	0.074	0.62	99
11-Mar	0.64	0.17	0.074	0.57	91
12-Mar	0.84	0.21	0.074	0.77	123
13-Mar	0.87	0.36	0.074	0.80	128
14-Mar	0.91	0.46	0.074	0.84	134
15-Mar	0.90	0.11	0.074	0.83	133
16-Mar	0.87	0.22	0.074	0.80	128
17-Mar	1.00	0.50	0.074	0.93	149
18-Mar	0.83	0.00	0.074	0.76	122
19-Mar	0.85	0.37	0.074	0.78	125
20-Mar	0.73	0.00	0.074	0.66	105
21-Mar	0.69	0.02	0.074	0.62	99
22-Mar	0.68	0.14	0.074	0.61	97
23-Mar	0.63	0.00	0.074	0.56	89
24-Mar	0.61	0.00	0.074	0.54	86
25-Mar	0.58	0.07	0.074	0.51	81
26-Mar	0.57	0.00	0.074	0.50	80
27-Mar	0.55	0.06	0.074	0.48	77
28-Mar	0.55	0.06	0.074	0.48	77
29-Mar	0.56	0.01	0.074	0.49	78
30-Mar	0.83	0.28	0.074	0.76	122
31-Mar	0.95	0.86	0.074	0.88	141
1-Apr	1.02	0.08	0.074	0.95	152

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
2-Apr	1.02	0.74	0.074	0.95	152
3-Apr	0.75	0.02	0.074	0.68	109
4-Apr	0.92	0.07	0.074	0.85	136
5-Apr	0.88	0.62	0.074	0.81	130
6-Apr	0.75	0.06	0.074	0.68	109
7-Apr	0.67	0.00	0.074	0.60	96
8-Apr	0.62	0.00	0.074	0.55	88
9-Apr	0.60	0.00	0.074	0.53	85
10-Apr	0.61	0.03	0.074	0.54	86
11-Apr	0.80	0.45	0.074	0.73	117
12-Apr	0.69	0.14	0.074	0.62	99
13-Apr	0.64	0.00	0.074	0.57	91
14-Apr	0.65	0.06	0.074	0.58	93
15-Apr	0.61	0.14	0.074	0.54	86
16-Apr	0.62	0.09	0.074	0.55	88
17-Apr	0.60	0.09	0.074	0.53	85
18-Apr	0.59	0.00	0.074	0.52	83
19-Apr	0.57	0.02	0.074	0.50	80
20-Apr	0.55	0.00	0.074	0.48	77
21-Apr	0.56	0.19	0.074	0.49	78
22-Apr	0.54	0.01	0.074	0.47	75
23-Apr	0.53	0.00	0.074	0.46	73
24-Apr	0.50	0.00	0.074	0.43	69
25-Apr	0.61	0.00	0.074	0.54	86
26-Apr	0.62	0.86	0.074	0.55	88
27-Apr	0.60	0.06	0.074	0.53	85
28-Apr	0.59	0.21	0.074	0.52	83
29-Apr	0.55	0.01	0.074	0.48	77
30-Apr	0.52	0.04	0.074	0.45	72
1-May	0.51	0.00	0.074	0.44	70
2-May	0.60	0.00	0.074	0.53	85
3-May	0.59	0.45	0.074	0.52	83
4-May	0.56	0.00	0.074	0.49	78
5-May	0.56	0.05	0.074	0.49	78
6-May	0.61	0.14	0.074	0.54	86
7-May	0.83	0.30	0.074	0.76	122
8-May	0.79	0.71	0.074	0.72	115
9-May	0.69	0.00	0.074	0.62	99
10-May	0.62	0.00	0.074	0.55	88
11-May	0.70	0.08	0.074	0.63	101
12-May	0.87	0.00	0.074	0.80	128
13-May	0.69	0.01	0.074	0.62	99
14-May	0.65	0.01	0.074	0.58	93
15-May	1.07	0.62	0.074	1.00	160
16-May	0.89	0.51	0.074	0.82	131
17-May	0.75	0.02	0.074	0.68	109
18-May	0.66	0.00	0.074	0.59	94
19-May	0.61	0.00	0.074	0.54	86
20-May	0.57	0.00	0.074	0.50	80

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
21-May	0.55	0.03	0.074	0.48	77
22-May	0.55	0.03	0.074	0.48	77
23-May	0.52	0.03	0.074	0.45	72
24-May	0.51	0.00	0.074	0.44	70
25-May	0.51	0.00	0.074	0.44	70
26-May	0.54	0.30	0.074	0.47	75
27-May	0.51	0.02	0.074	0.44	70
28-May	0.48	0.08	0.074	0.41	65
29-May	0.46	0.00	0.074	0.39	62
30-May	0.49	0.02	0.074	0.42	67
31-May	0.50	0.00	0.074	0.43	69
1-Jun	0.51	0.02	0.074	0.44	70
2-Jun	0.52	0.04	0.074	0.45	72
3-Jun	0.48	0.14	0.074	0.41	65
4-Jun	0.46	0.00	0.074	0.39	62
5-Jun	0.47	0.00	0.074	0.40	64
6-Jun	0.47	0.00	0.074	0.40	64
7-Jun	0.48	0.03	0.074	0.41	65
8-Jun	0.47	0.08	0.074	0.40	64
9-Jun	0.47	0.00	0.074	0.40	64
10-Jun	0.47	0.00	0.074	0.40	64
11-Jun	0.44	0.00	0.074	0.37	59
12-Jun	0.45	0.00	0.074	0.38	60
13-Jun	0.48	0.04	0.074	0.41	65
14-Jun	0.46	0.01	0.074	0.39	62
15-Jun	0.47	0.18	0.074	0.40	64
16-Jun	0.46	0.01	0.074	0.39	62
17-Jun	0.45	0.00	0.074	0.38	60
18-Jun	0.46	0.11	0.074	0.39	62
19-Jun	0.44	0.04	0.074	0.37	59
20-Jun	0.47	0.02	0.074	0.40	64
21-Jun	0.45	0.00	0.074	0.38	60
22-Jun	0.44	0.00	0.074	0.37	59
23-Jun	0.40	0.00	0.074	0.33	52
24-Jun	0.44	0.04	0.074	0.37	59
25-Jun	0.43	0.01	0.074	0.36	57
26-Jun	0.44	0.00	0.074	0.37	59
27-Jun	0.45	0.00	0.074	0.38	60
28-Jun	0.44	0.00	0.074	0.37	59
29-Jun	0.45	0.04	0.074	0.38	60
30-Jun	0.43	0.07	0.074	0.36	57
1-Jul	0.43	0.02	0.074	0.36	57
2-Jul	0.41	0.00	0.074	0.34	54
3-Jul	0.41	0.09	0.074	0.34	54
4-Jul	0.40	0.01	0.074	0.33	52
5-Jul	0.43	0.00	0.074	0.36	57
6-Jul	0.42	0.00	0.074	0.35	56
7-Jul	0.42	0.00	0.074	0.35	56
8-Jul	0.42	0.27	0.074	0.35	56

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
9-Jul	0.42	0.00	0.074	0.35	56
10-Jul	0.42	0.00	0.074	0.35	56
11-Jul	0.41	0.00	0.074	0.34	54
12-Jul	0.42	0.00	0.074	0.35	56
13-Jul	0.42	0.00	0.074	0.35	56
14-Jul	0.43	0.07	0.074	0.36	57
15-Jul	0.41	0.06	0.074	0.34	54
16-Jul	0.43	0.13	0.074	0.36	57
17-Jul	0.45	0.06	0.074	0.38	60
18-Jul	0.42	0.13	0.074	0.35	56
19-Jul	0.41	0.00	0.074	0.34	54
20-Jul	0.42	0.04	0.074	0.35	56
21-Jul	0.42	0.07	0.074	0.35	56
22-Jul	0.41	0.05	0.074	0.34	54
23-Jul	0.40	0.00	0.074	0.33	52
24-Jul	0.41	0.00	0.074	0.34	54
25-Jul	0.43	0.00	0.074	0.36	57
26-Jul	0.47	0.17	0.074	0.40	64
27-Jul	0.48	0.00	0.074	0.41	65
28-Jul	0.42	0.00	0.074	0.35	56
29-Jul	0.42	0.00	0.074	0.35	56
30-Jul	0.41	0.00	0.074	0.34	54
31-Jul	0.42	0.01	0.074	0.35	56
1-Aug	0.42	0.00	0.074	0.35	56
2-Aug	0.42	0.00	0.074	0.35	56
3-Aug	0.42	0.00	0.074	0.35	56
4-Aug	0.42	0.00	0.074	0.35	56
5-Aug	0.42	0.00	0.074	0.35	56
6-Aug	0.40	0.00	0.074	0.33	52
7-Aug	0.40	0.00	0.074	0.33	52
8-Aug	0.43	0.00	0.074	0.36	57
9-Aug	0.41	0.00	0.074	0.34	54
10-Aug	0.41	0.00	0.074	0.34	54
11-Aug	0.42	0.00	0.074	0.35	56
12-Aug	0.41	0.00	0.074	0.34	54
13-Aug	0.40	0.00	0.074	0.33	52
14-Aug	0.41	0.00	0.074	0.34	54
15-Aug	0.43	0.00	0.074	0.36	57
16-Aug	0.43	0.00	0.074	0.36	57
17-Aug	0.41	0.00	0.074	0.34	54
18-Aug	0.42	0.00	0.074	0.35	56
19-Aug	0.41	0.00	0.074	0.34	54
20-Aug	0.40	0.00	0.074	0.33	52
21-Aug	0.40	0.00	0.074	0.33	52
22-Aug	0.46	0.00	0.074	0.39	62
23-Aug	0.46	0.63	0.074	0.39	62
24-Aug	0.44	0.03	0.074	0.37	59
25-Aug	0.44	0.00	0.074	0.37	59
26-Aug	0.43	0.00	0.074	0.36	57

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
27-Aug	0.44	0.00	0.074	0.37	59
28-Aug	0.43	0.00	0.074	0.36	57
29-Aug	0.42	0.00	0.074	0.35	56
30-Aug	0.43	0.00	0.074	0.36	57
31-Aug	0.45	0.00	0.074	0.38	60
1-Sep	0.45	0.00	0.074	0.38	60
2-Sep	0.43	0.01	0.074	0.36	57
3-Sep	0.41	0.00	0.074	0.34	54
4-Sep	0.38	0.00	0.074	0.31	49
5-Sep	0.45	0.00	0.074	0.38	60
6-Sep	0.44	0.00	0.074	0.37	59
7-Sep	0.44	0.00	0.074	0.37	59
8-Sep	0.43	0.00	0.074	0.36	57
9-Sep	0.42	0.00	0.074	0.35	56
10-Sep	0.41	0.00	0.074	0.34	54
11-Sep	0.41	0.00	0.074	0.34	54
12-Sep	0.43	0.00	0.074	0.36	57
13-Sep	0.44	0.00	0.074	0.37	59
14-Sep	0.44	0.00	0.074	0.37	59
15-Sep	0.44	0.00	0.074	0.37	59
16-Sep	0.42	0.01	0.074	0.35	56
17-Sep	0.42	0.01	0.074	0.35	56
18-Sep	0.43	0.18	0.074	0.36	57
19-Sep	0.43	0.01	0.074	0.36	57
20-Sep	0.42	0.00	0.074	0.35	56
21-Sep	0.41	0.00	0.074	0.34	54
22-Sep	0.43	0.06	0.074	0.36	57
23-Sep	0.42	0.04	0.074	0.35	56
24-Sep	0.40	0.00	0.074	0.33	52
25-Sep	0.42	0.05	0.074	0.35	56
26-Sep	0.47	0.14	0.074	0.40	64
27-Sep	0.44	0.18	0.074	0.37	59
28-Sep	0.45	0.35	0.074	0.38	60
29-Sep	0.45	0.00	0.074	0.38	60
30-Sep	0.43	0.00	0.074	0.36	57
1-Oct	0.41	0.00	0.074	0.34	54
2-Oct	0.42	0.01	0.074	0.35	56
3-Oct	0.43	0.05	0.074	0.36	57
4-Oct	0.42	0.00	0.074	0.35	56
5-Oct	0.45	0.02	0.074	0.38	60
6-Oct	0.44	0.20	0.074	0.37	59
7-Oct	0.47	0.09	0.074	0.40	64
8-Oct	0.42	0.17	0.074	0.35	56
9-Oct	0.42	0.01	0.074	0.35	56
10-Oct	0.45	0.03	0.074	0.38	60
11-Oct	0.46	0.11	0.074	0.39	62
12-Oct	0.44	0.03	0.074	0.37	59
13-Oct	0.44	0.00	0.074	0.37	59
14-Oct	0.42	0.00	0.074	0.35	56

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
15-Oct	0.41	0.00	0.074	0.34	54
16-Oct	0.42	0.00	0.074	0.35	56
17-Oct	0.43	0.00	0.074	0.36	57
18-Oct	0.43	0.00	0.074	0.36	57
19-Oct	0.43	0.00	0.074	0.36	57
20-Oct	0.43	0.10	0.074	0.36	57
21-Oct	0.45	0.06	0.074	0.38	60
22-Oct	0.50	0.38	0.074	0.43	69
23-Oct	0.46	0.29	0.074	0.39	62
24-Oct	0.45	0.00	0.074	0.38	60
25-Oct	0.44	0.00	0.074	0.37	59
26-Oct	0.43	0.00	0.074	0.36	57
27-Oct	0.44	0.04	0.074	0.37	59
28-Oct	0.44	0.00	0.074	0.37	59
29-Oct	0.43	0.12	0.074	0.36	57
30-Oct	0.45	0.02	0.074	0.38	60
31-Oct	0.43	0.18	0.074	0.36	57
1-Nov	0.44	0.03	0.074	0.37	59
2-Nov	0.50	0.00	0.074	0.43	69
3-Nov	0.55	0.96	0.074	0.48	77
4-Nov	0.46	0.00	0.074	0.39	62
5-Nov	0.45	0.00	0.074	0.38	60
6-Nov	0.45	0.00	0.074	0.38	60
7-Nov	0.43	0.00	0.074	0.36	57
8-Nov	0.43	0.05	0.074	0.36	57
9-Nov	0.42	0.00	0.074	0.35	56
10-Nov	0.41	0.00	0.074	0.34	54
11-Nov	0.59	0.00	0.074	0.52	83
12-Nov	0.60	0.40	0.074	0.53	85
13-Nov	0.59	0.54	0.074	0.52	83
14-Nov	0.57	0.47	0.074	0.50	80
15-Nov	0.50	0.06	0.074	0.43	69
16-Nov	0.50	0.00	0.074	0.43	69
17-Nov	0.51	0.20	0.074	0.44	70
18-Nov	0.54	0.22	0.074	0.47	75
19-Nov	0.51	0.00	0.074	0.44	70
20-Nov	0.50	0.00	0.074	0.43	69
21-Nov	0.53	0.14	0.074	0.46	73
22-Nov	0.85	0.61	0.074	0.78	125
23-Nov	1.59	1.73	0.074	1.52	244
24-Nov	0.98	0.41	0.074	0.91	146
25-Nov	0.79	0.20	0.074	0.72	115
26-Nov	0.67	0.01	0.074	0.60	96
27-Nov	0.75	0.00	0.074	0.68	109
28-Nov	0.69	0.34	0.074	0.62	99
29-Nov	0.63	0.00	0.074	0.56	89
30-Nov	0.62	0.10	0.074	0.55	88
1-Dec	0.57	0.00	0.074	0.50	80
2-Dec	0.56	0.02	0.074	0.49	78

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
3-Dec	0.54	0.01	0.074	0.47	75
4-Dec	0.55	0.08	0.074	0.48	77
5-Dec	0.54	0.00	0.074	0.47	75
6-Dec	0.53	0.00	0.074	0.46	73
7-Dec	0.51	0.04	0.074	0.44	70
8-Dec	0.50	0.01	0.074	0.43	69
9-Dec	0.51	0.00	0.074	0.44	70
10-Dec	0.49	0.00	0.074	0.42	67
11-Dec	0.49	0.06	0.074	0.42	67
12-Dec	0.50	0.01	0.074	0.43	69
13-Dec	0.49	0.00	0.074	0.42	67
14-Dec	0.48	0.00	0.074	0.41	65
15-Dec	0.49	0.06	0.074	0.42	67
16-Dec	0.47	0.03	0.074	0.40	64
17-Dec	0.49	0.00	0.074	0.42	67
18-Dec	0.51	0.13	0.074	0.44	70
19-Dec	0.49	0.02	0.074	0.42	67
20-Dec	0.49	0.00	0.074	0.42	67
21-Dec	0.48	0.00	0.074	0.41	65
22-Dec	0.48	0.00	0.074	0.41	65
23-Dec	0.49	0.00	0.074	0.42	67
24-Dec	0.53	0.04	0.074	0.46	73
25-Dec	0.44	0.10	0.074	0.37	59
26-Dec	0.47	0.13	0.074	0.40	64
27-Dec	0.52	0.09	0.074	0.45	72
28-Dec	0.53	0.12	0.074	0.46	73
29-Dec	0.49	0.03	0.074	0.42	67
30-Dec	0.50	0.07	0.074	0.43	69
31-Dec	0.48	0.02	0.074	0.41	65
2012					
1-Jan	0.45	0.00	0.074	0.38	60
2-Jan	0.51	0.00	0.074	0.44	69
3-Jan	0.50	0.14	0.074	0.43	68
4-Jan	0.55	0.10	0.074	0.48	76
5-Jan	0.59	0.25	0.074	0.52	82
6-Jan	0.52	0.00	0.074	0.45	71
7-Jan	0.50	0.00	0.074	0.43	68
8-Jan	0.50	0.03	0.074	0.43	68
9-Jan	0.50	0.00	0.074	0.43	68
10-Jan	0.50	0.09	0.074	0.43	68
11-Jan	0.48	0.00	0.074	0.41	64
12-Jan	0.48	0.00	0.074	0.41	64
13-Jan	0.47	0.00	0.074	0.40	63
14-Jan	0.51	0.20	0.074	0.44	69
15-Jan	0.50	0.18	0.074	0.43	68
16-Jan	0.51	0.00	0.074	0.44	69
17-Jan	0.49	0.21	0.074	0.42	66
18-Jan	0.47	0.28	0.074	0.40	63
19-Jan	0.49	0.16	0.074	0.42	66

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
20-Jan	0.69	0.13	0.074	0.62	98
21-Jan	1.34	0.65	0.074	1.27	201
22-Jan	0.95	0.11	0.074	0.88	139
23-Jan	0.80	0.22	0.074	0.73	115
24-Jan	0.73	0.00	0.074	0.66	104
25-Jan	0.73	0.23	0.074	0.66	104
26-Jan	0.66	0.00	0.074	0.59	93
27-Jan	0.62	0.00	0.074	0.55	87
28-Jan	0.57	0.00	0.074	0.50	79
29-Jan	0.68	0.21	0.074	0.61	96
30-Jan	0.71	0.27	0.074	0.64	101
31-Jan	0.62	0.00	0.074	0.55	87
1-Feb	0.83	0.46	0.074	0.76	120
2-Feb	0.69	0.00	0.074	0.62	98
3-Feb	0.62	0.00	0.074	0.55	87
4-Feb	0.59	0.00	0.074	0.52	82
5-Feb	0.56	0.00	0.074	0.49	77
6-Feb	0.56	0.00	0.074	0.49	77
7-Feb	0.55	0.00	0.074	0.48	76
8-Feb	0.53	0.02	0.074	0.46	72
9-Feb	0.59	0.02	0.074	0.52	82
10-Feb	0.58	0.39	0.074	0.51	80
11-Feb	0.57	0.02	0.074	0.50	79
12-Feb	0.54	0.00	0.074	0.47	74
13-Feb	0.58	0.15	0.074	0.51	80
14-Feb	0.57	0.03	0.074	0.50	79
15-Feb	0.54	0.07	0.074	0.47	74
16-Feb	0.53	0.00	0.074	0.46	72
17-Feb	0.63	0.03	0.074	0.56	88
18-Feb	0.85	0.56	0.074	0.78	123
19-Feb	0.81	0.44	0.074	0.74	117
20-Feb	0.69	0.00	0.074	0.62	98
21-Feb	1.92	0.86	0.074	1.85	293
22-Feb	1.65	1.78	0.074	1.58	250
23-Feb	0.99	0.00	0.074	0.92	145
24-Feb	0.84	0.05	0.074	0.77	122
25-Feb	1.15	0.32	0.074	1.08	171
26-Feb	0.99	0.70	0.074	0.92	145
27-Feb	0.84	0.00	0.074	0.77	122
28-Feb	0.75	0.00	0.074	0.68	107
29-Feb	0.88	0.17	0.074	0.81	128
1-Mar	1.13	0.86	0.074	1.06	168
2-Mar	0.93	0.02	0.074	0.86	136
3-Mar	0.95	0.35	0.074	0.88	139
4-Mar	0.82	0.02	0.074	0.75	118
5-Mar	0.79	0.00	0.074	0.72	114
6-Mar	0.75	0.26	0.074	0.68	107
7-Mar	0.69	0.00	0.074	0.62	98
8-Mar	0.65	0.00	0.074	0.58	91

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
9-Mar	0.63	0.00	0.074	0.56	88
10-Mar	0.65	0.19	0.074	0.58	91
11-Mar	0.67	0.02	0.074	0.60	95
12-Mar	1.25	0.53	0.074	1.18	187
13-Mar	1.25	1.15	0.074	1.18	187
14-Mar	0.96	0.05	0.074	0.89	141
15-Mar	0.89	0.16	0.074	0.82	130
16-Mar	0.78	0.02	0.074	0.71	112
17-Mar	0.77	0.19	0.074	0.70	110
18-Mar	0.72	0.05	0.074	0.65	103
19-Mar	0.73	0.13	0.074	0.66	104
20-Mar	0.72	0.03	0.074	0.65	103
21-Mar	0.72	0.23	0.074	0.65	103
22-Mar	0.67	0.00	0.074	0.60	95
23-Mar	0.60	0.00	0.074	0.53	84
24-Mar	0.58	0.00	0.074	0.51	80
25-Mar	0.56	0.00	0.074	0.49	77
26-Mar	0.57	0.04	0.074	0.50	79
27-Mar	0.56	0.01	0.074	0.49	77
28-Mar	0.55	0.15	0.074	0.48	76
29-Mar	0.74	0.37	0.074	0.67	106
30-Mar	0.74	0.56	0.074	0.67	106
31-Mar	0.74	0.10	0.074	0.67	106
1-Apr	0.74	0.31	0.074	0.67	106
2-Apr	0.65	0.01	0.074	0.58	91
3-Apr	0.82	0.00	0.074	0.75	118
4-Apr	0.76	0.64	0.074	0.69	109
5-Apr	0.68	0.00	0.074	0.61	96
6-Apr	0.61	0.00	0.074	0.54	85
7-Apr	0.59	0.00	0.074	0.52	82
8-Apr	0.57	0.00	0.074	0.50	79
9-Apr	0.57	0.00	0.074	0.50	79
10-Apr	0.54	0.00	0.074	0.47	74
11-Apr	0.59	0.00	0.074	0.52	82
12-Apr	0.58	0.31	0.074	0.51	80
13-Apr	0.54	0.00	0.074	0.47	74
14-Apr	0.51	0.00	0.074	0.44	69
15-Apr	0.51	0.00	0.074	0.44	69
16-Apr	0.65	0.16	0.074	0.58	91
17-Apr	0.65	0.49	0.074	0.58	91
18-Apr	0.60	0.03	0.074	0.53	84
19-Apr	0.66	0.03	0.074	0.59	93
20-Apr	0.89	0.76	0.074	0.82	129
21-Apr	0.69	0.00	0.074	0.62	98
22-Apr	0.62	0.01	0.074	0.55	87
23-Apr	0.60	0.00	0.074	0.53	84
24-Apr	0.54	0.02	0.074	0.47	74
25-Apr	0.54	0.12	0.074	0.47	74
26-Apr	0.82	0.47	0.074	0.75	118

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
27-Apr	0.77	0.41	0.074	0.70	110
28-Apr	0.66	0.00	0.074	0.59	93
29-Apr	0.61	0.05	0.074	0.54	85
30-Apr	0.71	0.29	0.074	0.64	101
1-May	1.14	0.71	0.074	1.07	169
2-May	0.91	0.39	0.074	0.84	133
3-May	0.87	0.15	0.074	0.80	126
4-May	1.24	0.71	0.074	1.17	185
5-May	0.87	0.35	0.074	0.80	126
6-May	0.74	0.00	0.074	0.67	106
7-May	0.69	0.00	0.074	0.62	98
8-May	0.60	0.00	0.074	0.53	84
9-May	0.60	0.00	0.074	0.53	84
10-May	0.60	0.00	0.074	0.53	84
11-May	0.57	0.00	0.074	0.50	79
12-May	0.52	0.00	0.074	0.45	71
13-May	0.52	0.00	0.074	0.45	71
14-May	0.55	0.00	0.074	0.48	76
15-May	0.51	0.00	0.074	0.44	69
16-May	0.53	0.00	0.074	0.46	72
17-May	0.51	0.00	0.074	0.44	69
18-May	0.48	0.00	0.074	0.41	64
19-May	0.47	0.00	0.074	0.40	63
20-May	0.51	0.00	0.074	0.44	69
21-May	0.55	0.43	0.074	0.48	76
22-May	0.57	0.28	0.074	0.50	79
23-May	0.72	0.43	0.074	0.65	103
24-May	0.72	0.45	0.074	0.65	103
25-May	0.60	0.09	0.074	0.53	84
26-May	0.54	0.00	0.074	0.47	74
27-May	0.48	0.00	0.074	0.41	64
28-May	0.50	0.01	0.074	0.43	68
29-May	0.49	0.00	0.074	0.42	66
30-May	0.49	0.00	0.074	0.42	66
31-May	0.42	0.16	0.074	0.35	55
1-Jun	0.52	0.15	0.074	0.45	71
2-Jun	0.52	0.05	0.074	0.45	71
3-Jun	0.49	0.05	0.074	0.42	66
4-Jun	0.49	0.02	0.074	0.42	66
5-Jun	0.51	0.10	0.074	0.44	69
6-Jun	0.50	0.09	0.074	0.43	68
7-Jun	0.53	0.14	0.074	0.46	72
8-Jun	0.50	0.06	0.074	0.43	68
9-Jun	0.48	0.00	0.074	0.41	64
10-Jun	0.48	0.00	0.074	0.41	64
11-Jun	0.47	0.00	0.074	0.40	63
12-Jun	0.47	0.02	0.074	0.40	63
13-Jun	0.46	0.03	0.074	0.39	61
14-Jun	0.47	0.00	0.074	0.40	63

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
15-Jun	0.44	0.00	0.074	0.37	58
16-Jun	0.47	0.06	0.074	0.40	63
17-Jun	0.48	0.22	0.074	0.41	64
18-Jun	0.58	0.44	0.074	0.51	80
19-Jun	0.49	0.02	0.074	0.42	66
20-Jun	0.46	0.00	0.074	0.39	61
21-Jun	0.46	0.00	0.074	0.39	61
22-Jun	0.60	0.00	0.074	0.53	84
23-Jun	0.81	0.97	0.074	0.74	117
24-Jun	0.67	0.35	0.074	0.60	95
25-Jun	0.59	0.00	0.074	0.52	82
26-Jun	0.53	0.00	0.074	0.46	72
27-Jun	0.53	0.00	0.074	0.46	72
28-Jun	0.49	0.00	0.074	0.42	66
29-Jun	0.50	0.02	0.074	0.43	68
30-Jun	0.49	0.10	0.074	0.42	66
1-Jul	0.49	0.09	0.074	0.42	66
2-Jul	0.48	0.00	0.074	0.41	64
3-Jul	0.71	0.77	0.074	0.64	101
4-Jul	0.56	0.15	0.074	0.49	77
5-Jul	0.52	0.00	0.074	0.45	71
6-Jul	0.50	0.00	0.074	0.43	68
7-Jul	0.49	0.00	0.074	0.42	66
8-Jul	0.50	0.00	0.074	0.43	68
9-Jul	0.48	0.01	0.074	0.41	64
10-Jul	0.49	0.00	0.074	0.42	66
11-Jul	0.47	0.00	0.074	0.40	63
12-Jul	0.45	0.00	0.074	0.38	60
13-Jul	0.53	0.00	0.074	0.46	72
14-Jul	0.54	0.67	0.074	0.47	74
15-Jul	0.51	0.08	0.074	0.44	69
16-Jul	0.50	0.06	0.074	0.43	68
17-Jul	0.47	0.00	0.074	0.40	63
18-Jul	0.45	0.00	0.074	0.38	60
19-Jul	0.45	0.00	0.074	0.38	60
20-Jul	0.52	0.32	0.074	0.45	71
21-Jul	0.46	0.16	0.074	0.39	61
22-Jul	0.48	0.00	0.074	0.41	64
23-Jul	0.47	0.23	0.074	0.40	63
24-Jul	0.47	0.00	0.074	0.40	63
25-Jul	0.45	0.00	0.074	0.38	60
26-Jul	0.44	0.00	0.074	0.37	58
27-Jul	0.43	0.00	0.074	0.36	57
28-Jul	0.43	0.00	0.074	0.36	57
29-Jul	0.43	0.00	0.074	0.36	57
30-Jul	0.42	0.00	0.074	0.35	55
31-Jul	0.43	0.00	0.074	0.36	57
1-Aug	0.45	0.00	0.074	0.38	60
2-Aug	0.43	0.00	0.074	0.36	57

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
3-Aug	0.43	0.00	0.074	0.36	57
4-Aug	0.41	0.00	0.074	0.34	53
5-Aug	0.43	0.00	0.074	0.36	57
6-Aug	0.44	0.00	0.074	0.37	58
7-Aug	0.43	0.00	0.074	0.36	57
8-Aug	0.43	0.00	0.074	0.36	57
9-Aug	0.42	0.00	0.074	0.35	55
10-Aug	0.42	0.00	0.074	0.35	55
11-Aug	0.41	0.00	0.074	0.34	53
12-Aug	0.42	0.00	0.074	0.35	55
13-Aug	0.42	0.00	0.074	0.35	55
14-Aug	0.42	0.00	0.074	0.35	55
15-Aug	0.42	0.00	0.074	0.35	55
16-Aug	0.43	0.00	0.074	0.36	57
17-Aug	0.41	0.00	0.074	0.34	53
18-Aug	0.40	0.00	0.074	0.33	52
19-Aug	0.41	0.00	0.074	0.34	53
20-Aug	0.42	0.00	0.074	0.35	55
21-Aug	0.41	0.00	0.074	0.34	53
22-Aug	0.42	0.00	0.074	0.35	55
23-Aug	0.41	0.00	0.074	0.34	53
24-Aug	0.41	0.00	0.074	0.34	53
25-Aug	0.40	0.00	0.074	0.33	52
26-Aug	0.41	0.00	0.074	0.34	53
27-Aug	0.41	0.00	0.074	0.34	53
28-Aug	0.41	0.00	0.074	0.34	53
29-Aug	0.43	0.05	0.074	0.36	57
30-Aug	0.43	0.00	0.074	0.36	57
31-Aug	0.42	0.00	0.074	0.35	55
1-Sep	0.40	0.00	0.074	0.33	52
2-Sep	0.40	0.00	0.074	0.33	52
3-Sep	0.44	0.00	0.074	0.37	58
4-Sep	0.43	0.00	0.074	0.36	57
5-Sep	0.43	0.00	0.074	0.36	57
6-Sep	0.42	0.00	0.074	0.35	55
7-Sep	0.42	0.00	0.074	0.35	55
8-Sep	0.42	0.00	0.074	0.35	55
9-Sep	0.42	0.00	0.074	0.35	55
10-Sep	0.45	0.22	0.074	0.38	60
11-Sep	0.43	0.00	0.074	0.36	57
12-Sep	0.43	0.00	0.074	0.36	57
13-Sep	0.42	0.00	0.074	0.35	55
14-Sep	0.42	0.00	0.074	0.35	55
15-Sep	0.40	0.00	0.074	0.33	52
16-Sep	0.43	0.00	0.074	0.36	57
17-Sep	0.43	0.00	0.074	0.36	57
18-Sep	0.43	0.00	0.074	0.36	57
19-Sep	0.44	0.00	0.074	0.37	58
20-Sep	0.44	0.00	0.074	0.37	58

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
21-Sep	0.42	0.02	0.074	0.35	55
22-Sep	0.41	0.02	0.074	0.34	53
23-Sep	0.44	0.01	0.074	0.37	58
24-Sep	0.43	0.00	0.074	0.36	57
25-Sep	0.43	0.00	0.074	0.36	57
26-Sep	0.43	0.00	0.074	0.36	57
27-Sep	0.43	0.00	0.074	0.36	57
28-Sep	0.42	0.00	0.074	0.35	55
29-Sep	0.42	0.00	0.074	0.35	55
30-Sep	0.43	0.00	0.074	0.36	57
1-Oct	0.44	0.00	0.074	0.37	58
2-Oct	0.43	0.00	0.074	0.36	57
3-Oct	0.43	0.00	0.074	0.36	57
4-Oct	0.42	0.00	0.074	0.35	55
5-Oct	0.40	0.00	0.074	0.33	52
6-Oct	0.40	0.00	0.074	0.33	52
7-Oct	0.40	0.00	0.074	0.33	52
8-Oct	0.43	0.00	0.074	0.36	57
9-Oct	0.42	0.00	0.074	0.35	55
10-Oct	0.42	0.00	0.074	0.35	55
11-Oct	0.42	0.00	0.074	0.35	55
12-Oct	0.42	0.00	0.074	0.35	55
13-Oct	0.44	0.25	0.074	0.37	58
14-Oct	0.49	0.28	0.074	0.42	66
15-Oct	0.48	0.34	0.074	0.41	64
16-Oct	0.46	0.23	0.074	0.39	61
17-Oct	0.42	0.00	0.074	0.35	55
18-Oct	0.51	0.00	0.074	0.44	69
19-Oct	0.61	0.67	0.074	0.54	85
20-Oct	0.50	0.70	0.074	0.43	68
21-Oct	0.58	0.24	0.074	0.51	80
22-Oct	0.51	0.09	0.074	0.44	69
23-Oct	0.49	0.21	0.074	0.42	66
24-Oct	0.48	0.03	0.074	0.41	64
25-Oct	0.46	0.08	0.074	0.39	61
26-Oct	0.48	0.00	0.074	0.41	64
27-Oct	0.48	0.20	0.074	0.41	64
28-Oct	0.49	0.17	0.074	0.42	66
29-Oct	0.49	0.16	0.074	0.42	66
30-Oct	0.56	0.08	0.074	0.49	77
31-Oct	0.75	0.62	0.074	0.68	107
1-Nov	0.63	0.52	0.074	0.56	88
2-Nov	0.56	0.00	0.074	0.49	77
3-Nov	1.09	0.18	0.074	1.02	161
4-Nov	0.56	0.05	0.074	0.49	77
5-Nov	0.56	0.18	0.074	0.49	77
6-Nov	0.55	0.01	0.074	0.48	76
7-Nov	0.52	0.09	0.074	0.45	71
8-Nov	0.48	0.00	0.074	0.41	64

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
9-Nov	0.47	0.00	0.074	0.40	63
10-Nov	0.46	0.00	0.074	0.39	61
11-Nov	0.49	0.00	0.074	0.42	66
12-Nov	0.52	0.37	0.074	0.45	71
13-Nov	0.56	0.00	0.074	0.49	77
14-Nov	0.55	0.37	0.074	0.48	76
15-Nov	0.50	0.01	0.074	0.43	68
16-Nov	0.49	0.16	0.074	0.42	66
17-Nov	0.64	0.35	0.074	0.57	90
18-Nov	0.67	0.21	0.074	0.60	95
19-Nov	1.43	0.55	0.074	1.36	215
20-Nov	1.00	1.54	0.074	0.93	147
21-Nov	0.88	0.28	0.074	0.81	128
22-Nov	0.72	0.14	0.074	0.65	103
23-Nov	0.73	0.15	0.074	0.66	104
24-Nov	0.69	0.10	0.074	0.62	98
25-Nov	0.64	0.03	0.074	0.57	90
26-Nov	0.61	0.00	0.074	0.54	85
27-Nov	0.58	0.00	0.074	0.51	80
28-Nov	0.55	0.00	0.074	0.48	76
29-Nov	0.61	0.06	0.074	0.54	85
30-Nov	0.79	0.26	0.074	0.72	114
1-Dec	1.03	0.69	0.074	0.96	152
2-Dec	0.93	0.27	0.074	0.86	136
3-Dec	0.77	0.03	0.074	0.70	110
4-Dec	0.81	0.19	0.074	0.74	117
5-Dec	0.74	0.10	0.074	0.67	106
6-Dec	0.73	0.00	0.074	0.66	104
7-Dec	0.77	0.33	0.074	0.70	110
8-Dec	0.68	0.07	0.074	0.61	96
9-Dec	0.65	0.00	0.074	0.58	91
10-Dec	0.65	0.14	0.074	0.58	91
11-Dec	0.65	0.00	0.074	0.58	91
12-Dec	0.80	0.37	0.074	0.73	115
13-Dec	0.70	0.05	0.074	0.63	99
14-Dec	0.81	0.37	0.074	0.74	117
15-Dec	0.69	0.00	0.074	0.62	98
16-Dec	0.80	0.05	0.074	0.73	115
17-Dec	1.12	0.72	0.074	1.05	166
18-Dec	0.87	0.18	0.074	0.80	126
19-Dec	0.95	0.03	0.074	0.88	139
20-Dec	1.13	0.63	0.074	1.06	168
21-Dec	0.87	0.18	0.074	0.80	126
22-Dec	0.82	0.06	0.074	0.75	118
23-Dec	0.79	0.18	0.074	0.72	114
24-Dec	0.74	0.20	0.074	0.67	106
25-Dec	0.68	0.00	0.074	0.61	96
26-Dec	0.68	0.10	0.074	0.61	96
27-Dec	0.71	0.11	0.074	0.64	101

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
28-Dec	0.65	0.03	0.074	0.58	91
29-Dec	0.68	0.06	0.074	0.61	96
30-Dec	0.63	0.15	0.074	0.56	88
31-Dec	0.61	0.00	0.074	0.54	85
2013					
1-Jan	0.56	0.00	0.074	0.49	77
2-Jan	0.58	0.00	0.074	0.51	80
3-Jan	0.56	0.00	0.074	0.49	77
4-Jan	0.54	0.00	0.074	0.47	74
5-Jan	0.53	0.00	0.074	0.46	72
6-Jan	0.56	0.14	0.074	0.49	77
7-Jan	0.92	0.56	0.074	0.85	133
8-Jan	0.84	0.11	0.074	0.77	121
9-Jan	1.45	0.86	0.074	1.38	217
10-Jan	1.01	0.37	0.074	0.94	148
11-Jan	0.81	0.02	0.074	0.74	116
12-Jan	0.70	0.00	0.074	0.63	99
13-Jan	0.65	0.00	0.074	0.58	91
14-Jan	0.62	0.00	0.074	0.55	86
15-Jan	0.59	0.00	0.074	0.52	81
16-Jan	0.57	0.00	0.074	0.50	78
17-Jan	0.57	0.00	0.074	0.50	78
18-Jan	0.59	0.00	0.074	0.52	81
19-Jan	0.56	0.00	0.074	0.49	77
20-Jan	0.55	0.00	0.074	0.48	75
21-Jan	0.57	0.00	0.074	0.50	78
22-Jan	0.56	0.00	0.074	0.49	77
23-Jan	0.57	0.02	0.074	0.50	78
24-Jan	0.59	0.24	0.074	0.52	81
25-Jan	0.59	0.06	0.074	0.52	81
26-Jan	0.67	0.07	0.074	0.60	94
27-Jan	0.94	0.44	0.074	0.87	137
28-Jan	1.38	0.60	0.074	1.31	206
29-Jan	1.26	0.93	0.074	1.19	187
30-Jan	1.33	0.69	0.074	1.26	198
31-Jan	1.14	0.35	0.074	1.07	168
1-Feb	0.91	0.08	0.074	0.84	132
2-Feb	0.78	0.01	0.074	0.71	111
3-Feb	0.74	0.00	0.074	0.67	105
4-Feb	0.75	0.12	0.074	0.68	107
5-Feb	0.69	0.00	0.074	0.62	97
6-Feb	0.65	0.00	0.074	0.58	91
7-Feb	0.75	0.14	0.074	0.68	107
8-Feb	0.81	0.01	0.074	0.74	116
9-Feb	0.59	0.02	0.074	0.52	81
10-Feb	0.58	0.07	0.074	0.51	80
11-Feb	0.59	0.01	0.074	0.52	81
12-Feb	0.60	0.11	0.074	0.53	83
13-Feb	0.56	0.02	0.074	0.49	77

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
14-Feb	0.58	0.14	0.074	0.51	80
15-Feb	0.56	0.01	0.074	0.49	77
16-Feb	0.58	0.06	0.074	0.51	80
17-Feb	0.66	0.34	0.074	0.59	92
18-Feb	0.64	0.09	0.074	0.57	89
19-Feb	0.61	0.00	0.074	0.54	85
20-Feb	0.56	0.02	0.074	0.49	77
21-Feb	0.57	0.01	0.074	0.50	78
22-Feb	0.59	0.12	0.074	0.52	81
23-Feb	0.65	0.36	0.074	0.58	91
24-Feb	0.60	0.01	0.074	0.53	83
25-Feb	0.64	0.06	0.074	0.57	89
26-Feb	0.58	0.14	0.074	0.51	80
27-Feb	0.56	0.01	0.074	0.49	77
28-Feb	0.58	0.03	0.074	0.51	80
1-Mar	0.57	0.18	0.074	0.50	78
2-Mar	0.59	0.00	0.074	0.52	81
3-Mar	0.59	0.16	0.074	0.52	81
4-Mar	0.56	0.04	0.074	0.49	77
5-Mar	0.55	0.01	0.074	0.48	75
6-Mar	0.65	0.02	0.074	0.58	91
7-Mar	0.81	0.66	0.074	0.74	116
8-Mar	0.67	0.02	0.074	0.60	94
9-Mar	0.62	0.01	0.074	0.55	86
10-Mar	0.57	0.00	0.074	0.50	78
11-Mar	0.56	0.00	0.074	0.49	77
12-Mar	0.61	0.04	0.074	0.54	85
13-Mar	0.67	0.33	0.074	0.60	94
14-Mar	0.67	0.00	0.074	0.60	94
15-Mar	0.59	0.17	0.074	0.52	81
16-Mar	0.77	0.29	0.074	0.70	110
17-Mar	0.71	0.00	0.074	0.64	100
18-Mar	0.65	0.10	0.074	0.58	91
19-Mar	0.61	0.01	0.074	0.54	85
20-Mar	0.61	0.12	0.074	0.54	85
21-Mar	0.61	0.08	0.074	0.54	85
22-Mar	0.59	0.03	0.074	0.52	81
23-Mar	0.55	0.00	0.074	0.48	75
24-Mar	0.55	0.00	0.074	0.48	75
25-Mar	0.54	0.00	0.074	0.47	74
26-Mar	0.52	0.00	0.074	0.45	70
27-Mar	0.49	0.00	0.074	0.42	66
28-Mar	0.49	0.00	0.074	0.42	66
29-Mar	0.48	0.00	0.074	0.40	64
30-Mar	0.48	0.00	0.074	0.41	65
31-Mar	0.45	0.00	0.074	0.37	59
1-Apr	0.46	0.00	0.074	0.39	61
2-Apr	0.45	0.00	0.074	0.38	59
3-Apr	0.44	0.00	0.074	0.37	58

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
4-Apr	0.47	0.00	0.074	0.40	62
5-Apr	0.55	0.27	0.074	0.48	75
6-Apr	0.65	0.10	0.074	0.58	91
7-Apr	0.82	0.70	0.074	0.75	118
8-Apr	0.69	0.52	0.074	0.62	97
9-Apr	0.60	0.00	0.074	0.53	83
10-Apr	0.58	0.01	0.074	0.51	80
11-Apr	0.55	0.00	0.074	0.48	75
12-Apr	0.56	0.00	0.074	0.49	77
13-Apr	0.66	0.32	0.074	0.59	92
14-Apr	0.61	0.03	0.074	0.54	85
15-Apr	0.57	0.00	0.074	0.50	78
16-Apr	0.54	0.00	0.074	0.47	74
17-Apr	0.52	0.00	0.074	0.45	70
18-Apr	0.54	0.06	0.074	0.47	74
19-Apr	0.81	0.55	0.074	0.74	116
20-Apr	0.67	0.26	0.074	0.60	94
21-Apr	0.65	0.06	0.074	0.58	91
22-Apr	0.59	0.01	0.074	0.52	81
23-Apr	0.54	0.00	0.074	0.47	74
24-Apr	0.51	0.00	0.074	0.44	69
25-Apr	0.52	0.00	0.074	0.45	70
26-Apr	0.49	0.00	0.074	0.42	66
27-Apr	0.49	0.00	0.074	0.42	66
28-Apr	0.52	0.24	0.074	0.45	70
29-Apr	0.51	0.06	0.074	0.44	69
30-Apr	0.49	0.08	0.074	0.42	66
1-May	0.47	0.00	0.074	0.40	62
2-May	0.47	0.00	0.074	0.40	62
3-May	0.48	0.00	0.074	0.41	64
4-May	0.45	0.00	0.074	0.38	59
5-May	0.46	0.00	0.074	0.39	61
6-May	0.48	0.00	0.074	0.41	64
7-May	0.46	0.00	0.074	0.39	61
8-May	0.45	0.00	0.074	0.38	59
9-May	0.45	0.00	0.074	0.38	59
10-May	0.44	0.00	0.074	0.37	58
11-May	0.44	0.00	0.074	0.37	58
12-May	0.48	0.17	0.074	0.41	64
13-May	0.50	0.05	0.074	0.43	67
14-May	0.48	0.29	0.074	0.41	64
15-May	0.48	0.00	0.074	0.41	64
16-May	0.46	0.09	0.074	0.39	61
17-May	0.44	0.00	0.074	0.37	58
18-May	0.45	0.11	0.074	0.38	59
19-May	0.45	0.01	0.074	0.38	59
20-May	0.51	0.00	0.074	0.44	69
21-May	0.54	0.22	0.074	0.47	74
22-May	0.49	0.30	0.074	0.42	66

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
23-May	0.47	0.12	0.074	0.40	62
24-May	0.44	0.00	0.074	0.37	58
25-May	0.43	0.02	0.074	0.36	56
26-May	0.45	0.12	0.074	0.38	59
27-May	0.44	0.13	0.074	0.37	58
28-May	0.45	0.14	0.074	0.38	59
29-May	0.49	0.01	0.074	0.42	66
30-May	0.70	0.78	0.074	0.63	99
31-May	0.67	0.36	0.074	0.60	94
1-Jun	0.55	0.00	0.074	0.48	75
2-Jun	0.54	0.01	0.074	0.47	74
3-Jun	0.51	0.00	0.074	0.44	69
4-Jun	0.49	0.00	0.074	0.42	66
5-Jun	0.49	0.00	0.074	0.42	66
6-Jun	0.48	0.00	0.074	0.41	64
7-Jun	0.46	0.00	0.074	0.39	61
8-Jun	0.44	0.00	0.074	0.37	58
9-Jun	0.45	0.00	0.074	0.38	59
10-Jun	0.45	0.00	0.074	0.38	59
11-Jun	0.44	0.00	0.074	0.37	58
12-Jun	0.43	0.01	0.074	0.36	56
13-Jun	0.44	0.01	0.074	0.37	58
14-Jun	0.42	0.00	0.074	0.35	55
15-Jun	0.43	0.00	0.074	0.36	56
16-Jun	0.44	0.00	0.074	0.37	58
17-Jun	0.44	0.04	0.074	0.37	58
18-Jun	0.43	0.03	0.074	0.36	56
19-Jun	0.44	0.00	0.074	0.37	58
20-Jun	0.49	0.09	0.074	0.42	66
21-Jun	0.47	0.37	0.074	0.40	62
22-Jun	0.42	0.00	0.074	0.35	55
23-Jun	0.43	0.00	0.074	0.36	56
24-Jun	0.44	0.05	0.074	0.37	58
25-Jun	0.47	0.04	0.074	0.40	62
26-Jun	0.46	0.30	0.074	0.39	61
27-Jun	0.46	0.13	0.074	0.39	61
28-Jun	0.43	0.05	0.074	0.36	56
29-Jun	0.42	0.00	0.074	0.35	55
30-Jun	0.42	0.00	0.074	0.35	55
1-Jul	0.44	0.00	0.074	0.37	58
2-Jul	0.43	0.00	0.074	0.36	56
3-Jul	0.42	0.00	0.074	0.35	55
4-Jul	0.38	0.00	0.074	0.31	48
5-Jul	0.41	0.00	0.074	0.34	53
6-Jul	0.40	0.00	0.074	0.33	51
7-Jul	0.41	0.00	0.074	0.34	53
8-Jul	0.42	0.00	0.074	0.35	55
9-Jul	0.41	0.00	0.074	0.34	53
10-Jul	0.41	0.00	0.074	0.34	53

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
11-Jul	0.40	0.00	0.074	0.33	51
12-Jul	0.40	0.00	0.074	0.33	51
13-Jul	0.40	0.00	0.074	0.33	51
14-Jul	0.39	0.00	0.074	0.32	50
15-Jul	0.40	0.00	0.074	0.33	51
16-Jul	0.39	0.00	0.074	0.32	50
17-Jul	0.40	0.02	0.074	0.33	51
18-Jul	0.40	0.00	0.074	0.33	51
19-Jul	0.39	0.00	0.074	0.32	50
20-Jul	0.38	0.00	0.074	0.31	48
21-Jul	0.40	0.00	0.074	0.33	51
22-Jul	0.42	0.00	0.074	0.35	55
23-Jul	0.40	0.00	0.074	0.33	51
24-Jul	0.40	0.00	0.074	0.33	51
25-Jul	0.39	0.00	0.074	0.32	50
26-Jul	0.39	0.00	0.074	0.32	50
27-Jul	0.39	0.00	0.074	0.32	50
28-Jul	0.41	0.00	0.074	0.34	53
29-Jul	0.41	0.00	0.074	0.34	53
30-Jul	0.40	0.00	0.074	0.33	51
31-Jul	0.38	0.00	0.074	0.31	48
1-Aug	0.39	0.00	0.074	0.32	50
2-Aug	0.48	0.07	0.074	0.41	64
3-Aug	0.40	0.58	0.074	0.33	51
4-Aug	0.40	0.00	0.074	0.33	51
5-Aug	0.40	0.00	0.074	0.33	51
6-Aug	0.41	0.00	0.074	0.34	53
7-Aug	0.40	0.00	0.074	0.33	51
8-Aug	0.39	0.00	0.074	0.32	50
9-Aug	0.39	0.00	0.074	0.32	50
10-Aug	0.39	0.04	0.074	0.32	50
11-Aug	0.41	0.17	0.074	0.34	53
12-Aug	0.43	0.00	0.074	0.36	56
13-Aug	0.43	0.00	0.074	0.36	56
14-Aug	0.41	0.00	0.074	0.34	53
15-Aug	0.42	0.13	0.074	0.35	55
16-Aug	0.41	0.00	0.074	0.34	53
17-Aug	0.39	0.00	0.074	0.32	50
18-Aug	0.39	0.00	0.074	0.32	50
19-Aug	0.40	0.00	0.074	0.33	51
20-Aug	0.39	0.00	0.074	0.32	50
21-Aug	0.40	0.00	0.074	0.33	51
22-Aug	0.40	0.00	0.074	0.33	51
23-Aug	0.40	0.00	0.074	0.33	51
24-Aug	0.40	0.02	0.074	0.33	51
25-Aug	0.40	0.00	0.074	0.33	51
26-Aug	0.41	0.00	0.074	0.34	53
27-Aug	0.43	0.00	0.074	0.36	56
28-Aug	0.44	0.34	0.074	0.37	58

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
29-Aug	0.45	0.16	0.074	0.38	59
30-Aug	0.43	0.01	0.074	0.36	56
31-Aug	0.43	0.00	0.074	0.36	56
1-Sep	0.40	0.00	0.074	0.33	51
2-Sep	0.44	0.00	0.074	0.37	58
3-Sep	0.44	0.12	0.074	0.37	58
4-Sep	0.43	0.09	0.074	0.36	56
5-Sep	0.48	0.00	0.074	0.41	64
6-Sep	0.58	0.97	0.074	0.51	80
7-Sep	0.46	0.18	0.074	0.39	61
8-Sep	0.44	0.01	0.074	0.37	58
9-Sep	0.44	0.01	0.074	0.37	58
10-Sep	0.44	0.00	0.074	0.37	58
11-Sep	0.44	0.00	0.074	0.37	58
12-Sep	0.44	0.00	0.074	0.37	58
13-Sep	0.42	0.00	0.074	0.35	55
14-Sep	0.41	0.00	0.074	0.34	53
15-Sep	0.45	0.00	0.074	0.38	59
16-Sep	0.46	0.41	0.074	0.39	61
17-Sep	0.44	0.03	0.074	0.37	58
18-Sep	0.45	0.11	0.074	0.38	59
19-Sep	0.44	0.00	0.074	0.37	58
20-Sep	0.44	0.00	0.074	0.37	58
21-Sep	0.42	0.03	0.074	0.35	55
22-Sep	0.43	0.00	0.074	0.36	56
23-Sep	0.43	0.05	0.074	0.36	56
24-Sep	0.45	0.09	0.074	0.38	59
25-Sep	0.45	0.01	0.074	0.38	59
26-Sep	0.43	0.00	0.074	0.36	56
27-Sep	0.44	0.05	0.074	0.37	58
28-Sep	0.56	0.24	0.074	0.49	77
29-Sep	0.54	0.74	0.074	0.47	74
30-Sep	0.58	0.20	0.074	0.51	80
1-Oct	0.49	0.11	0.074	0.42	66
2-Oct	0.51	0.09	0.074	0.44	69
3-Oct	0.51	0.00	0.074	0.44	69
4-Oct	0.46	0.01	0.074	0.39	61
5-Oct	0.43	0.00	0.074	0.36	56
6-Oct	0.45	0.00	0.074	0.38	59
7-Oct	0.48	0.14	0.074	0.41	64
8-Oct	0.47	0.28	0.074	0.40	62
9-Oct	0.45	0.02	0.074	0.38	59
10-Oct	0.44	0.01	0.074	0.37	58
11-Oct	0.44	0.00	0.074	0.37	58
12-Oct	0.42	0.03	0.074	0.35	55
13-Oct	0.43	0.00	0.074	0.36	56
14-Oct	0.42	0.00	0.074	0.35	55
15-Oct	0.42	0.00	0.074	0.35	55
16-Oct	0.42	0.00	0.074	0.35	55

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
17-Oct	0.43	0.00	0.074	0.36	56
18-Oct	0.42	0.00	0.074	0.35	55
19-Oct	0.42	0.00	0.074	0.35	55
20-Oct	0.42	0.00	0.074	0.35	55
21-Oct	0.43	0.00	0.074	0.36	56
22-Oct	0.43	0.01	0.074	0.36	56
23-Oct	0.42	0.01	0.074	0.35	55
24-Oct	0.43	0.00	0.074	0.36	56
25-Oct	0.42	0.00	0.074	0.35	55
26-Oct	0.40	0.00	0.074	0.33	51
27-Oct	0.44	0.19	0.074	0.37	58
28-Oct	0.43	0.00	0.074	0.36	56
29-Oct	0.41	0.00	0.074	0.34	53
30-Oct	0.41	0.00	0.074	0.34	53
31-Oct	0.44	0.03	0.074	0.37	58
1-Nov	0.43	0.10	0.074	0.36	56
2-Nov	1.17	0.30	0.074	1.10	173
3-Nov	0.50	0.68	0.074	0.43	67
4-Nov	0.49	0.00	0.074	0.42	66
5-Nov	0.48	0.12	0.074	0.41	64
6-Nov	0.47	0.07	0.074	0.40	62
7-Nov	0.54	0.20	0.074	0.47	74
8-Nov	0.51	0.12	0.074	0.44	69
9-Nov	0.47	0.00	0.074	0.40	62
10-Nov	0.46	0.04	0.074	0.39	61
11-Nov	0.46	0.01	0.074	0.39	61
12-Nov	0.45	0.02	0.074	0.38	59
13-Nov	0.45	0.01	0.074	0.38	59
14-Nov	0.46	0.00	0.074	0.39	61
15-Nov	0.66	0.11	0.074	0.59	92
16-Nov	0.92	1.10	0.074	0.85	133
17-Nov	0.69	0.86	0.074	0.62	97
18-Nov	0.68	0.06	0.074	0.61	96
19-Nov	0.75	0.52	0.074	0.68	107
20-Nov	0.59	0.00	0.074	0.52	81
21-Nov	0.54	0.00	0.074	0.47	74
22-Nov	0.50	0.00	0.074	0.43	67
23-Nov	0.50	0.00	0.074	0.43	67
24-Nov	0.50	0.00	0.074	0.43	67
25-Nov	0.48	0.00	0.074	0.41	64
26-Nov	0.48	0.00	0.074	0.41	64
27-Nov	0.48	0.03	0.074	0.41	64
28-Nov	0.44	0.00	0.074	0.37	58
29-Nov	0.43	0.01	0.074	0.36	56
30-Nov	0.45	0.06	0.074	0.38	59
1-Dec	0.64	0.27	0.074	0.57	89
2-Dec	0.63	0.38	0.074	0.56	88
3-Dec	0.55	0.02	0.074	0.48	75
4-Dec	0.51	0.00	0.074	0.44	69

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)
5-Dec	0.50	0.00	0.074	0.43	67
6-Dec	0.48	0.00	0.074	0.41	64
7-Dec	0.46	0.00	0.074	0.39	61
8-Dec	0.47	0.00	0.074	0.40	62
9-Dec	0.46	0.00	0.074	0.39	61
10-Dec	0.47	0.00	0.074	0.40	62
11-Dec	0.46	0.00	0.074	0.39	61
12-Dec	0.46	0.00	0.074	0.39	61
13-Dec	0.45	0.02	0.074	0.38	59
14-Dec	0.44	0.01	0.074	0.37	58
15-Dec	0.46	0.04	0.074	0.39	61
16-Dec	0.48	0.03	0.074	0.41	64
17-Dec	0.46	0.00	0.074	0.39	61
18-Dec	0.47	0.02	0.074	0.40	62
19-Dec	0.45	0.04	0.074	0.38	59
20-Dec	0.48	0.15	0.074	0.41	64
21-Dec	0.68	0.15	0.074	0.61	96
22-Dec	0.78	0.30	0.074	0.71	111
23-Dec	0.93	0.47	0.074	0.86	135
24-Dec	0.73	0.15	0.074	0.66	103
25-Dec	0.56	0.00	0.074	0.49	77
26-Dec	0.56	0.01	0.074	0.49	77
27-Dec	0.56	0.00	0.074	0.49	77
28-Dec	0.52	0.09	0.074	0.45	70
29-Dec	0.50	0.01	0.074	0.43	67
30-Dec	0.50	0.00	0.074	0.43	67
31-Dec	0.51	0.04	0.074	0.44	69

City of Stanwood
2014 Comprehensive Sewer System Plan
Appendix F - Infiltration Data and Analyses

2009 population	6,073
2010 population	6,231
2011 population	6,220
2012 population	6,300
2013 population	6,340

(green)	Notable Rain Event (> 0.30 in.)
(blue)	Max Dry-Weather Infiltration - First Day

Max. Q_{res} for Infiltration (gpcd)
120

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)	Q_{avg} Dry-Weather Average (MGD)	Q_{res} Dry-Weather Average (gpcd)
2011							
23-Feb	0.70	0.22	0.074	0.63	101		
24-Feb	0.71	0.54	0.074	0.64	102		
25-Feb	0.67	0.02	0.074	0.60	96		
26-Feb	0.60	0.00	0.074	0.53	85		
27-Feb	0.71	0.13	0.074	0.64	102		
28-Feb	0.97	0.24	0.074	0.90	144		
1-Mar	0.81	0.04	0.074	0.74	118	0.72	104
2-Mar	0.74	0.09	0.074	0.67	107		
3-Mar	0.67	0.01	0.074	0.60	96		
4-Mar	0.66	0.07	0.074	0.59	94		
5-Mar	0.67	0.20	0.074	0.60	96		

Note:
-Q_{avg} = Average of March 1st through March 4th only; February 22nd through February 28th WWTP flows could be attributed to inflow events

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)	Q_{avg} Dry-Weather Average (MGD)	Q_{res} Dry-Weather Average (gpcd)
2011							
3-May	0.59	0.45	0.074	0.52	83		
4-May	0.56	0.00	0.074	0.49	78		
5-May	0.56	0.05	0.074	0.49	78		
6-May	0.61	0.14	0.074	0.54	86		
7-May	0.83	0.30	0.074	0.76	122		
8-May	0.79	0.71	0.074	0.72	115		
9-May	0.69	0.00	0.074	0.62	99	0.70	101
10-May	0.62	0.00	0.074	0.55	88		
11-May	0.70	0.08	0.074	0.63	101		
12-May	0.87	0.00	0.074	0.80	128		
13-May	0.69	0.01	0.074	0.62	99		
14-May	0.65	0.01	0.074	0.58	93		
15-May	1.07	0.62	0.074	1.00	160		

Note:
-Q_{avg} = Average of May 9th through May 14th only; May 3rd through May 8th WWTP flows could be attributed to inflow events

Date	Q (MGD)	Precip. (in.)	Q_{ind} (MGD)	Q_{res} (MGD)	Q_{res} (gpcd)	Q_{avg} Dry-Weather Average (MGD)	Q_{res} Dry-Weather Average (gpcd)
2013							
27-Jan	0.94	0.44	0.074	0.87	137		
28-Jan	1.38	0.60	0.074	1.31	206		
29-Jan	1.26	0.93	0.074	1.19	187		
30-Jan	1.33	0.69	0.074	1.26	198		
31-Jan	1.14	0.35	0.074	1.07	168		
1-Feb	0.91	0.08	0.074	0.84	132	0.75	107
2-Feb	0.78	0.01	0.074	0.71	111		
3-Feb	0.74	0.00	0.074	0.67	105		
4-Feb	0.75	0.12	0.074	0.68	107		
5-Feb	0.69	0.00	0.074	0.62	97		
6-Feb	0.65	0.00	0.074	0.58	91		
7-Feb	0.75	0.14	0.074	0.68	107		

Note:
-Q_{avg} = Average of February 1st through February 6th only; January 27th through January 31st WWTP flows could be attributed to inflow events

APPENDIX G

FUTURE DEVELOPMENT SEWER FLOW PROJECTIONS

Appendix G - Future Development Sewer Flow Projections

Year	STA Service Area Population	STA Service Area Employees	Avg. Annual Plant Flow (GPD)[2]	Avg. Annual Gallons per Day per ERU	Available Avg. Annual Plant Flow ERUs	Max. Month Plant Flow (GPD)	Max. Mo. Gallons per Day per ERU	Available Max. Month Plant Flow ERUs	ERUs[1]	Surplus or Deficient Wastewater Treatment Plant ERU Capacity	
2008	5,885	NA	545,833	265		710,000	345		2,060		
2009	6,073	NA	553,161			794,516					
2010	6,231	NA	545,709			660,323					
2011	6,220	NA	559,983			808,710					
2012	6,300	NA	596,801			778,710					
2013	**6,340**	**0**	**523,495**	**239**	**6,264**	**753,548**	**345**	**4,352**	**2,186**	**2,166**	
2014	6,530	0	653,000	290	5,172	939,965	417	3,593	2,252	1,342	
2015	6,770	64	679,240	290	5,172	977,736	417	3,593	2,342	1,251	
2016	7,010	129	705,515	290	5,172	1,015,558	417	3,593	2,433	1,161	
2017	7,250	193	731,755	290	5,172	1,053,329	417	3,593	2,523	1,070	
2018	7,490	258	758,030	290	5,172	1,091,151	417	3,593	2,614	979	
2019	7,730	322	784,270	290	5,172	1,128,922	417	3,593	2,704	889	
2020	7,970	387	810,545	290	5,172	1,166,744	417	3,593	2,795	798	
2021	**8,210**	**451**	**836,785**	**290**	**5,172**	**1,204,515**	**417**	**3,593**	**2,885**	**708**	
2022	8,416	496	858,960	290	5,172	1,236,435	417	3,593	2,962	631	
2023	8,622	542	881,170	290	5,172	1,268,405	417	3,593	3,039	555	<< WWTP at 85% of capacity.[3]
2024	8,828	587	903,345	290	5,172	1,300,325	417	3,593	3,115	478	
2025	9,034	632	925,520	290	5,172	1,332,245	417	3,593	3,191	402	
2026	9,240	677	947,695	290	5,172	1,364,165	417	3,593	3,268	325	
2027	9,446	723	969,905	290	5,172	1,396,135	417	3,593	3,345	249	
2028	9,652	768	992,080	290	5,172	1,428,055	417	3,593	3,421	172	
2029	9,858	813	1,014,255	290	5,172	1,459,975	417	3,593	3,497	96	
2030	10,064	859	1,036,465	290	5,172	1,491,946	417	3,593	3,574	19	<< WWTP at capacity.
2031	10,269	904	1,058,540	290	5,172	1,523,722	417	3,593	3,650	-57	
2032	10,475	949	1,080,715	290	5,172	1,555,642	417	3,593	3,727	-133	
2033	10,681	994	1,102,890	290	5,172	1,587,561	417	3,593	3,803	-210	
2034	10,887	1,040	1,125,100	290	5,172	1,619,532	417	3,593	3,880	-286	
2035	**11,085**	**1,085**	**1,146,475**	**290**	**5,172**	**1,650,300**	**417**	**3,593**	**3,953**	**-360**	

NOTES:

1 - ERUs were calculated using an average household size of 2.9 people per house.

2 - The projected flows presented in Appendix G were estimated assuming a future average annual influent flow rate of 100 gallons per capita per day, which is in accordance with State Department of Ecology's (Ecology) Criteria for Sewage Works Design (commonly known as the "Orange Book"). The projected flows presented in Appendix E were estimated assuming a future average annual influent flow rate of 35 gallons per day per person per shift for future sewer drainage subbasins where primarily commercial and industrial development is expected, which is in accordance with the Ecology's sewer system design guidelines.

3 - The City must begin facility planning, design, and construction to replace the existing wastewater treatment plant (WWTP) by the time the existing WWTP exceeds 85% of its capacity. The City should plan to begin facility planning and design to replace the existing WWTP prior to this time.

Parameter	Limit	85% of Limit
Flow (GPD)	1,500,000	1,275,000
BOD (ppd)	4,100	3,485
TSS (ppd)	4,100	3,485

APPENDIX H

AVERAGE AND PEAK MONTHLY BOD AND TSS

City of Stanwood
2014 Comprehensive Sewer System Plan
Appendix H - Average and Peak Monthly BOD and TSS

Year	Month	Days/Mo.	Max. Day BOD_i (mg/L)	Max. Day BOD_i (ppd)	Avg. Monthly BOD_i (mg/L)	Avg. Monthly BOD_i (ppd)	Avg. Monthly BOD_e (ppd)	Max. Day TSS_i (mg/L)	Max. Day TSS_i (ppd)	Avg. Monthly TSS_i (mg/L)	Avg. Monthly TSS_i (ppd)	Avg. Monthly TSS_e (ppd)
2005	Jan-05	31	683		276	1,273	20	967		317	1,417	48
	Feb-05	28	239		206	828	10	296		243	980	16
	Mar-05	31	492		255	1,033	57	840		340	1,391	119
	Apr-05	30	314		245	1,145	68	308		249	1,169	153
	May-05	31	427		281	1,119	13	393		302	1,134	13
	Jun-05	30	447		339	1,372	NA	449		299	1,210	NA
	Jul-05	31	644		439	1,703	NA	732		423	1,642	NA
	Aug-05	31	427		336	1,382	42	404		295	1,221	40
	Sep-05	30	292		189	680	14	442		336	1,212	60
	Oct-05	31	322		152	575	7	333		297	1,133	66
	Nov-05	30	261		134	626	63	314		282	1,328	162
	Dec-05	31	287		185	884	133	490		249	1,187	195
	Average				**253**	**1,052**	**43**			**303**	**1,252**	**87**
	Max Month				**439**	**1,703**	**133**			**423**	**1,642**	**195**
2006	Jan-06	31	440		203	1,202	19	464		227	1,395	48
	Feb-06	28	404		293	1,492	34	339		239	1,204	39
	Mar-06	31	330		261	1,157	34	327		233	1,033	34
	Apr-06	30	326		291	1,311	28	293		249	1,122	21
	May-06	31	397		343	1,327	18	413		303	1,172	20
	Jun-06	30	440		352	1,393	11	369		320	1,268	24
	Jul-06	31	482		428	1,625	13	403		338	1,280	24
	Aug-06	31	376		322	1,146	8	396		315	1,120	18
	Sep-06	30	374		308	1,194	10	469		323	1,254	24
	Oct-06	31	344		270	1,020	10	397		324	1,228	21
	Nov-06	30	593		256	1,358	23	571		316	1,763	39
	Dec-06	31	912		375	2,028	33	282		230	1,272	44
	Average				**309**	**1,354**	**20**			**285**	**1,259**	**30**
	Max Month				**428**	**2,028**	**34**			**338**	**1,763**	**48**
2007	Jan-07	31	395	1,878	260	1,384	58	385	1,830	214	1,121	49
	Feb-07	28	309	1,340	270	1,198	22	274	1,188	213	943	30
	Mar-07	31	392	1,798	288	1,373	19	298	1,392	241	1,143	17
	Apr-07	30	477	2,029	384	1,676	15	356	1,485	289	1,253	19
	May-07	31	530	2,033	408	1,593	16	403	1,546	310	1,207	20
	Jun-07	30	579	2,173	433	1,689	16	423	1,799	359	1,406	24
	Jul-07	31	549	2,023	461	1,707	15	423	1,588	345	1,270	9
	Aug-07	31	580	2,273	422	1,572	23	427	1,531	305	1,136	30
	Sep-07	30	461	1,696	416	1,564	15	409	1,774	355	1,339	14
	Oct-07	31	469	1,956	406	1,672	19	455	2,011	331	1,371	30
	Nov-07	30	470	1,789	398	1,559	18	414	1,617	331	1,298	21
	Dec-07	31	633	3,168	390	1,820	18	502	2,638	302	1,442	28
	Average				**378**	**1,567**	**21**			**300**	**1,244**	**24**
	Max Month				**461**	**1,820**	**58**			**359**	**1,442**	**49**
2008	Jan-08	31	498	2,492	316	1,648	30	504	2,816	258	1,356	42
	Feb-08	29	389	2,332	302	1,445	15	312	1,535	235	1,112	17
	Mar-08	31	352	1,891	295	1,369	11	281	1,252	238	1,103	13
	Apr-08	30	445	2,153	309	1,535	12	314	1,519	247	1,221	14
	May-08	31	371	1,551	281	1,339	13	320	1,489	252	1,203	14
	Jun-08	30	375	1,564	311	1,412	18	294	1,280	250	1,139	25
	Jul-08	31	544	2,178	396	1,515	16	342	1,266	287	1,093	25
	Aug-08	31	576	2,210	415	1,653	15	452	1,630	311	1,238	19
	Sep-08	30	634	2,274	433	1,669	16	344	1,345	316	1,221	15
	Oct-08	31	731	2,865	486	1,828	19	593	2,324	359	1,348	16
	Nov-08	30	437	2,318	338	1,706	4	402	1,813	269	1,348	40
	Dec-08	31	549	2,564	310	1,585	10	502	2,345	281	1,401	22
	Average				**349**	**1,559**	**15**			**275**	**1,232**	**22**
	Max Month				**486**	**1,828**	**30**			**359**	**1,401**	**42**

City of Stanwood
2014 Comprehensive Sewer System Plan
Appendix H - Average and Peak Monthly BOD and TSS

Year	Month	Days/Mo.	Max. Day BOD_i (mg/L)	Max. Day BOD_i (ppd)	Avg. Monthly BOD_i (mg/L)	Avg. Monthly BOD_i (ppd)	Avg. Monthly BOD_e (ppd)	Max. Day TSS_i (mg/L)	Max. Day TSS_i (ppd)	Avg. Monthly TSS_i (mg/L)	Avg. Monthly TSS_i (ppd)	Avg. Monthly TSS_e (ppd)
2009	Jan-09	31	340	1,645	193	1,137	54	379	2,108	249	1,542	116
	Feb-09	28	375	1,689	325	1,398	7	456	2,055	361	1,558	21
	Mar-09	31	353	1,553	283	1,289	8	420	1,786	312	1,425	20
	Apr-09	30	433	1,950	273	1,285	18	442	1,991	301	1,421	38
	May-09	31	416	2,325	313	1,505	19	635	3,548	324	1,562	36
	Jun-09	30	615	2,257	350	1,340	11	519	2,034	343	1,322	23
	Jul-09	31	482	1,889	372	1,377	9	449	1,648	326	1,202	7
	Aug-09	31	564	1,976	367	1,333	11	554	2,049	391	1,424	10
	Sep-09	30	665	2,496	427	1,611	15	593	2,226	384	1,450	14
	Oct-09	31	400	1,811	313	1,451	17	411	1,680	308	1,406	33
	Nov-09	30	704	3,405	329	1,818	35	781	3,778	318	1,742	44
	Dec-09	31	1,014	4,651	375	1,851	20	846	3,881	369	1,813	47
	Average				**327**	**1,450**	**19**			**332**	**1,489**	**34**
	Max Month				**427**	**1,851**	**54**			**391**	**1,813**	**116**
2010	Jan-10	31	459	2,980	304	1,793	48	449	3,310	298	1,769	89
	Feb-10	28	344	1,655	263	1,239	14	387	1,717	304	1,429	71
	Mar-10	31	416	1,978	262	1,153	16	323	1,308	243	1,059	28
	Apr-10	30	369	1,660	273	1,393	29	340	1,475	247	1,274	53
	May-10	31	572	2,338	403	1,688	20	520	2,125	365	1,540	22
	Jun-10	30	476	2,702	288	1,427	13	514	3,147	315	1,583	24
	Jul-10	31	515	1,873	408	1,466	14	464	1,664	370	1,330	12
	Aug-10	31	830	2,838	487	1,757	10	679	2,322	421	1,522	14
	Sep-10	30	538	2,423	432	1,796	11	602	2,711	360	1,503	19
	Oct-10	31	477	1,750	372	1,423	8	386	1,441	327	1,253	15
	Nov-10	30	360	1,681	253	1,227	11	403	1,784	270	1,324	28
	Dec-10	31	327	1,664	234	1,258	6	294	1,672	229	1,247	34
	Average				**332**	**1,468**	**17**			**312**	**1,403**	**34**
	Max Month				**487**	**1,796**	**48**			**421**	**1,769**	**89**
2011	Jan-11	31	782	3,667	395	2,330	17	552	3,131	292	1,792	33
	Feb-11	28	370	1,821	250	1,294	6	404	2,055	273	1,420	14
	Mar-11	31	327	1,854	234	1,371	22	312	1,707	213	1,244	31
	Apr-11	30	270	1,284	204	1,091	17	317	1,824	219	1,191	31
	May-11	31	346	1,443	226	1,108	6	302	1,464	253	1,242	22
	Jun-11	30	515	1,933	360	1,387	12	465	1,745	344	1,334	23
	Jul-11	31	530	1,926	469	1,691	20	421	1,544	371	1,338	39
	Aug-11	31	534	1,915	442	1,578	19	447	1,678	343	1,225	18
	Sep-11	30	503	1,846	430	1,557	24	421	1,545	350	1,269	28
	Oct-11	31	511	1,918	442	1,611	17	517	1,854	376	1,370	24
	Nov-11	30	414	1,830	319	1,384	28	329	1,372	234	1,029	47
	Dec-11	31	531	2,246	419	1,763	36	366	1,587	303	1,272	43
	Average				**349**	**1,514**	**19**			**298**	**1,311**	**29**
	Max Month				**469**	**2,330**	**36**			**376**	**1,792**	**47**

City of Stanwood
2014 Comprehensive Sewer System Plan
Appendix H - Average and Peak Monthly BOD and TSS

Year	Month	Days/Mo.	Max. Day BOD_i (mg/L)	Max. Day BOD_i (ppd)	Avg. Monthly BOD_i (mg/L)	Avg. Monthly BOD_i (ppd)	Avg. Monthly BOD_e (ppd)	Max. Day TSS_i (mg/L)	Max. Day TSS_i (ppd)	Avg. Monthly TSS_i (mg/L)	Avg. Monthly TSS_i (ppd)	Avg. Monthly TSS_e (ppd)
2012	Jan-12	31	410	1,710	309	1,423	19	398	1,626	283	1,276	47
	Feb-12	29	392	1,954	253	1,526	30	320	1,679	208	1,282	48
	Mar-12	31	373	1,742	221	1,303	20	280	1,471	209	1,272	41
	Apr-12	30	318	1,990	246	1,298	21	348	1,567	250	1,285	51
	May-12	31	466	1,632	242	1,162	15	591	2,070	301	1,497	46
	Jun-12	30	450	1,764	388	1,587	12	383	1,675	325	1,330	22
	Jul-12	31	753	3,077	437	1,722	17	518	1,944	340	1,336	24
	Aug-12	31	613	2,096	462	1,633	14	448	1,607	357	1,265	22
	Sep-12	30	600	2,152	415	1,493	9	607	2,177	388	1,396	17
	Oct-12	31	519	1,861	390	1,540	15	485	1,739	316	1,264	27
	Nov-12	30	397	1,722	276	1,354	9	395	1,713	251	1,242	33
	Dec-12	31	293	1,683	226	1,427	17	282	1,529	193	1,214	38
	Average				**322**	**1,456**	**17**			**285**	**1,305**	**35**
	Max Month				**462**	**1,722**	**30**			**388**	**1,497**	**51**
	Sum (lbs/Yr.)											
	Growth (%)											
2013	Jan-13	31	609	2,844	295	1,786	20	384	3,005	253	1,588	45
	Feb-13	28	345	1,772	299	1,497	28	292	1,427	260	1,297	73
	Mar-13	31	443	1,921	300	1,454	11	401	1,739	281	1,358	23
	Apr-13	30	674	2,530	381	1,625	9	515	1,933	335	1,427	30
	May-13	31	530	2,166	375	1,499	12	380	1,500	337	1,344	22
	Jun-13	30	461	1,725	385	1,463	14	538	1,974	395	1,498	21
	Jul-13	31	568	2,037	394	1,337	11	424	1,384	337	1,135	20
	Aug-13	31	540	1,922	474	1,624	8	730	2,374	439	1,498	10
	Sep-13	30	625	2,241	459	1,689	14	755	2,708	457	1,683	19
	Oct-13	31	553	1,937	417	1,540	9	645	2,313	432	1,594	13
	Nov-13	30	529	2,118	409	1,739	12	539	2,158	386	1,634	19
	Dec-13	31	489	1,876	373	1,677	14	523	2,050	347	1,561	23
	Average				**380**	**1,578**	**14**			**355**	**1,468**	**27**
	Max Month				**474**	**1,786**	**28**			**457**	**1,683**	**73**
2005-2013	**Average**				**333**	**1,444**				**305**	**1,329**	
2005-2013	**Max Month**				**487**	**2,330**				**457**	**1,813**	

APPENDIX I

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.

Section 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. Otherwise, connection to the public sewer is required where the closest point on the building to an available sewer main is within 200 feet of that sewer main AND one of the following is true:

The property has a failed or failing septic system; OR

Buildings generating sewage are proposed as part of a project or development; OR

Improvements are proposed that would require an expansion of an existing septic drain field; OR

A property owner has been included in a Local Improvement District (LID) for sewer connection.

In the case of private residential or commercial developments where the developed property abuts a right-of-way in which a public sewer is located or where a service connection is otherwise provided, connection of all structures generating sewage shall be required to connect to the public sewer regardless of distance from the public sewer.

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 x 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)

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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 are covered by the UPC as adopted by the City of Stanwood. Inspection of the sewer is the responsibility of the City.

When a new main is being installed in front or alongside of existing properties, a side sewer shall stubbed to the existing lots at their property line.

All side sewers and individual grinders pumps shall be operated and maintained by the respective property/building owner from the building to the sewer main. The property/building owner shall be responsible for all repairs of the side sewer and/or grinder pump, including repairs in the public right-of-way or sewer easement.

5B.140 Grease Traps and Interceptors

Grease traps and interceptors shall be 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 . 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.

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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 may be introduced into the sewer system shall have a grease trap or grease interceptor to prevent the discharge of fat, oil, and grease waste. Such pretreatment facilities shall be either a grease trap or grease 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..

Grease 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 grease 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.

All grease interceptors and grease traps shall be properly installed, maintained and operated by the user at the user's expense. The pretreatment facilities shall be kept in continuous operation at all times, and shall be maintained to provide efficient operation. Cleaning must be performed by a service contractor qualified to perform such cleaning, or in a manner approved by the City. All material removed shall be disposed of in accordance with all state and federal regulations. Oil and grease waste and grit removed from such facilities shall not be disposed of in the sanitary or storm sewer. Furthermore, the use of hot water, enzymes, bacteria, chemicals or other agents or devices that cause the contents of a pretreatment device to be discharged into the sanitary sewer system is prohibited. Records of maintenance shall be made readily available on-site to the City for review and inspection, and must be maintained for a minimum of five years. All maintenance records shall be submitted on a routine basis for businesses whose operations are known to generate high levels of oil and grease or who have failed in the past to properly maintain their pretreatment facilities and fail to produce a discharge quality in compliance with the City's requirements.

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

<u>Motor</u>

- 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

<u>STANDARD DETAILS</u>

S–1	TYPE 1 MANHOLE
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
S–11	GREASE INTERCEPTOR
S–12	INDOOR GREASE TRAP
WSDOT B–85.50–01	DROP CONNECTIONS
WSDOT B–85.20–00	SIDE SEWER CONNECTION
WSDOT B–90.40–00	CONCRETE THRUST BLOCK
WSDOT B–55.20–00	PIPE ZONE BEDDING AND BACKFILL

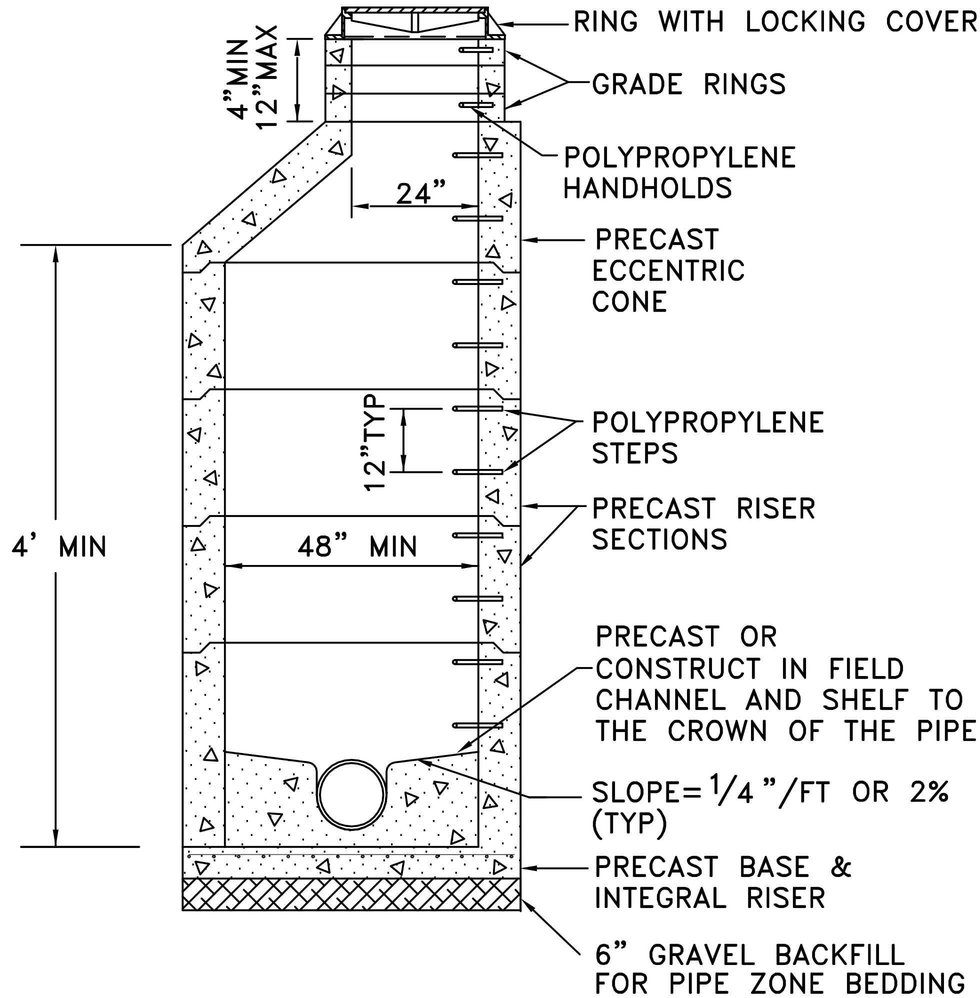
City of Stanwood

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.

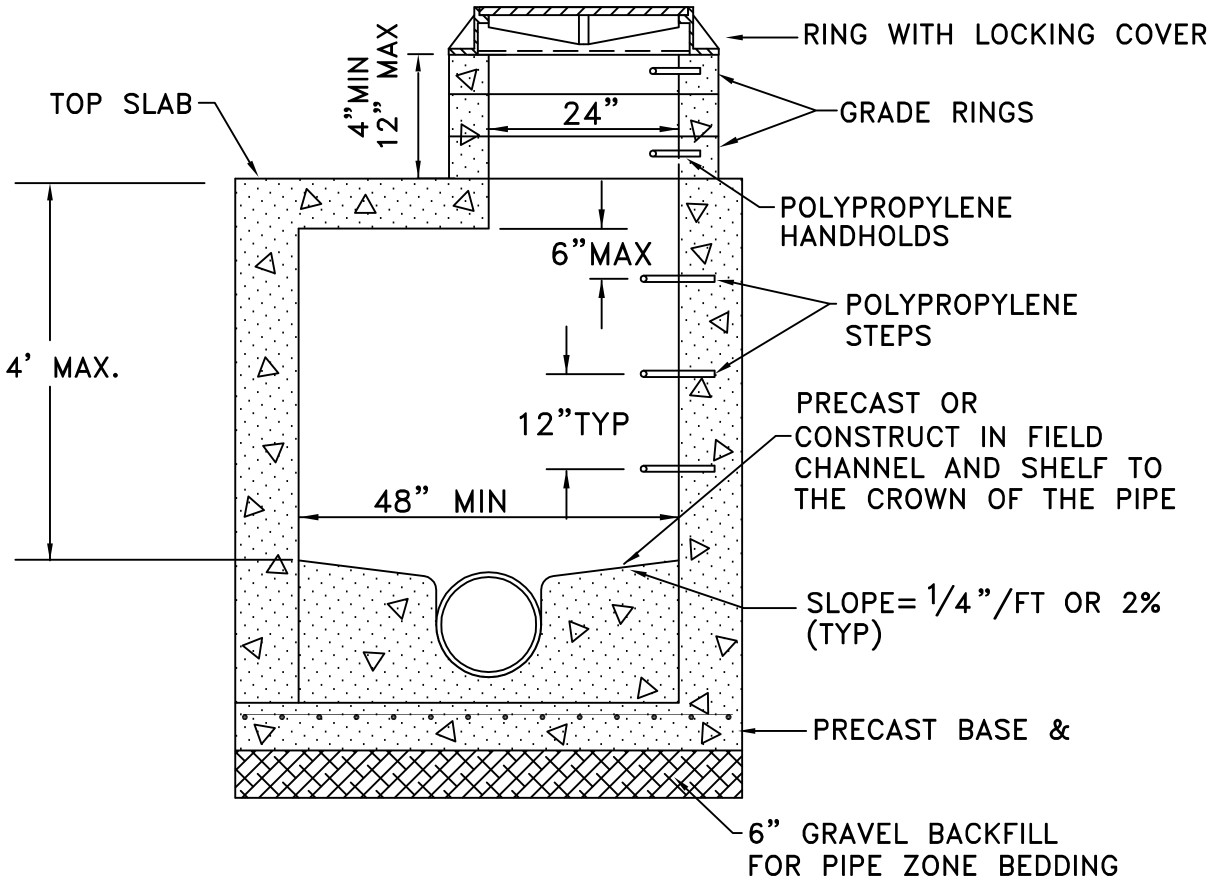
2. STEPS IN MANHOLE SHALL HAVE 6" MINIMUM CLEARANCE. HANDHOLES IN ADJUSTMENT SECTION SHALL HAVE 3" MINIMUM CLEARANCE THE FIRST STEP OR HANDHOLD SHALL BE A MAXIMUM OF 12" FROM THE TOP OF THE COVER.

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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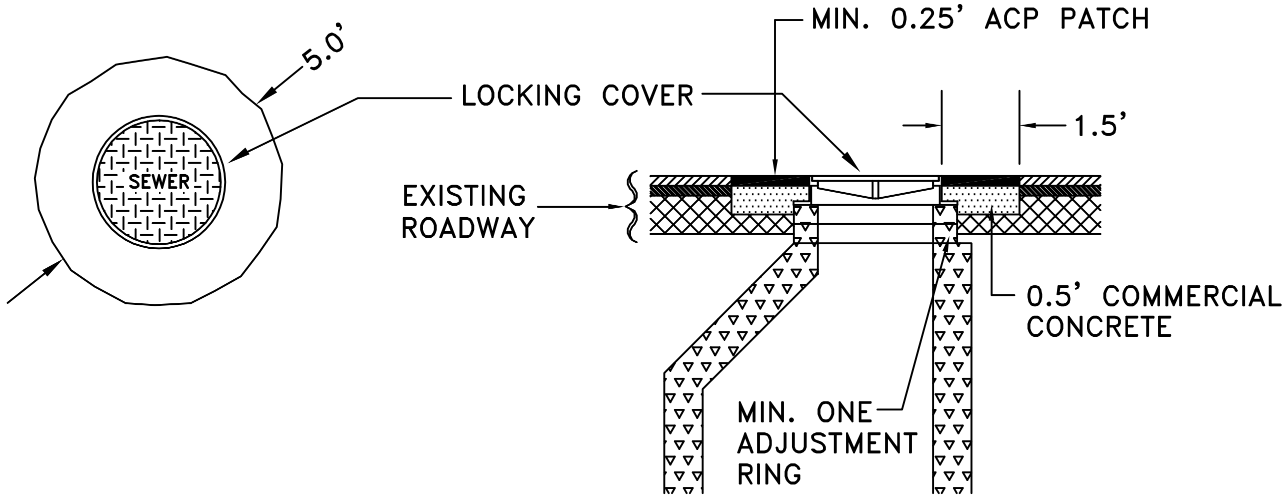
4. SEE DETAIL S-3 FOR MANHOLE COLLAR INSTALLATION.

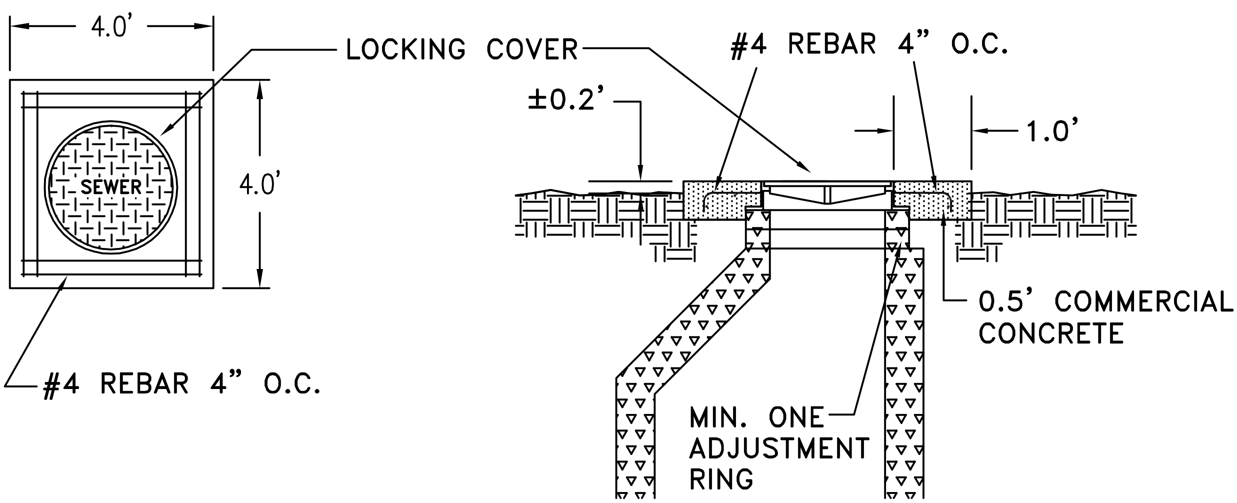
5. A SEWER GUARD SHALL BE INSTALLED IN ANY MANHOLE SUBJECT TO FLOODING.

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

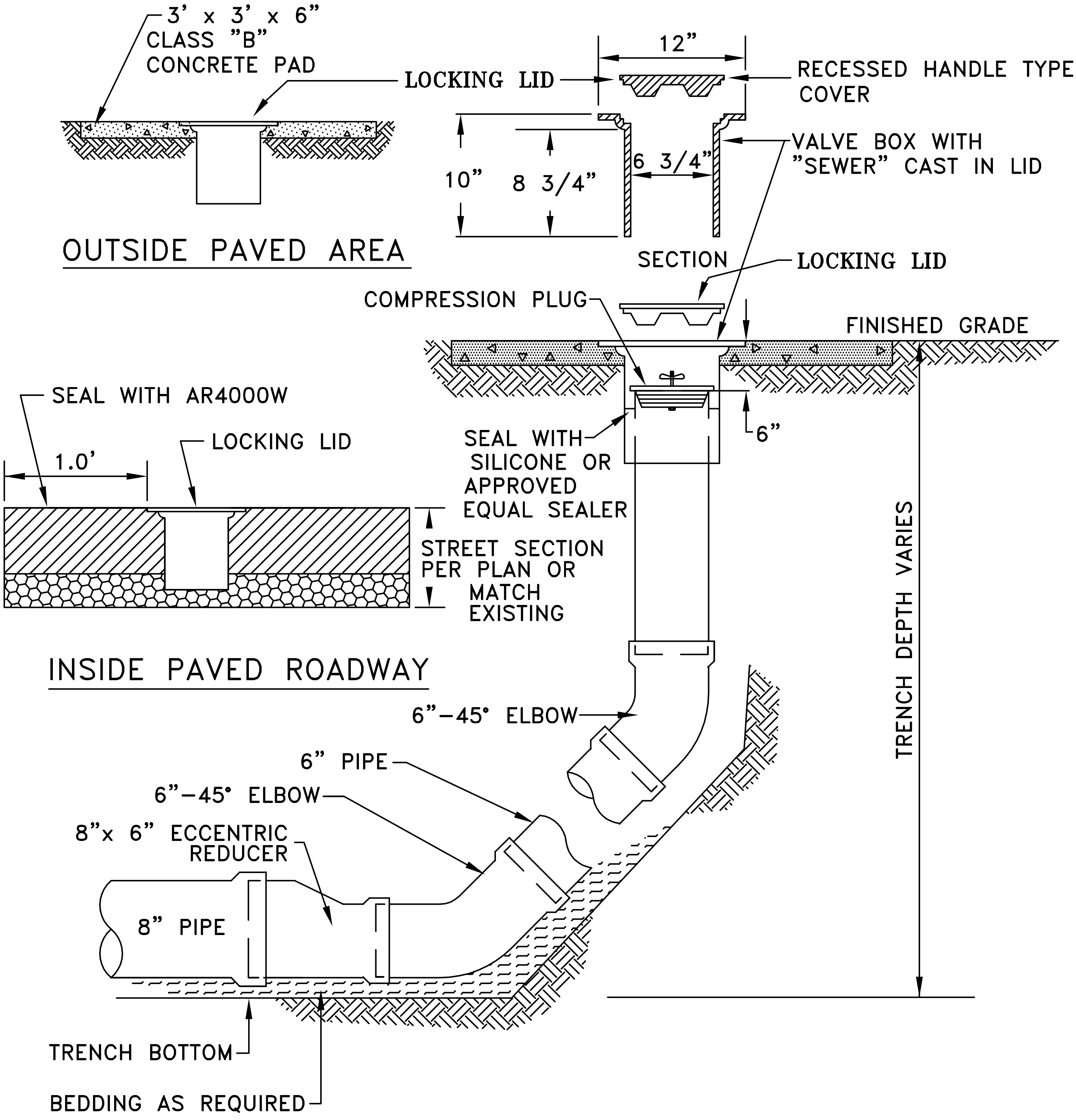


MANHOLE OUTSIDE ASPHALT



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-3



NOTE:

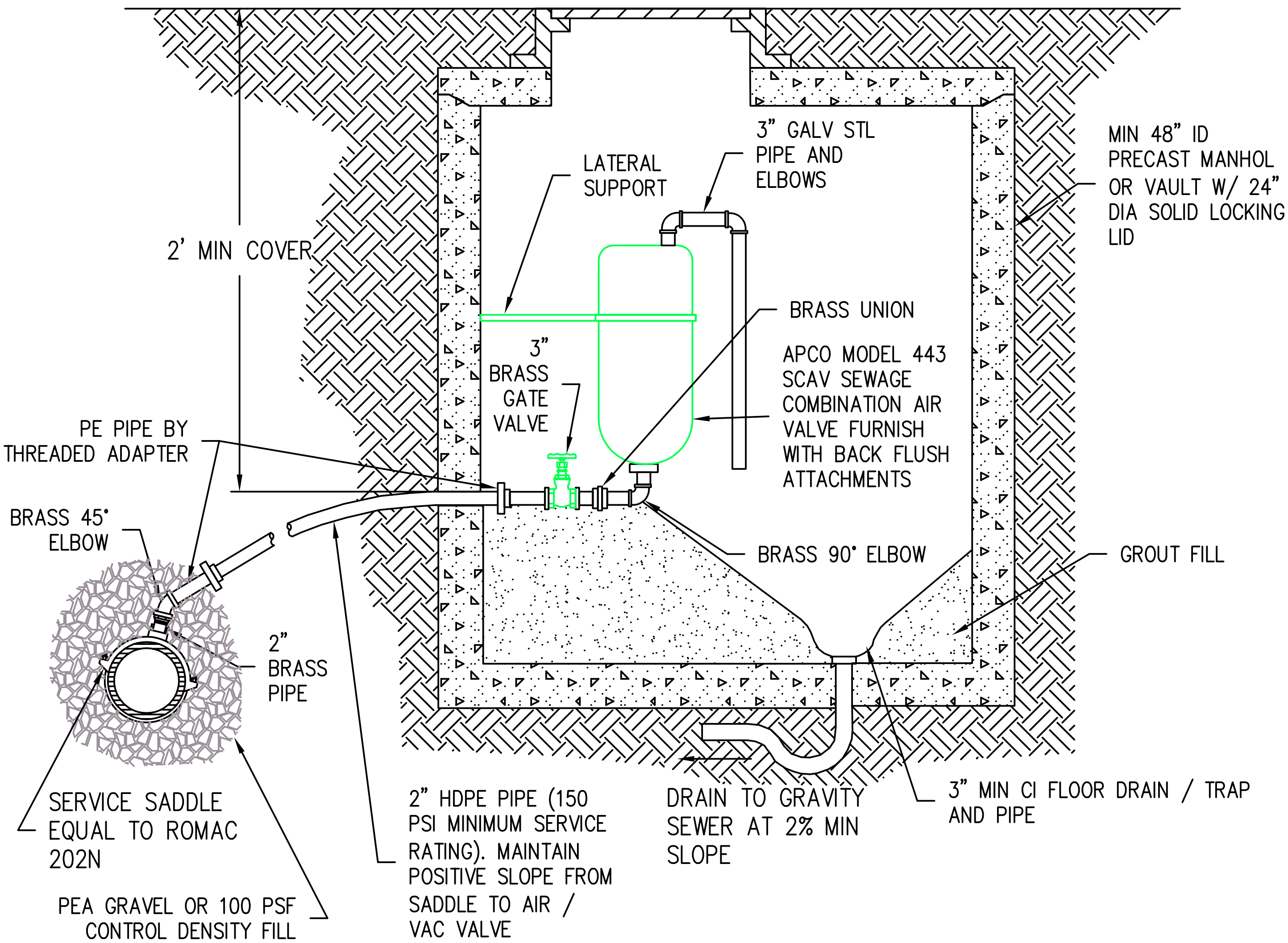
ALL SEWER PIPE SHALL BE ASTM 3034
SDR 35.

City of Stanwood

SEWER SYSTEM STANDARD DETAIL

CLEANOUT

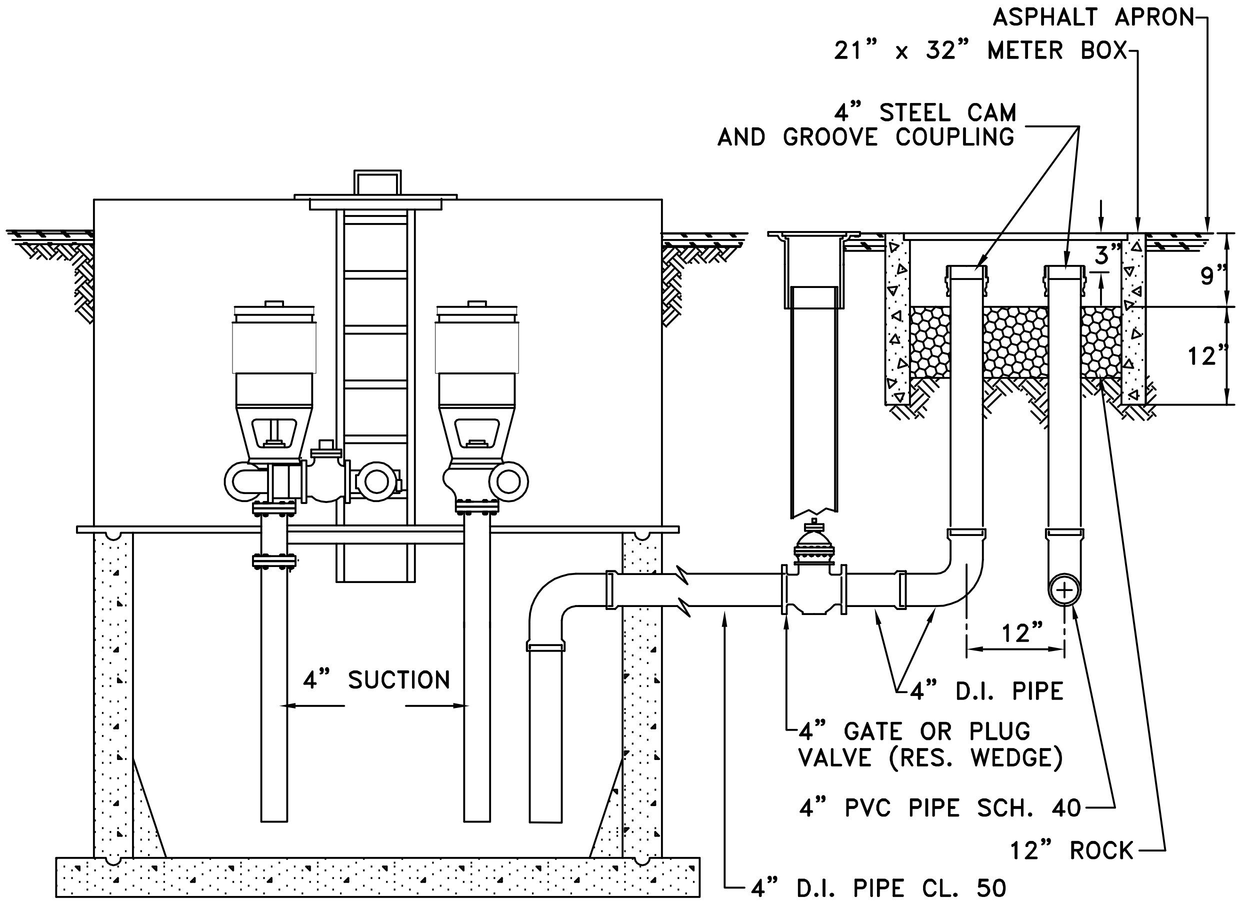
File: STADETS04	Revised: OCT 14, 2003	Printed: OCT 14, 2003	DRAWING NO.	S-4



NOTE:

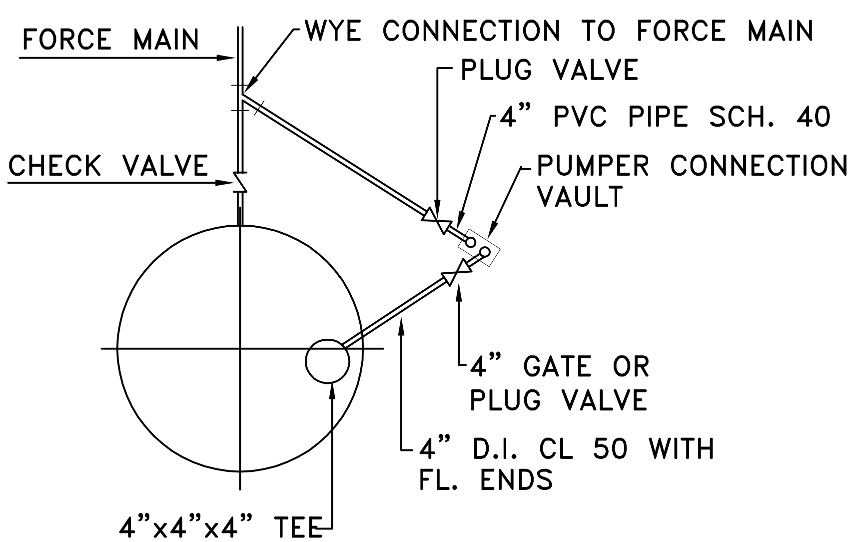
1. LOCATE AIR RELEASE ASSEMBLY IN SIDEWALK WHEN POSSIBLE.

City of Stanwood	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-5



LIFT STATION

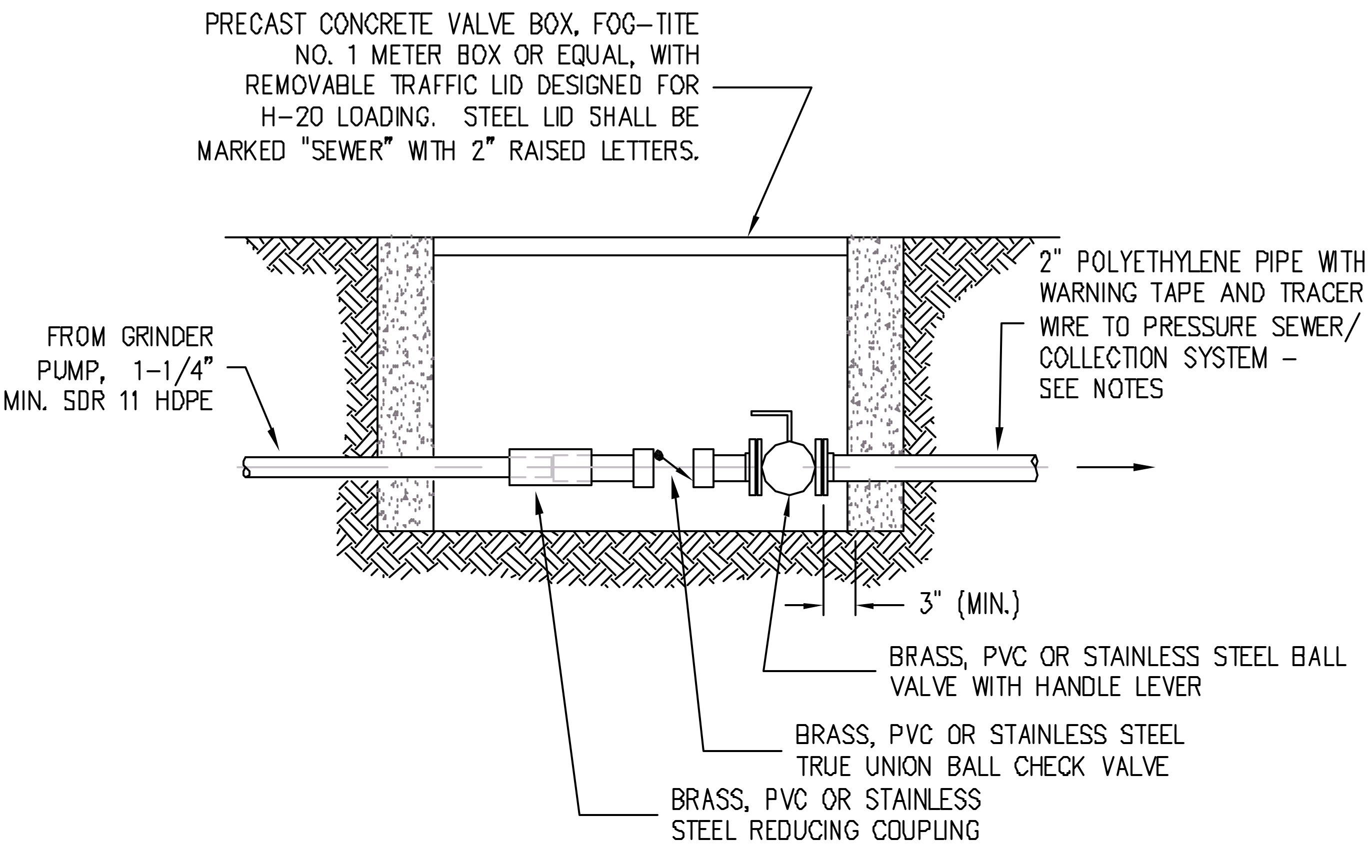
PUMPER CONNECTION VAULT



PLAN VIEW

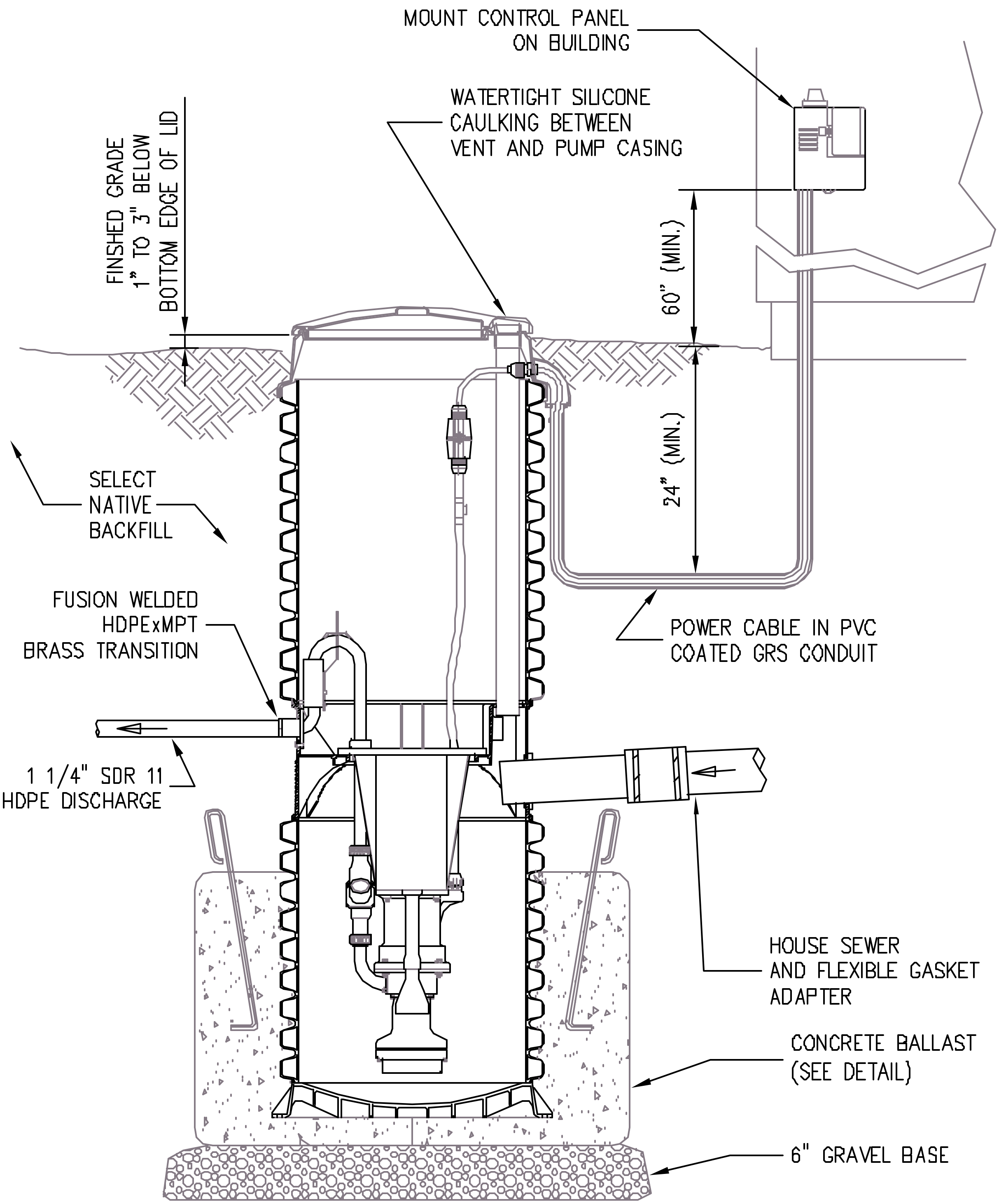
NOTE:
ENGINEER TO REVISE PIPE SIZING AS REQUIRED FOR SPECIFIC APPLICATIONS

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	

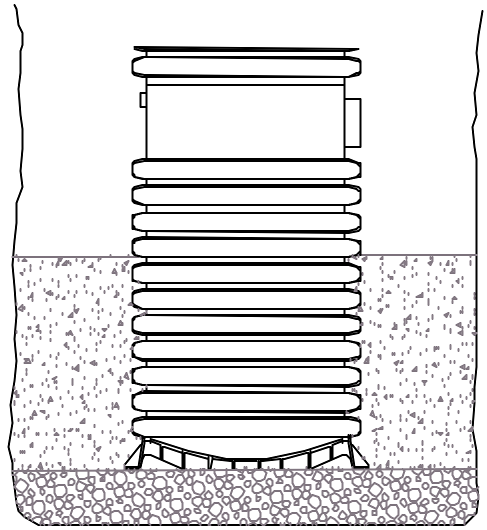


NOTES:
CONNECTION TO THE FORCE MAIN SHALL BE BY FUSION WELDED SADDLE OR ROMAC SERVICE SADDLE WITH STAINLESS STEEL STRAPS. CONNECTION TO A 2-INCH FORCE MAIN MAY ALSO BE MADE BY A BRASS, COPPER, STAINLESS STEEL OR PVC SCH 40 COMPRESSION TEE AND FITTING.

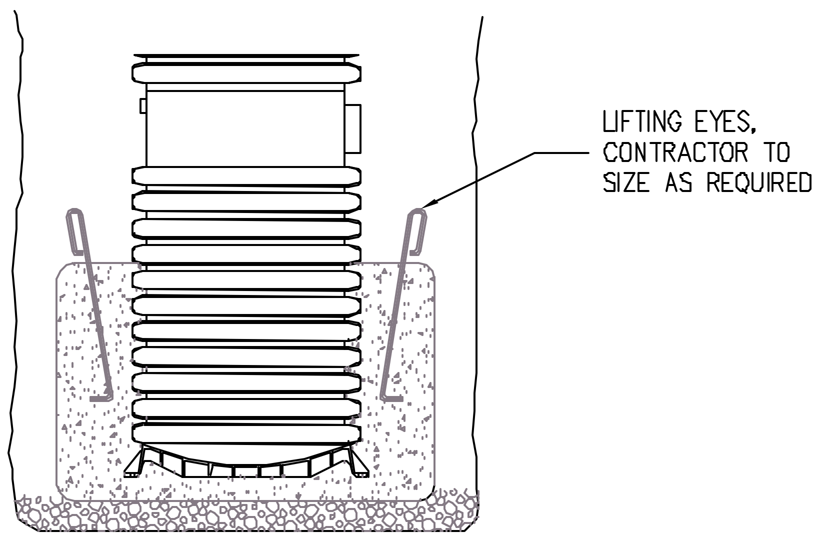
City of Stanwood		SEWER SYSTEM STANDARD DETAIL
		TYPICAL PRESSURE SEWER SERVICE DETAIL
File: stdets07 / Revised: MAR 10, 2004 / Printed: MAR 10, 2004		DRAWING NO. S-7



City of Stanwood		SEWER SYSTEM STANDARD DETAIL **TYPICAL E-1 GRINDER PUMP INSTALLATION**
File: stdets08 | 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.

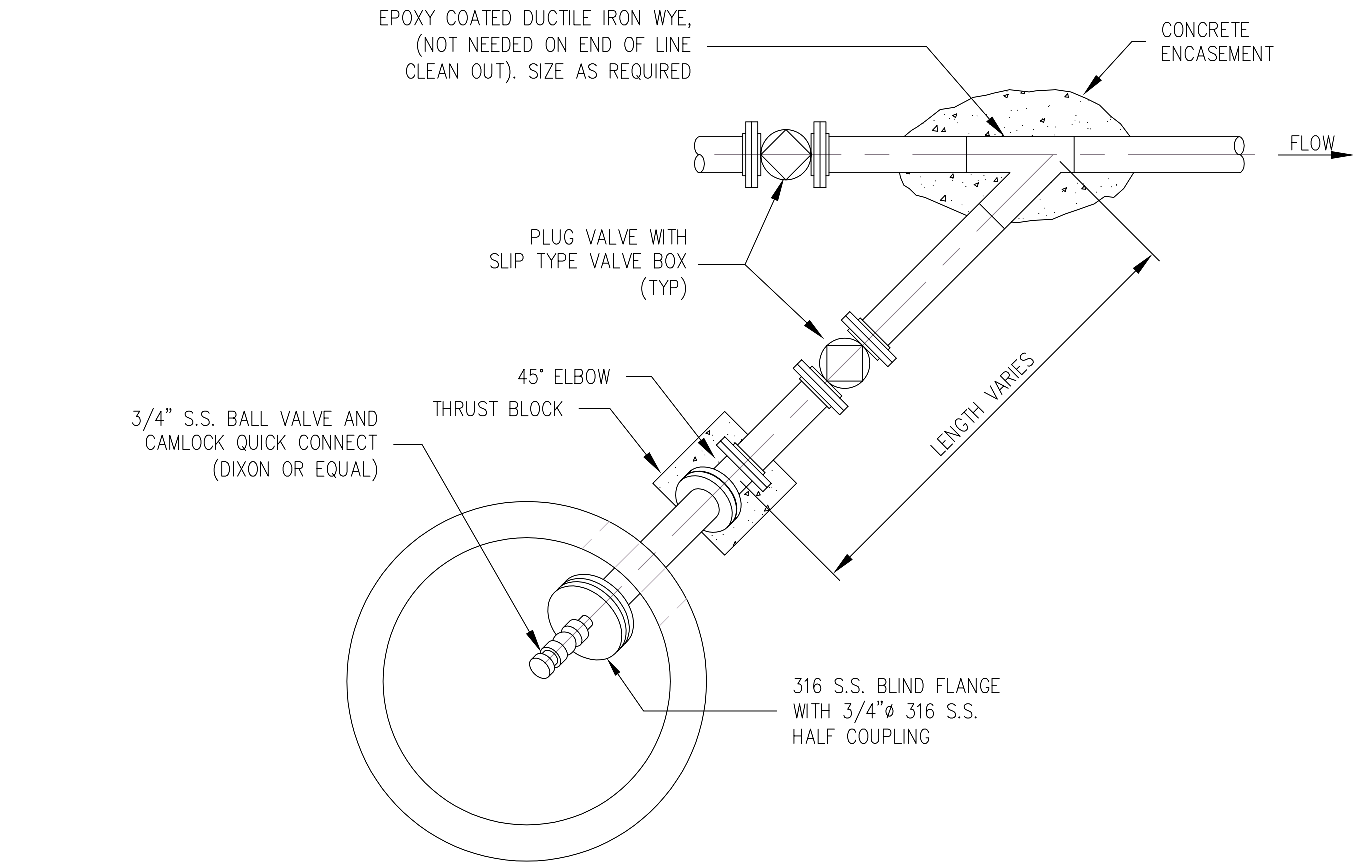
City of Stanwood

SEWER SYSTEM STANDARD DETAIL

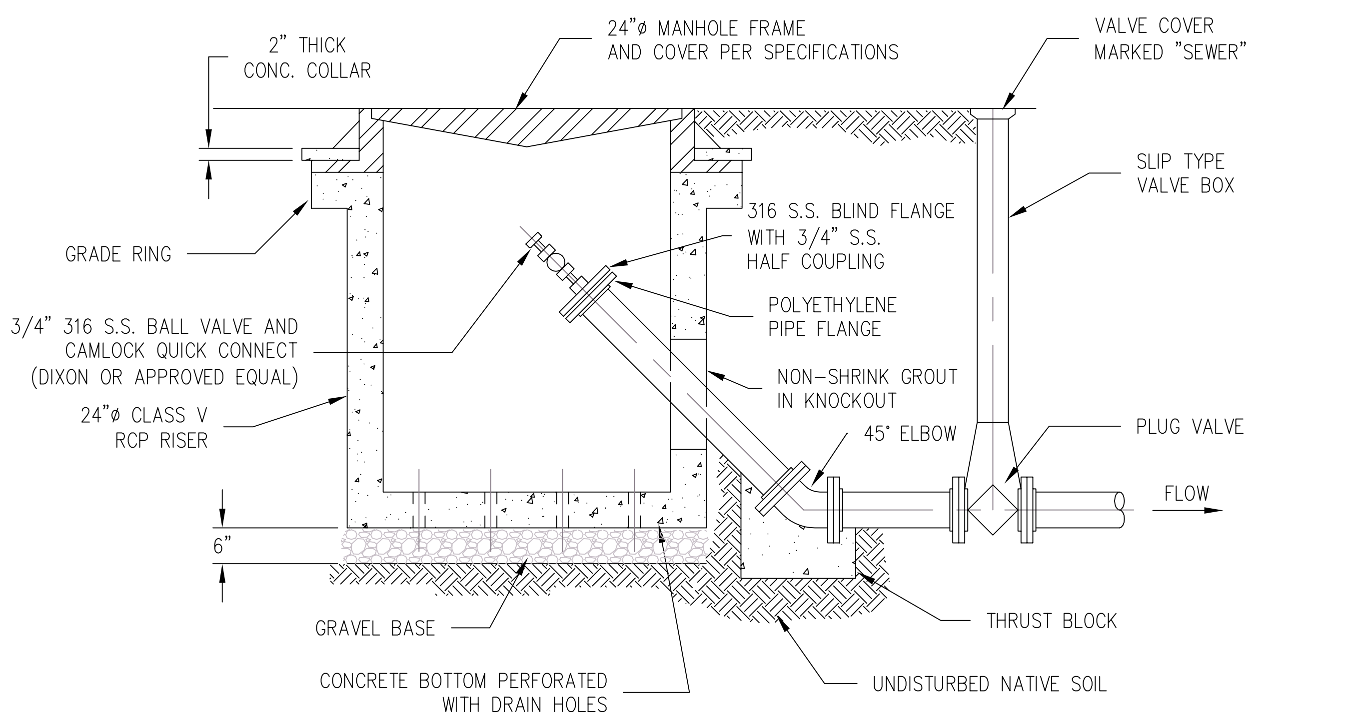
GRINDER PUMP INSTALLATION
CONCRETE BALLAST

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-10

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.

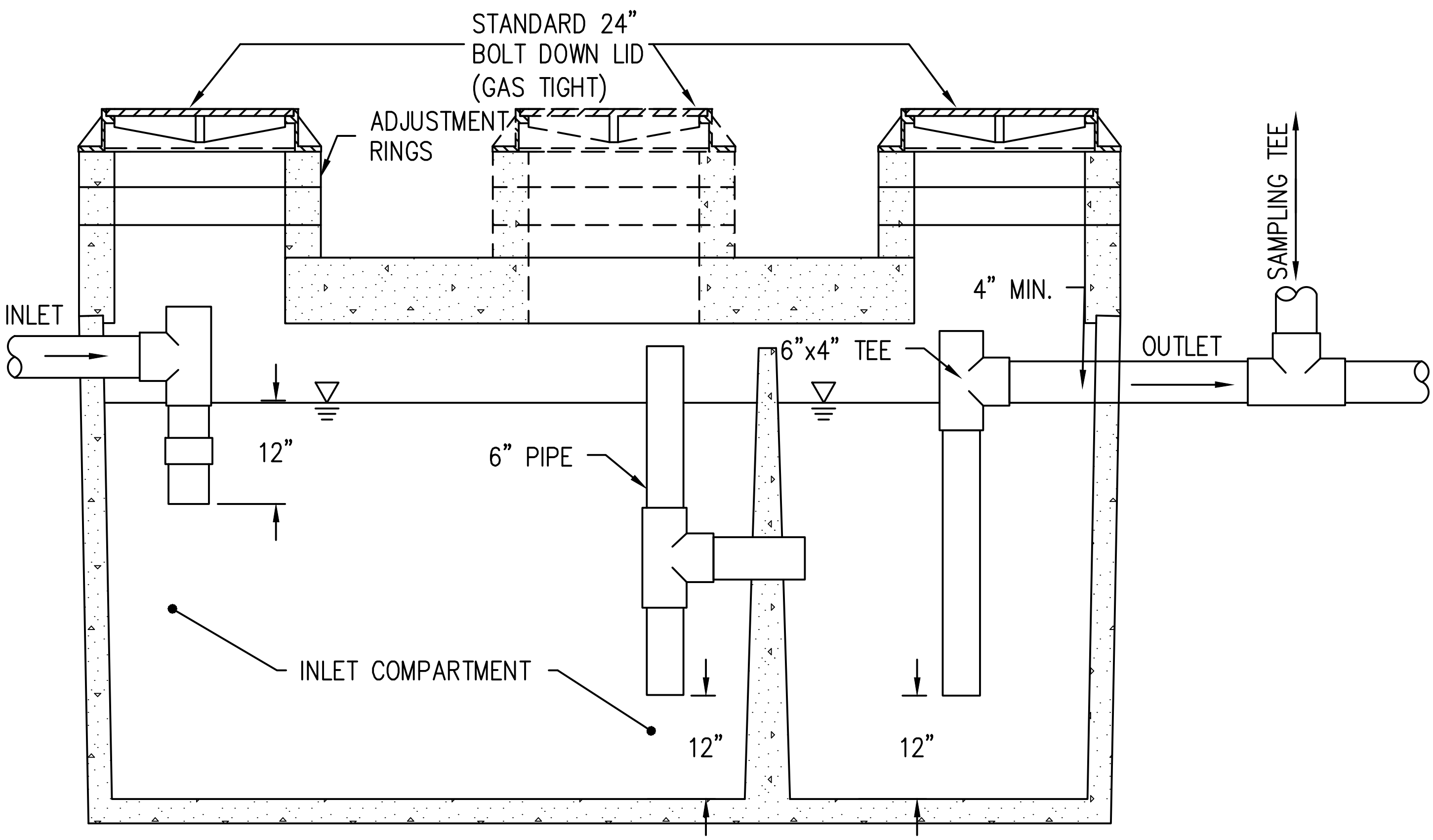
SIZING CALCULATION

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

File:STADETS11 | Revised: Dec. 12, 2013 | Printed: Jan. 10, 2014

SEWER SYSTEM STANDARD DETAIL

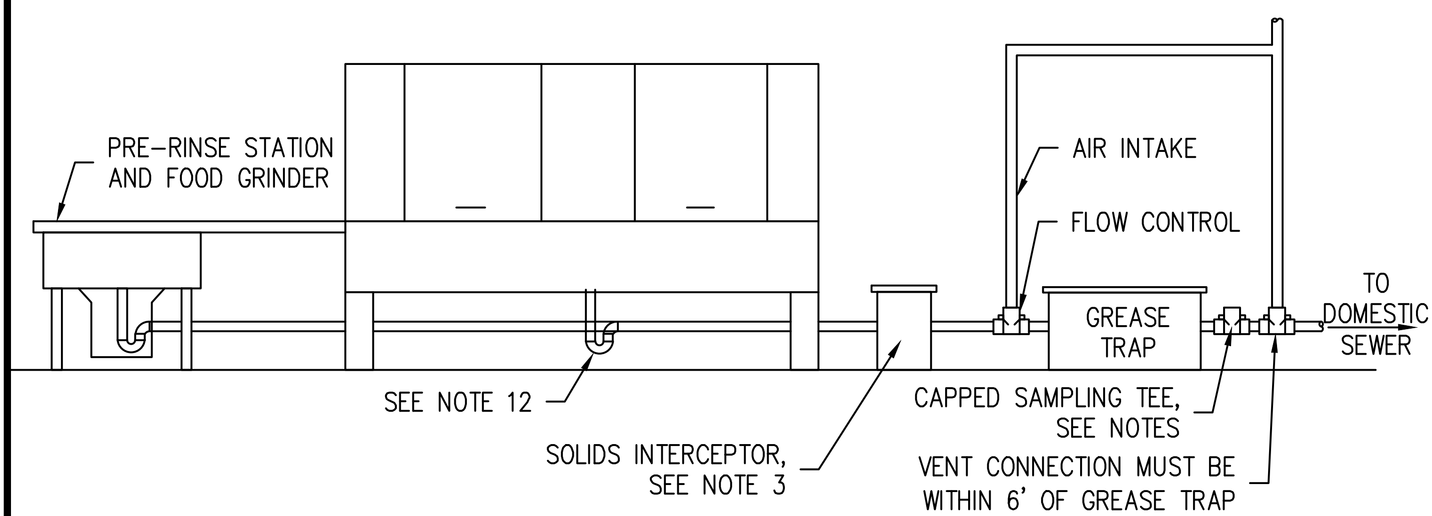
GREASE INTERCEPTOR

DRAWING NO. S-11

NOTES:

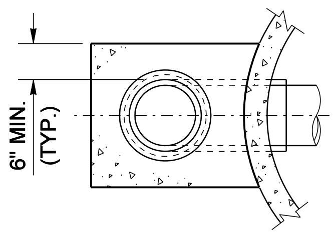
1. GREASE TRAPS INSTALLED IN LIEU OF EXTERNAL INTERCEPTORS ARE ONLY ALLOWED WITH WRITTEN PERMISSION OF THE PUBLIC WORKS DIRECTOR.
2. ALL TRAPS WILL BE APPROPRIATELY SIZED TO THE UNIFORM PLUMBING CODE OR OTHER ACCEPTABLE METHOD.
3. TRAPS WILL HAVE A SOLIDS INTERCEPTOR INSTALLED PRIOR TO THE FLOW CONTROL 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

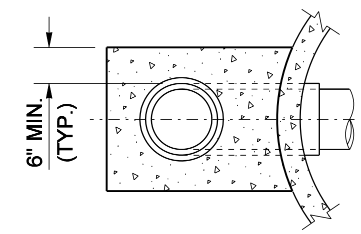


City of Stanwood		SEWER SYSTEM STANDARD DETAIL
		INDOOR GREASE TRAP
File:STADETS12	Revised: Dec. 12, 2013	Printed: Jan. 10, 2014
	DRAWING NO.	S-12

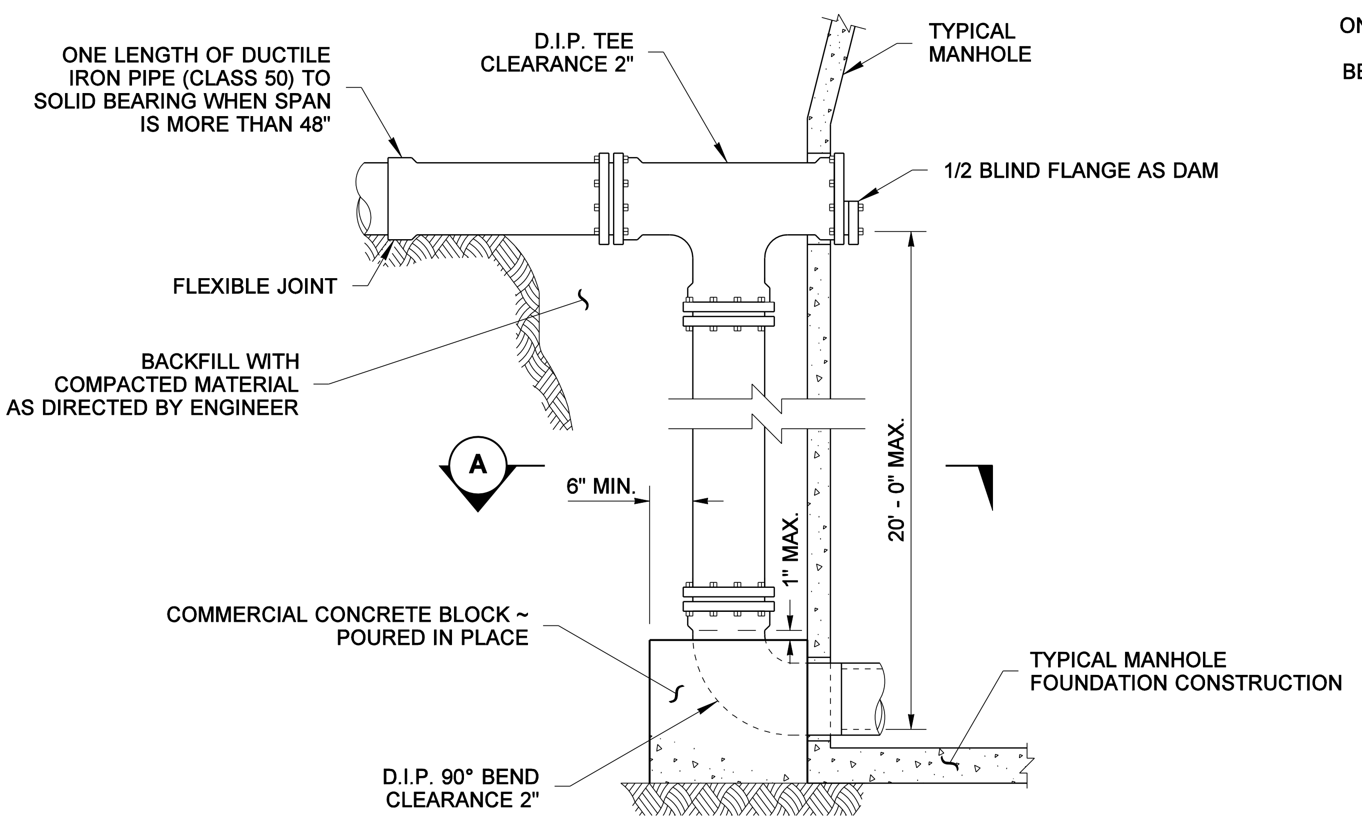
DRAWN BY: LISA CYFORD



SECTION A

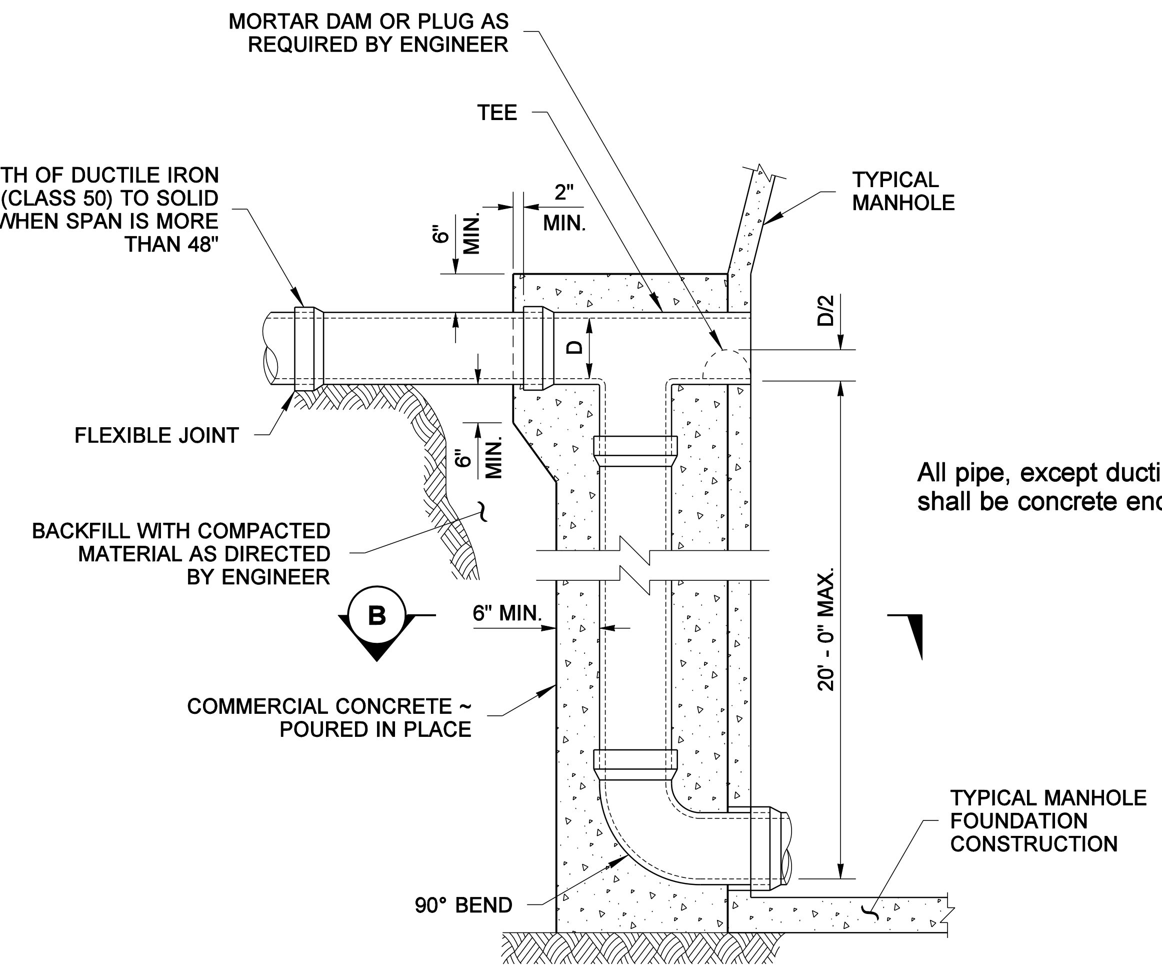


SECTION B



ELEVATION

DUCTILE IRON DROP CONNECTION



All pipe, except ductile iron pipe, shall be concrete encased.

ELEVATION

CONCRETE ENCASED DROP CONNECTION

FOR SANITARY SEWER USE

NOTE: THIS PLAN IS NOT A LEGAL ENGINEERING DOCUMENT BUT AN ELECTRONIC DUPLICATE. THE ORIGINAL, SIGNED BY THE ENGINEER AND APPROVED FOR PUBLICATION, IS KEPT ON FILE AT THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION. A COPY MAY BE OBTAINED UPON REQUEST.

DROP CONNECTIONS

STANDARD PLAN B-85.50-01

SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

Pasco Bakotich III — STATE DESIGN ENGINEER

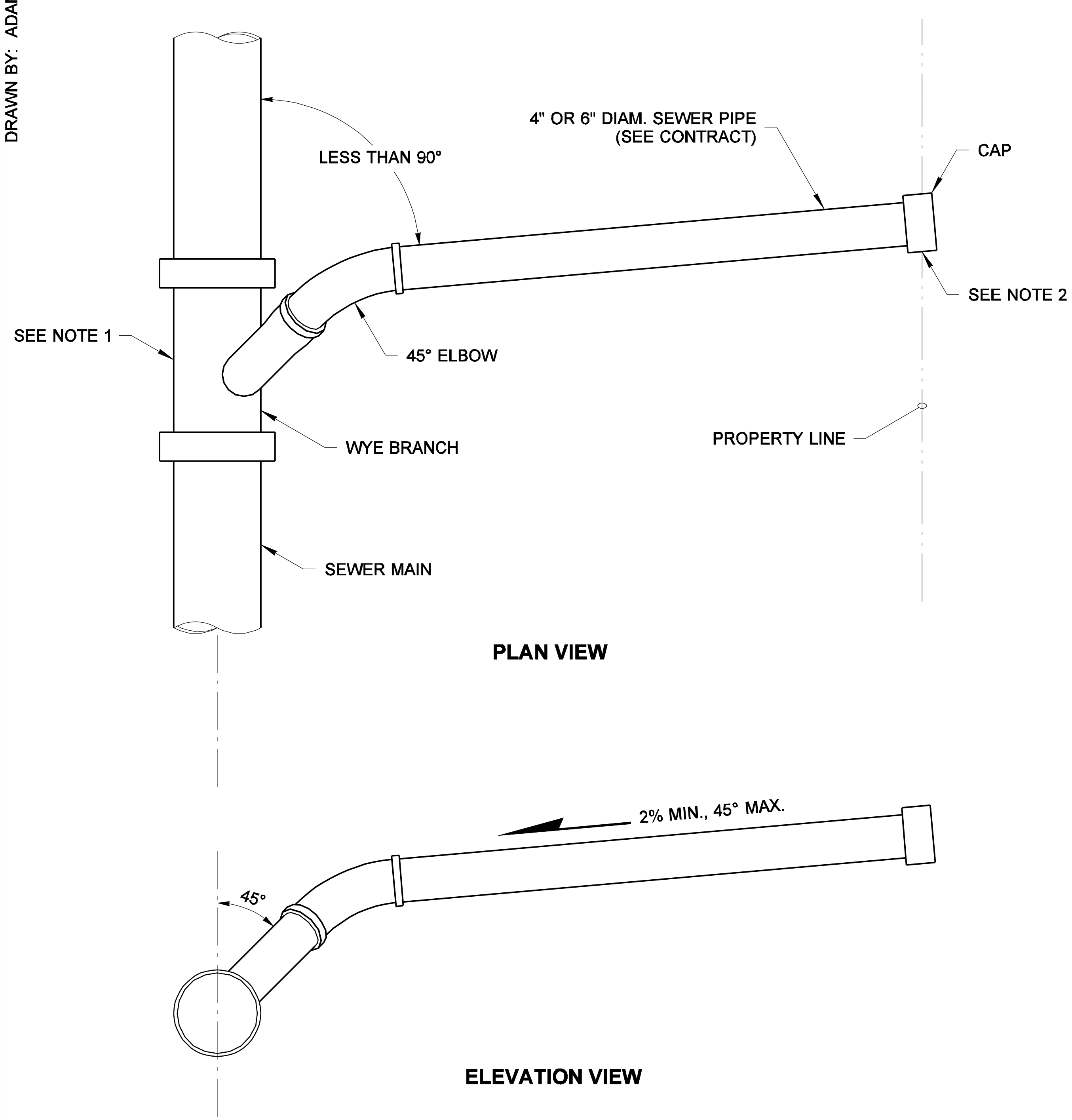
06-10-08 — DATE

Washington State Department of Transportation

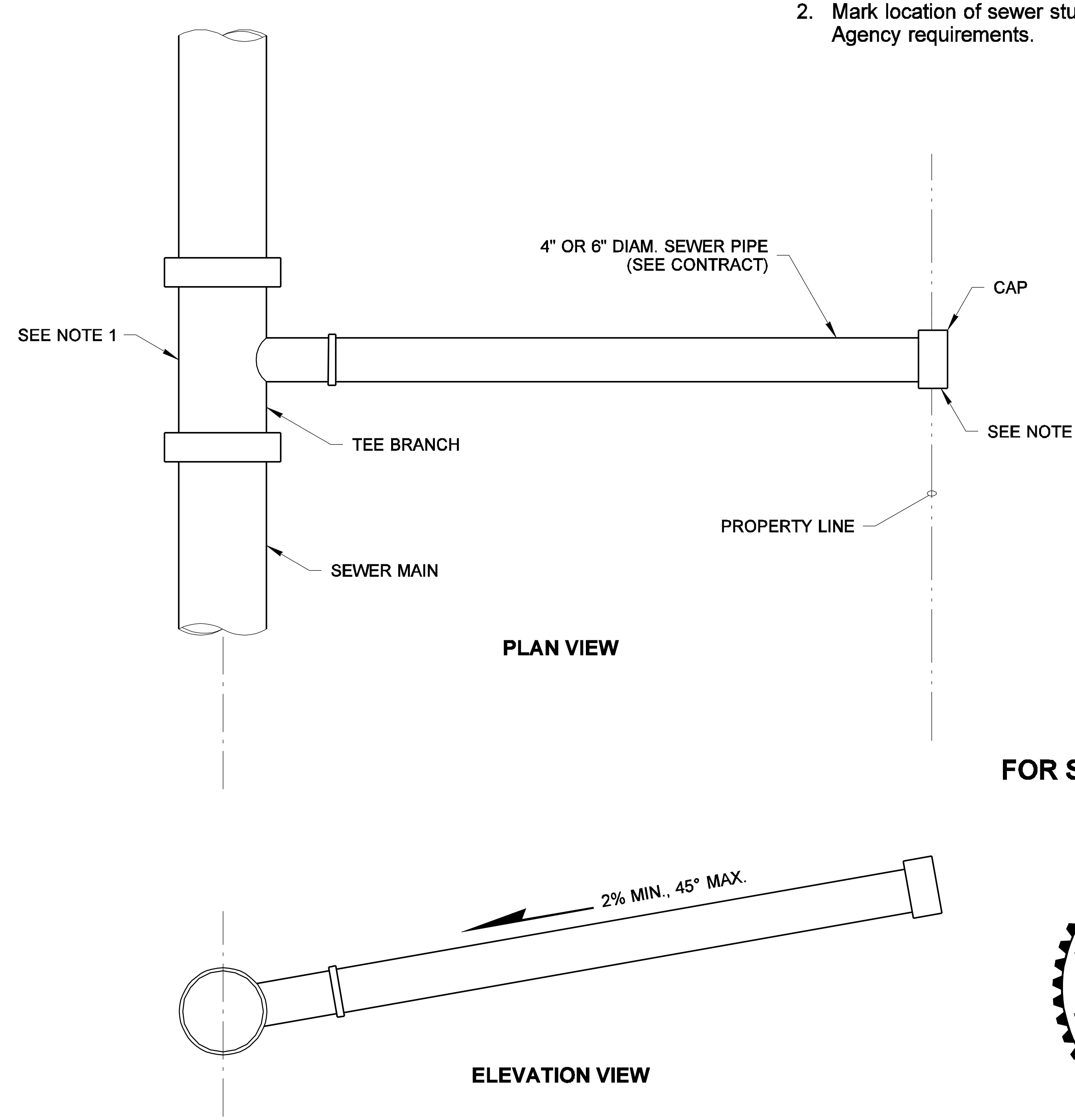
DRAWN BY: ADAM COCHRAN

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.



WYE CONNECTION



TEE CONNECTION

FOR SANITARY SEWER USE

NOTE: THIS PLAN IS NOT A LEGAL ENGINEERING DOCUMENT BUT AN ELECTRONIC DUPLICATE. THE ORIGINAL, SIGNED BY THE ENGINEER AND APPROVED FOR PUBLICATION, IS KEPT ON FILE AT THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION. A COPY MAY BE OBTAINED UPON REQUEST.

SIDE SEWER CONNECTION

STANDARD PLAN B-85.20-00

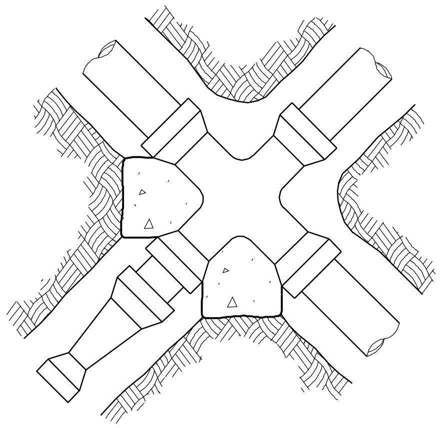
SHEET 1 OF 1 SHEET

APPROVED FOR PUBLICATION

Harold J. Peterfeso — 06-01-06

STATE DESIGN ENGINEER — DATE

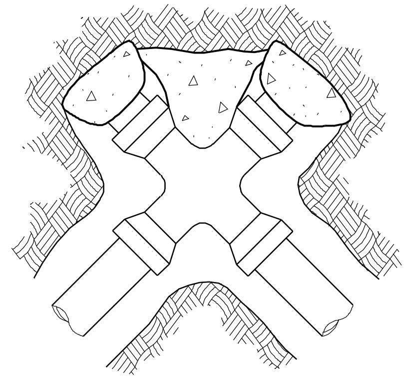
Washington State Department of Transportation



PLAN VIEW

UNBALANCED CROSS

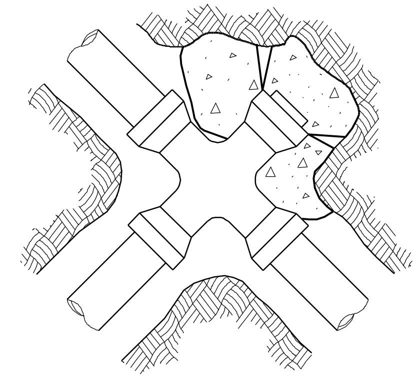
(USE COLUMN **A**)



PLAN VIEW

PLUGGED CROSS

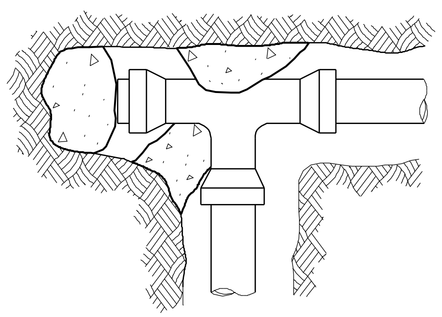
(USE COLUMN **B**)



PLAN VIEW

PLUGGED CROSS

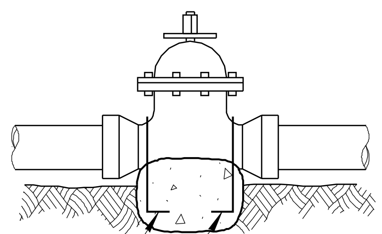
(USE COLUMN **A**)



PLAN VIEW

PLUGGED TEE

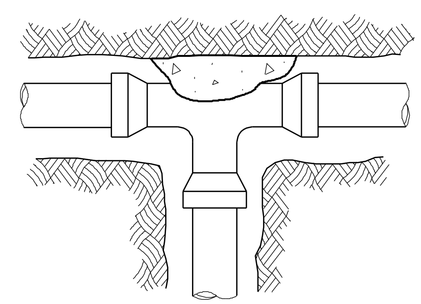
(USE COLUMN **B**)



PROFILE VIEW

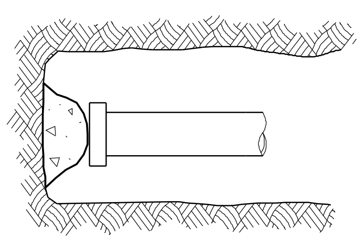
VALVE

(USE COLUMN **A**)



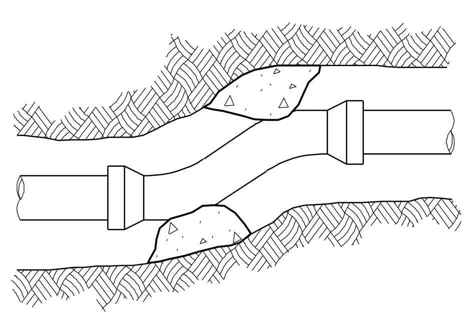
PLAN VIEW

TEE



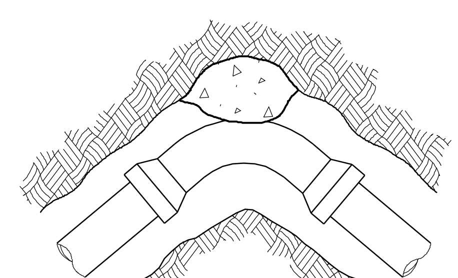
PLAN VIEW

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

NOTE: THIS PLAN IS NOT A LEGAL ENGINEERING DOCUMENT BUT AN ELECTRONIC DUPLICATE. THE ORIGINAL, SIGNED BY THE ENGINEER AND APPROVED FOR PUBLICATION, IS KEPT ON FILE AT THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION. A COPY MAY BE OBTAINED UPON REQUEST.

CONCRETE THRUST BLOCK

STANDARD PLAN B-90.40-00

SHEET 1 OF 1 SHEET

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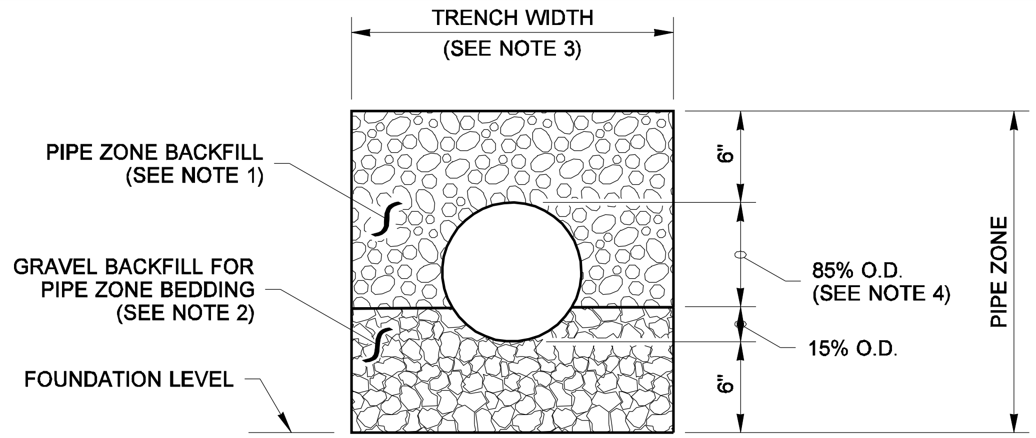
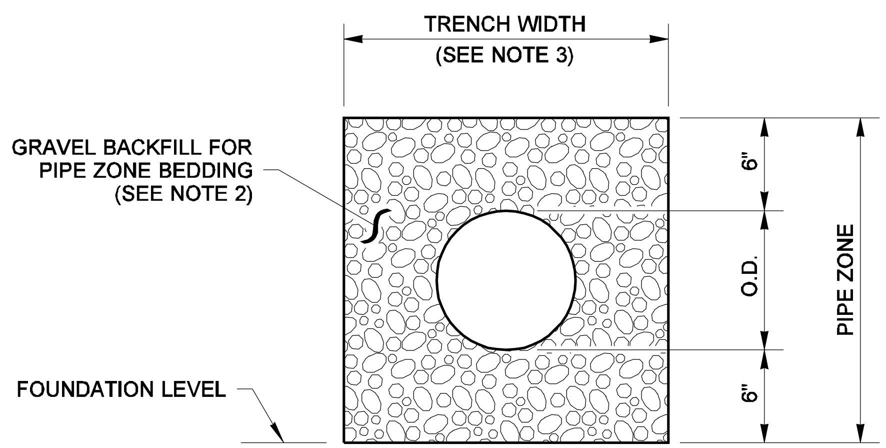
06-08-06 — DATE

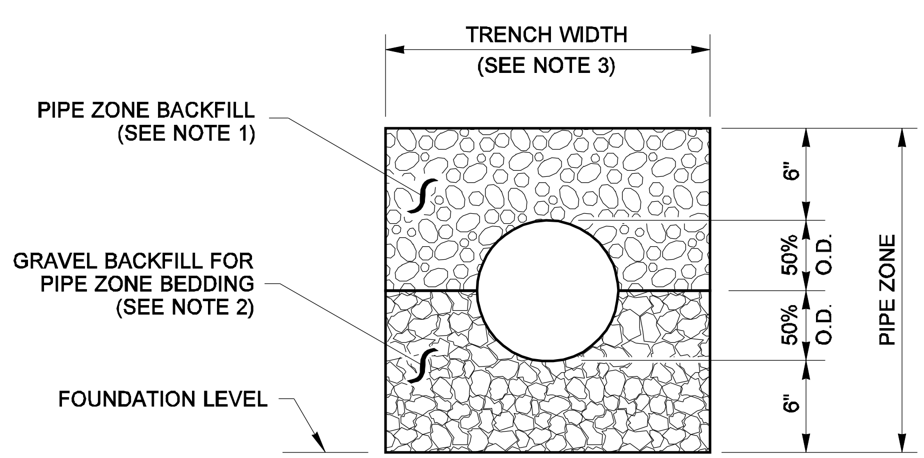
Washington State Department of Transportation



CONCRETE AND DUCTILE IRON PIPE



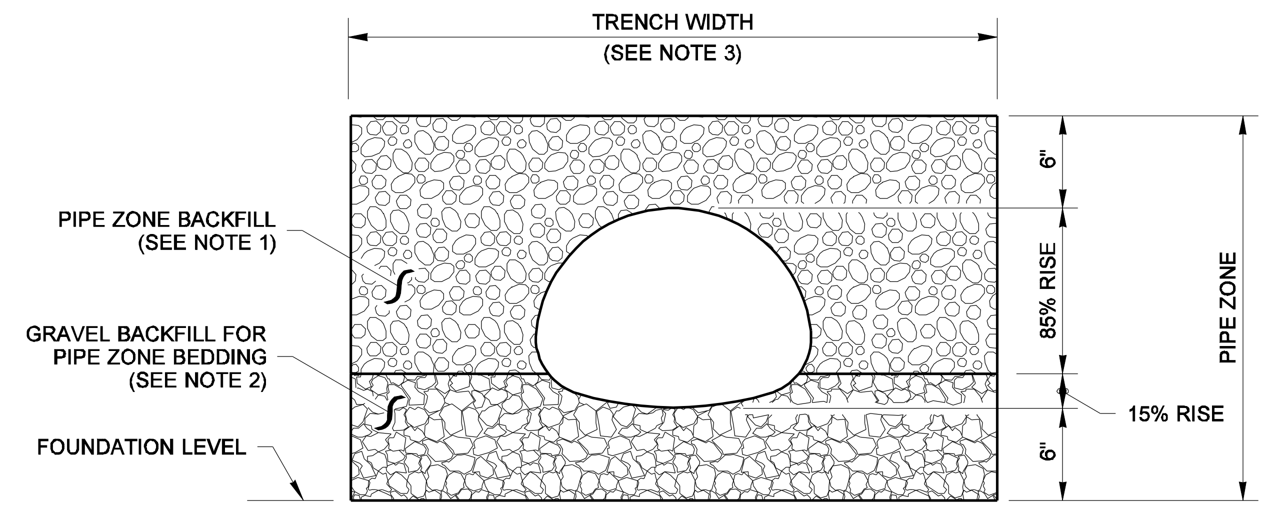
THERMOPLASTIC PIPE



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"

NOTE: THIS PLAN IS NOT A LEGAL ENGINEERING DOCUMENT BUT AN ELECTRONIC DUPLICATE. THE ORIGINAL, SIGNED BY THE ENGINEER AND APPROVED FOR PUBLICATION, IS KEPT ON FILE AT THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION. A COPY MAY BE OBTAINED UPON REQUEST.

PIPE ZONE BEDDING AND BACKFILL

STANDARD PLAN B-55.20-00

SHEET 1 OF 1 SHEET

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06-01-06 — DATE

Washington State Department of Transportation

APPENDIX J

EXISTING, EXISTING WITH IMPROVEMENTS, 6-YEAR, AND 20-YEAR SEWER CAD PIPE CAPACITY DATA

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-21	MH-19	234.62	MH-20	228.59	0.046	131	Circle	PVC	8 inch	1,164	1	0.1	
P-23	MH-20	228.49	MH-22	215.96	0.06	209	Circle	PVC	8 inch	1,328	2	0.1	
P-26	MH-22	215.86	MH-25	188.81	0.117	232	Circle	PVC	8 inch	1,852	3	0.1	
P-28	MH-25	179.83	MH-27	164.06	0.145	109	Circle	PVC	8 inch	2,063	4	0.2	
P-30	MH-27	164.06	MH-29	151.94	0.098	124	Circle	PVC	8 inch	1,696	5	0.3	
P-32	MH-29	151.84	MH-31	139.99	0.119	100	Circle	PVC	8 inch	1,867	6	0.3	
P-34	MH-31	139.99	MH-33	139.89	0.001	113	Circle	PVC	8 inch	161	7	4.3	
P-36	MH-33	139.89	MH-35	133.12	0.041	166	Circle	PVC	8 inch	1,095	8	0.7	
P-38	MH-35	133.02	MH-37	127.2	0.03	195	Circle	PVC	8 inch	937	9	0.9	
P-40	MH-37	126	MH-39	121.64	0.023	186	Circle	PVC	8 inch	830	10	1.2	
P-42	MH-39	121.54	MH-41	120.21	0.005	271	Circle	PVC	8 inch	380	13	3.4	
P-44	MH-41	120.11	MH-43	118.75	0.005	267	Circle	PVC	8 inch	387	17	4.3	
P-46	MH-43	118.65	MH-45	118.22	0.005	84	Circle	PVC	8 inch	388	18	4.7	
P-48	MH-45	118.12	MH-47	117.06	0.005	211	Circle	PVC	8 inch	384	19	5	
P-50	MH-47	116.96	MH-49	116.8	0.009	18	Circle	PVC	8 inch	511	20	3.9	
P-52	MH-49	117.07	MH-51	114.49	0.018	147	Circle	Concrete	8 inch	719	386	53.7	
P-54	MH-51	114.49	MH-53	110.02	0.016	277	Circle	Concrete	8 inch	689	387	56.2	
P-56	MH-53	110.02	MH-55	106.76	0.065	50	Circle	Concrete	8 inch	1,385	390	28.1	
P-58	MH-55	106.76	MH-57	95.81	0.07	157	Circle	Concrete	8 inch	1,432	390	27.3	
P-60	MH-57	95.81	MH-59	85.38	0.083	125	Circle	Concrete	8 inch	1,567	391	25	
P-62	MH-59	85.38	MH-61	72.78	0.093	136	Circle	Concrete	8 inch	1,651	392	23.8	
P-64	MH-61	72.78	MH-63	66.2	0.076	87	Circle	Concrete	8 inch	1,492	395	26.5	
P-68	MH-65	43	MH-67	41.96	0.004	249	Circle	Concrete	8 inch	351	3	0.8	
P-70	MH-67	41.86	MH-69	26.74	0.075	202	Circle	Concrete	8 inch	1,484	1,127	76	
P-72	MH-69	26.74	MH-71	19.77	0.071	98	Circle	Concrete	8 inch	1,446	1,130	78.1	
P-78	MH-75	-4.53	MH-77	-5.51	0.004	253	Circle	Asbestos Cement	14 inch	1,774	7	0.4	
P-80	MH-77	-5.51	MH-79	-6.29	0.002	363	Circle	Cast iron	14 inch	1,211	9	0.7	
P-82	MH-79	-6.29	MH-81	-6.72	0.001	409	Circle	Asbestos Cement	14 inch	924	10	1.1	
P-84	MH-81	-6.72	MH-83	-7.12	0.003	132	Circle	Asbestos Cement	14 inch	1,569	16	1	
P-86	MH-83	-7.12	MH-85	-7.95	0.003	297	Circle	Asbestos Cement	14 inch	1,507	33	2.2	
P-88	MH-85	-7.95	MH-87	-8.58	0.002	323	Circle	Asbestos Cement	14 inch	1,259	35	2.8	
P-90	MH-87	-8.27	MH-89	-9.07	0.002	343	Circle	Asbestos Cement	14 inch	1,377	43	3.1	
P-92	MH-89	-9.07	MH-91	-10.11	0.003	342	Circle	Asbestos Cement	14 inch	1,572	46	2.9	
P-94	MH-91	-10.11	MH-93	-10.32	0.001	284	Circle	Asbestos Cement	14 inch	775	75	9.7	
P-100	MH-97	-11.33	MH-99	-12.08	0.003	291	Circle	Asbestos Cement	14 inch	1,447	96	6.6	
P-102	MH-99	-13.2	MH-101	-13.29	0	245	Circle	Asbestos Cement	20 inch	1,414	485	34.3	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-104	MH-103	190.8	MH-25	188.81	0.017	119	Circle	PVC	8 inch	701	1	0.1	
P-124	MH-122	240.58	MH-123	237.2	0.01	343	Circle	PVC	8 inch	538	1	0.2	
P-126	MH-123	237.2	MH-125	225.96	0.037	305	Circle	PVC	8 inch	1,041	349	33.5	
P-128	MH-125	225.8	MH-127	206.99	0.047	400	Circle	PVC	8 inch	1,176	350	29.7	
P-130	MH-127	206.87	MH-129	196.08	0.027	400	Circle	PVC	8 inch	891	350	39.3	
P-132	MH-129	196.08	MH-131	184.48	0.032	362	Circle	PVC	8 inch	971	351	36.2	
P-134	MH-131	184.38	MH-133	183.38	0.024	42	Circle	PVC	8 inch	837	352	42.1	
P-136	MH-133	182.62	MH-135	174.75	0.025	314	Circle	PVC	15 inch	4,590	353	7.7	
P-138	MH-135	174.68	MH-137	173.14	0.005	327	Circle	PVC	15 inch	1,990	354	17.8	
P-140	MH-137	173.06	MH-139	171.81	0.005	252	Circle	PVC	15 inch	2,042	355	17.4	
P-142	MH-139	171.74	MH-141	169.66	0.005	401	Circle	PVC	15 inch	2,088	356	17	
P-144	MH-141	169.58	MH-143	168.74	0.004	205	Circle	PVC	15 inch	1,856	356	19.2	
P-146	MH-143	168.72	MH-145	167.22	0.005	291	Circle	PVC	15 inch	2,082	357	17.2	
P-148	MH-145	167.18	MH-147	139.79	0.069	397	Circle	PVC	15 inch	7,615	358	4.7	
P-150	MH-147	139.66	MH-149	136.31	0.01	336	Circle	PVC	15 inch	2,895	359	12.4	
P-152	MH-149	136.22	MH-151	135.04	0.012	100	Circle	PVC	15 inch	3,149	360	11.4	
P-154	MH-151	134.87	MH-153	131.93	0.022	134	Circle	PVC	15 inch	4,294	361	8.4	
P-156	MH-153	131.83	MH-155	131.09	0.007	100	Circle	PVC	15 inch	3,242	363	11.2	
P-158	MH-155	130.99	MH-157	122.09	0.036	249	Circle	PVC	15 inch	7,126	364	5.1	
P-159	MH-157	122.09	MH-49	117.19	0.016	310	Circle	PVC	15 inch	4,738	365	7.7	
P-162	MH-160	132.95	MH-161	132.4	0.002	242	Circle	PVC	12 inch	762	1	0.1	
P-163	MH-161	132.4	MH-153	132.25	0.002	72	Circle	PVC	12 inch	730	2	0.2	
P-166	MH-164	123.49	MH-165	122.73	0.004	191	Circle	PVC	8 inch	342	1	0.3	
P-168	MH-165	122.63	MH-167	122.15	0.004	124	Circle	PVC	8 inch	337	2	0.5	
P-169	MH-167	122.05	MH-39	120.77	0.004	328	Circle	PVC	8 inch	339	3	0.8	
P-172	MH-170	122.82	MH-171	121.62	0.004	301	Circle	PVC	8 inch	342	1	0.3	
P-174	MH-171	121.52	MH-173	120.85	0.004	167	Circle	PVC	8 inch	344	2	0.5	
P-175	MH-173	120.85	MH-41	120.21	0.002	286	Circle	PVC	8 inch	257	3	1	
P-178	MH-176	224.22	MH-177	222.68	0.005	305	Circle	PVC	8 inch	385	2	0.5	
P-180	MH-177	222.68	MH-179	218.82	0.013	308	Circle	PVC	8 inch	607	4	0.7	
P-182	MH-179	218.82	MH-181	214.41	0.018	239	Circle	PVC	8 inch	737	6	0.8	
P-184	MH-181	214.41	MH-183	202.48	0.056	212	Circle	PVC	8 inch	1,287	10	0.8	
P-186	MH-183	202.48	MH-185	194.44	0.039	206	Circle	PVC	8 inch	1,071	12	1.1	
P-188	MH-185	194.44	MH-187	161.6	0.699	47	Circle	PVC	8 inch	4,533	14	0.3	
P-190	MH-187	191.6	MH-189	190.78	0.005	162	Circle	PVC	8 inch	386	16	4.2	
P-192	MH-189	190.78	MH-191	184.15	0.042	157	Circle	PVC	8 inch	1,115	18	1.6	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-194	MH-191	184.15	MH-193	161.51	0.081	279	Circle	PVC	8 inch	1,545	20	1.3	
P-196	MH-193	161.51	MH-195	154.32	0.171	42	Circle	PVC	8 inch	2,244	22	1	
P-198	MH-195	154.32	MH-197	143.68	0.083	128	Circle	PVC	8 inch	1,564	24	1.5	
P-200	MH-197	143.58	MH-199	141	0.031	84	Circle	Concrete	8 inch	950	26	2.7	
P-202	MH-199	139.9	MH-201	131.1	0.027	324	Circle	Concrete	8 inch	894	28	3.1	
P-204	MH-201	131	MH-203	124.76	0.013	476	Circle	Concrete	8 inch	621	30	4.8	
P-206	MH-203	124.66	MH-205	119.6	0.018	276	Circle	Concrete	8 inch	734	36	4.9	
P-208	MH-205	119.5	MH-207	119.06	0.019	23	Circle	PVC	8 inch	750	38	5	
P-210	MH-207	118.96	MH-209	117.37	0.006	263	Circle	PVC	12 inch	1,243	692	55.7	
P-212	MH-209	117.27	MH-211	115.62	0.006	275	Circle	PVC	12 inch	1,239	693	56	
P-214	MH-211	115.52	MH-213	113.3	0.006	366	Circle	PVC	12 inch	1,245	702	56.4	
P-216	MH-213	113.2	MH-215	105.58	0.027	278	Circle	PVC	12 inch	2,647	712	26.9	
P-218	MH-215	105.48	MH-217	101.95	0.01	353	Circle	PVC	12 inch	1,599	714	44.7	
P-220	MH-217	101.7	MH-219	101.6	0.007	15	Circle	PVC	12 inch	1,306	716	54.8	
P-222	MH-219	101.5	MH-221	94.51	0.097	72	Circle	Concrete	8 inch	1,690	717	42.4	
P-230	MH-228	126.83	MH-229	125.31	0.005	308	Circle	Concrete	8 inch	381	1	0.4	
P-232	MH-229	123.21	MH-231	123.14	0	409	Circle	Concrete	8 inch	71	3	4	
P-234	MH-231	123.04	MH-233	119.5	0.017	205	Circle	PVC	8 inch	713	4	0.6	
P-236	MH-233	119.4	MH-235	116.1	0.015	218	Circle	PVC	8 inch	667	6	0.8	
P-237	MH-235	116	MH-211	115.62	0.013	30	Circle	PVC	8 inch	610	7	1.1	
P-240	MH-238	132	MH-239	130.1	0.015	126	Circle	PVC	8 inch	666	14	2.2	
P-242	MH-239	130	MH-241	120.1	0.029	337	Circle	PVC	8 inch	930	16	1.7	
P-247	MH-245	244.65	MH-246	240.69	0.011	365	Circle	PVC	8 inch	565	1	0.2	
P-249	MH-246	240.59	MH-248	230.55	0.102	98	Circle	PVC	8 inch	1,736	3	0.2	
P-251	MH-248	230.45	MH-250	219.1	0.028	400	Circle	PVC	8 inch	914	4	0.5	
P-253	MH-250	210.6	MH-252	208.76	0.006	288	Circle	PVC	8 inch	434	10	2.3	
P-255	MH-252	208.66	MH-254	194.58	0.054	263	Circle	PVC	8 inch	1,255	11	0.9	
P-257	MH-254	194.48	MH-256	182.94	0.05	230	Circle	PVC	8 inch	1,215	13	1	
P-259	MH-256	182.84	MH-258	181.42	0.004	360	Circle	PVC	8 inch	341	14	4.1	
P-261	MH-258	181.32	MH-260	161.9	0.071	272	Circle	PVC	10 inch	2,627	407	15.5	
P-263	MH-260	161.8	MH-262	147.91	0.131	106	Circle	PVC	10 inch	3,560	409	11.5	
P-265	MH-262	147.66	MH-264	134.16	0.042	320	Circle	PVC	10 inch	2,020	416	20.6	
P-267	MH-264	134.06	MH-266	125.91	0.025	324	Circle	PVC	10 inch	1,560	417	26.7	
P-269	MH-266	125.71	MH-268	124.75	0.004	271	Circle	Steel	12 inch	952	418	44	
P-271	MH-268	124.5	MH-270	123.36	0.004	307	Circle	Steel	12 inch	974	632	64.8	
P-273	MH-270	123.26	MH-272	121.9	0.003	401	Circle	Steel	12 inch	931	633	68	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-275	MH-272	121.8	MH-274	120.44	0.003	401	Circle	Steel	12 inch	931	634	68.1	
P-276	MH-274	120.34	MH-207	119.06	0.003	375	Circle	Steel	12 inch	934	636	68.1	
P-279	MH-277	124	MH-278	116	0.017	464	Circle	PVC	6 inch	331	1	0.4	
P-288	MH-286	127.72	MH-287	126.43	0.004	300	Circle	PVC	8 inch	356	2	0.6	
P-289	MH-287	126.43	MH-203	124.76	0.006	300	Circle	PVC	8 inch	405	4	1	
P-292	MH-290	160.16	MH-291	160.04	0.005	23	Circle	PVC	8 inch	392	1	0.4	
P-294	MH-291	159.94	MH-293	153.99	0.048	125	Circle	PVC	8 inch	1,183	3	0.2	
P-295	MH-293	153.43	MH-262	145.67	0.031	253	Circle	PVC	8 inch	950	6	0.6	
P-297	MH-296	154.4	MH-293	153.53	0.031	28	Circle	PVC	8 inch	956	1	0.1	
P-300	MH-298	223.33	MH-299	213.27	0.04	253	Circle	PVC	8 inch	1,081	1	0.1	
P-302	MH-299	213.17	MH-301	212.79	0.004	93	Circle	PVC	8 inch	347	3	0.8	
P-303	MH-301	212.69	MH-250	210.7	0.013	159	Circle	PVC	8 inch	607	4	0.7	
P-306	MH-304	126.25	MH-43	118.75	0.025	304	Circle	PVC	8 inch	852	1	0.1	
P-309	MH-307	143.9	MH-308	141.24	0.03	90	Circle	PVC	8 inch	932	2	0.2	
P-311	MH-308	141.2	MH-310	125.96	0.049	312	Circle	PVC	8 inch	1,199	3	0.3	
P-313	MH-310	125.74	MH-312	116.72	0.032	282	Circle	PVC	8 inch	970	9	1	
P-315	MH-312	116.62	MH-314	116.19	0.007	58	Circle	PVC	8 inch	467	11	2.4	
P-317	MH-314	116.14	MH-316	113.49	0.014	189	Circle	PVC	8 inch	642	13	2	
P-319	MH-316	113.26	MH-318	109.89	0.015	227	Circle	PVC	8 inch	661	22	3.3	
P-321	MH-318	109.82	MH-320	109.48	0.006	54	Circle	PVC	8 inch	430	30	6.9	
P-323	MH-320	109.45	MH-322	108.34	0.005	220	Circle	PVC	8 inch	385	31	8.2	
P-325	MH-322	108.28	MH-324	107.47	0.005	180	Circle	PVC	8 inch	364	49	13.4	
P-328	MH-326	135.65	MH-327	129.51	0.038	162	Circle	PVC	8 inch	1,056	2	0.1	
P-330	MH-327	129.35	MH-329	127.37	0.025	78	Circle	PVC	8 inch	864	3	0.4	
P-331	MH-329	127.3	MH-310	125.92	0.011	124	Circle	PVC	8 inch	572	5	0.8	
P-334	MH-332	155.87	MH-333	148.67	0.05	145	Circle	PVC	8 inch	1,209	2	0.1	
P-336	MH-333	148.6	MH-335	134.6	0.063	223	Circle	PVC	8 inch	1,359	3	0.2	
P-338	MH-335	134.54	MH-337	129.68	0.032	150	Circle	PVC	8 inch	976	5	0.5	
P-340	MH-337	129.66	MH-339	118.75	0.053	206	Circle	PVC	8 inch	1,248	6	0.5	
P-341	MH-339	118.72	MH-316	113.43	0.056	94	Circle	PVC	8 inch	1,287	8	0.6	
P-344	MH-342	151.34	MH-343	149.82	0.022	69	Circle	PVC	8 inch	805	2	0.2	
P-346	MH-343	149.65	MH-345	134.49	0.057	264	Circle	PVC	8 inch	1,300	3	0.2	
P-348	MH-345	134.49	MH-347	127.94	0.043	151	Circle	PVC	8 inch	1,130	5	0.4	
P-349	MH-347	127.84	MH-318	109.89	0.079	227	Circle	PVC	8 inch	1,525	6	0.4	
P-352	MH-350	144	MH-351	141.69	0.025	92	Circle	PVC	8 inch	859	2	0.2	
P-354	MH-351	141.61	MH-353	133.61	0.04	201	Circle	PVC	8 inch	1,082	3	0.3	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-356	MH-353	133.6	MH-355	126.19	0.028	269	Circle	PVC	8 inch	900	5	0.5	
P-358	MH-355	126.15	MH-357	120.57	0.03	187	Circle	PVC	8 inch	937	6	0.7	
P-360	MH-357	120.26	MH-359	116.05	0.03	142	Circle	PVC	8 inch	934	9	1	
P-361	MH-359	115.93	MH-322	108.45	0.057	132	Circle	PVC	8 inch	1,291	11	0.9	
P-363	MH-362	124.05	MH-357	120.22	0.023	170	Circle	PVC	8 inch	814	2	0.2	
P-366	MH-364	142.26	MH-365	134.78	0.034	221	Circle	PVC	8 inch	998	2	0.2	
P-368	MH-365	134.73	MH-367	128.57	0.027	231	Circle	PVC	8 inch	886	3	0.4	
P-369	MH-367	128.57	MH-322	108.47	0.097	207	Circle	PVC	8 inch	1,690	5	0.3	
P-372	MH-370	230.75	MH-371	224.6	0.079	78	Circle	PVC	8 inch	1,523	1	0	
P-374	MH-371	224.43	MH-373	201.79	0.081	278	Circle	PVC	8 inch	1,548	1	0.1	
P-376	MH-373	201.7	MH-375	196.85	0.016	301	Circle	PVC	8 inch	688	2	0.2	
P-378	MH-375	196.72	MH-377	179.76	0.068	249	Circle	PVC	8 inch	1,415	3	0.2	
P-380	MH-377	179.56	MH-379	155.67	0.089	267	Circle	PVC	8 inch	1,622	3	0.2	
P-382	MH-379	155.55	MH-381	139.74	0.108	147	Circle	PVC	8 inch	1,779	4	0.2	
P-384	MH-381	139.43	MH-383	131.82	0.035	219	Circle	PVC	12 inch	2,981	9	0.3	
P-386	MH-383	131.66	MH-385	131.33	0.016	20	Circle	PVC	12 inch	2,054	18	0.9	
P-388	MH-385	131.26	MH-387	125.21	0.098	62	Circle	PVC	12 inch	4,995	18	0.4	
P-390	MH-389	125.59	MH-387	125.21	0.007	58	Circle	PVC	12 inch	1,294	0	0	
P-392	MH-391	131.26	MH-385	130.79	0.011	42	Circle	PVC	12 inch	1,692	0	0	
P-394	MH-393	197.93	MH-375	196.75	0.009	128	Circle	PVC	8 inch	521	1	0.1	
P-397	MH-395	226.27	MH-396	221.56	0.044	106	Circle	PVC	8 inch	1,143	1	0	
P-399	MH-396	221.36	MH-398	216.32	0.048	106	Circle	PVC	8 inch	1,183	1	0.1	
P-401	MH-398	216.08	MH-400	212.33	0.046	81	Circle	PVC	8 inch	1,167	2	0.1	
P-403	MH-400	212.21	MH-402	194.02	0.046	399	Circle	PVC	8 inch	1,158	2	0.2	
P-405	MH-402	193.84	MH-404	179.16	0.045	327	Circle	PVC	8 inch	1,149	3	0.3	
P-407	MH-404	179.02	MH-406	161.08	0.053	338	Circle	PVC	8 inch	1,249	4	0.3	
P-408	MH-406	161	MH-381	139.74	0.055	387	Circle	PVC	8 inch	1,271	5	0.4	
P-410	MH-409	165.94	MH-406	161.08	0.014	350	Circle	PVC	8 inch	639	1	0.1	
P-412	MH-411	198.2	MH-402	193.94	0.029	145	Circle	PVC	8 inch	930	1	0.1	
P-462	MH-459	135.92	MH-461	134.77	0.012	92	Circle	PVC	8 inch	606	221	36.4	
P-467	MH-465	179.62	MH-466	178.85	0.007	112	Circle	PVC	8 inch	450	1	0.1	
P-469	MH-466	178.85	MH-468	171.09	0.032	239	Circle	PVC	8 inch	977	1	0.1	
P-471	MH-468	170.92	MH-470	160.08	0.037	293	Circle	PVC	8 inch	1,043	2	0.1	
P-473	MH-470	159.94	MH-472	159.08	0.005	159	Circle	PVC	8 inch	399	2	0.5	
P-475	MH-472	159.03	MH-474	158.19	0.006	146	Circle	PVC	8 inch	411	3	0.6	
P-477	MH-474	157.88	MH-476	156.37	0.004	359	Circle	PVC	8 inch	352	6	1.6	

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P-479	MH-476	156.21	MH-478	155.85	0.005	71	Circle	PVC	8 inch	386	6	1.6	
P-481	MH-478	155.85	MH-480	155.15	0.004	180	Circle	PVC	8 inch	338	7	1.9	
P-483	MH-480	155.02	MH-482	154.72	0.005	64	Circle	PVC	8 inch	371	7	1.9	
P-485	MH-482	154.72	MH-484	152.33	0.035	69	Circle	PVC	8 inch	1,009	8	0.7	
P-487	MH-484	152.33	MH-486	146.91	0.022	244	Circle	PVC	8 inch	808	8	1	
P-489	MH-486	146.6	MH-488	138.64	0.031	256	Circle	PVC	12 inch	2,820	9	0.3	
P-490	MH-488	138.5	MH-383	131.82	0.035	193	Circle	PVC	12 inch	2,975	9	0.3	
P-493	MH-491	191.11	MH-492	182.09	0.032	282	Circle	PVC	8 inch	970	1	0.1	
P-495	MH-492	181.98	MH-494	180.01	0.007	282	Circle	PVC	8 inch	453	1	0.2	
P-497	MH-494	179.94	MH-496	179	0.006	150	Circle	PVC	8 inch	429	2	0.3	
P-499	MH-496	178.93	MH-498	174.07	0.021	230	Circle	PVC	8 inch	788	2	0.3	
P-500	MH-498	173.93	MH-474	158.13	0.061	260	Circle	PVC	8 inch	1,337	3	0.2	
P-513	MH-511	186.12	MH-512	183.48	0.01	276	Circle	PVC	8 inch	530	2	0.4	
P-515	MH-512	183.18	MH-514	181.06	0.006	382	Circle	PVC	8 inch	404	4	1	
P-517	MH-514	180.95	MH-516	179.74	0.007	166	Circle	PVC	8 inch	463	8	1.7	
P-519	MH-516	185.06	MH-518	183.46	0.004	401	Circle	PVC	10 inch	621	13	2.2	
P-520	MH-518	183.36	MH-431	181.58	0.004	399	Circle	PVC	10 inch	657	15	2.3	
P-523	MH-521	193	MH-522	190.1	0.011	268	Circle	PVC	8 inch	564	2	0.3	
P-525	MH-522	190	MH-524	189.1	0.014	65	Circle	PVC	8 inch	638	4	0.6	
P-527	MH-524	189	MH-526	187.1	0.008	250	Circle	PVC	8 inch	473	8	1.6	
P-528	MH-526	187	MH-427	185	0.008	249	Circle	PVC	8 inch	486	10	2	
P-530	MH-529	190.75	MH-524	189.1	0.016	101	Circle	PVC	8 inch	693	2	0.3	
P-532	MH-531	192.81	MH-514	189.44	0.01	343	Circle	PVC	8 inch	538	2	0.4	
P-534	MH-533	189	MH-425	187.6	0.008	173	Circle	PVC	8 inch	488	2	0.4	
P-536	MH-535	186.97	MH-429	182.6	0.013	348	Circle	PVC	8 inch	608	2	0.3	
P-539	MH-537	181.15	MH-538	179.99	0.005	211	Circle	PVC	8 inch	402	2	0.5	
P-541	MH-538	179.89	MH-540	177.66	0.01	218	Circle	PVC	8 inch	549	4	0.7	
P-543	MH-540	177.56	MH-542	177.25	0.005	58	Circle	PVC	8 inch	397	6	1.5	
P-545	MH-542	177.15	MH-544	175.1	0.015	141	Circle	PVC	8 inch	654	8	1.2	
P-547	MH-544	175	MH-546	172.2	0.009	324	Circle	PVC	8 inch	504	10	1.9	
P-548	MH-546	171.98	MH-437	169.85	0.006	345	Circle	PVC	8 inch	426	19	4.5	
P-551	MH-549	180.72	MH-550	178.72	0.021	97	Circle	PVC	8 inch	779	2	0.2	
P-553	MH-550	178.62	MH-552	177.73	0.006	148	Circle	PVC	8 inch	421	4	0.9	
P-555	MH-552	177.63	MH-554	176.62	0.006	169	Circle	PVC	8 inch	419	6	1.4	
P-556	MH-554	176.52	MH-546	172.2	0.016	278	Circle	PVC	8 inch	676	8	1.1	
P-559	MH-557	202.17	MH-558	201.77	0.005	76	Circle	PVC	8 inch	393	2	0.5	

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P-561	MH-558	201.77	MH-560	199.93	0.005	400	Circle	PVC	8 inch	368	4	1	
P-563	MH-560	199.83	MH-562	195.7	0.012	346	Circle	PVC	8 inch	593	17	2.9	
P-565	MH-562	196.23	MH-564	195.93	0.004	77	Circle	PVC	8 inch	339	19	5.7	
P-567	MH-564	195.83	MH-566	194.35	0.004	375	Circle	PVC	8 inch	341	21	6.2	
P-569	MH-566	194.23	MH-568	193.79	0.005	86	Circle	PVC	8 inch	388	23	5.9	
P-571	MH-568	193.79	MH-570	192.42	0.005	288	Circle	PVC	8 inch	374	25	6.7	
P-573	MH-570	199.35	MH-572	176.21	0.062	373	Circle	PVC	8 inch	1,351	36	2.7	
P-575	MH-572	176.11	MH-574	173.45	0.009	281	Circle	PVC	8 inch	528	38	7.3	
P-576	MH-574	173.35	MH-441	171.25	0.005	400	Circle	PVC	8 inch	393	40	10.3	
P-579	MH-577	252.92	MH-578	241.07	0.049	240	Circle	PVC	8 inch	1,205	2	0.2	
P-581	MH-578	240.97	MH-580	227.6	0.088	152	Circle	PVC	8 inch	1,608	4	0.2	
P-583	MH-580	227.5	MH-582	202.51	0.062	400	Circle	PVC	8 inch	1,356	8	0.6	
P-584	MH-582	202.41	MH-570	199.45	0.052	57	Circle	PVC	8 inch	1,236	10	0.8	
P-586	MH-585	233.68	MH-580	227.6	0.035	174	Circle	PVC	8 inch	1,014	2	0.2	
P-589	MH-587	234.47	MH-588	214.64	0.118	168	Circle	PVC	8 inch	1,863	2	0.1	
P-591	MH-588	214.54	MH-590	213.28	0.027	47	Circle	PVC	8 inch	888	4	0.4	
P-593	MH-590	213.18	MH-592	209.06	0.02	210	Circle	PVC	8 inch	760	6	0.8	
P-595	MH-592	208.96	MH-594	208.37	0.005	109	Circle	PVC	8 inch	399	8	1.9	
P-596	MH-594	208.27	MH-560	203.62	0.058	80	Circle	PVC	8 inch	1,308	10	0.7	
P-598	MH-597	226.56	MH-560	203.62	0.08	287	Circle	PVC	8 inch	1,533	2	0.1	
P-601	MH-599	158.18	MH-600	156.69	0.004	393	Circle	PVC	8 inch	334	2	0.6	
P-603	MH-600	156.59	MH-602	154.76	0.012	158	Circle	PVC	8 inch	584	4	0.7	
P-605	MH-602	154.66	MH-604	154.21	0.015	31	Circle	PVC	8 inch	653	6	0.9	
P-607	MH-604	154.11	MH-606	152.05	0.074	28	Circle	PVC	8 inch	1,471	8	0.5	
P-609	MH-606	152.05	MH-608	149.86	0.012	188	Circle	PVC	8 inch	585	10	1.6	
P-610	MH-608	149.86	MH-445	149.66	0.005	41	Circle	PVC	8 inch	379	12	3	
P-613	MH-611	163.36	MH-612	161.87	0.106	14	Circle	PVC	6 inch	822	2	0.2	
P-615	MH-612	161.77	MH-614	154.19	0.032	239	Circle	PVC	8 inch	966	6	0.6	
P-617	MH-614	154.09	MH-616	153.13	0.004	243	Circle	PVC	8 inch	341	8	2.3	
P-619	MH-616	153.03	MH-618	152.46	0.005	125	Circle	PVC	8 inch	366	12	3.1	
P-620	MH-618	152.36	MH-447	149.04	0.026	128	Circle	PVC	8 inch	873	13	1.5	
P-623	MH-621	154.04	MH-622	140.78	0.044	304	Circle	PVC	8 inch	1,133	2	0.2	
P-624	MH-622	140.62	MH-453	137.71	0.037	78	Circle	PVC	8 inch	1,048	4	0.4	
P-627	MH-625	143.5	MH-626	139.83	0.009	400	Circle	PVC	8 inch	519	2	0.4	
P-629	MH-626	139.75	MH-628	136.93	0.033	86	Circle	PVC	8 inch	982	10	1	
P-631	MH-628	136.87	MH-630	136.04	0.008	107	Circle	PVC	8 inch	478	12	2.4	

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P-632	MH-630	135.99	MH-457	135.25	0.007	104	Circle	PVC	8 inch	457	13	2.9	
P-635	MH-633	157.79	MH-634	156.13	0.011	153	Circle	PVC	8 inch	565	2	0.3	
P-637	MH-634	156.04	MH-636	146.32	0.028	348	Circle	PVC	8 inch	906	4	0.4	
P-638	MH-636	146.26	MH-626	139.92	0.034	187	Circle	PVC	8 inch	999	6	0.6	
P-640	MH-639	164.36	MH-612	161.87	0.035	72	Circle	PVC	6 inch	468	2	0.4	
P-642	MH-641	159.22	MH-616	153.13	0.055	110	Circle	PVC	8 inch	1,276	2	0.2	
P-645	MH-643	169.21	MH-644	167.81	0.007	196	Circle	PVC	8 inch	458	2	0.4	
P-647	MH-644	167.26	MH-646	165.55	0.007	252	Circle	PVC	8 inch	447	4	0.9	
P-649	MH-646	166.72	MH-648	164.43	0.013	172	Circle	PVC	8 inch	626	6	0.9	
P-651	MH-648	164.33	MH-650	162.57	0.007	244	Circle	PVC	8 inch	461	15	3.3	
P-653	MH-650	162.47	MH-652	158.81	0.015	240	Circle	PVC	8 inch	670	17	2.6	
P-655	MH-652	158.71	MH-654	143.06	0.043	360	Circle	PVC	8 inch	1,131	19	1.7	
P-657	MH-654	142.96	MH-656	140.35	0.029	90	Circle	PVC	8 inch	924	21	2.3	
P-659	MH-656	140.25	MH-658	136.45	0.026	148	Circle	PVC	8 inch	869	23	2.7	
P-660	MH-658	136.36	MH-459	135.79	0.004	140	Circle	PVC	8 inch	346	25	7.2	
P-663	MH-661	156.46	MH-662	154.06	0.02	118	Circle	PVC	8 inch	773	2	0.2	
P-665	MH-662	153.96	MH-664	144.93	0.024	374	Circle	PVC	8 inch	843	4	0.5	
P-666	MH-664	144.84	MH-451	144.31	0.013	42	Circle	PVC	8 inch	609	6	0.9	
P-669	MH-667	199.97	MH-668	196.79	0.028	113	Circle	PVC	8 inch	910	2	0.2	
P-671	MH-668	196.69	MH-670	180.94	0.059	267	Circle	PVC	8 inch	1,317	4	0.3	
P-673	MH-670	180.84	MH-672	172.51	0.067	124	Circle	PVC	8 inch	1,406	6	0.4	
P-674	MH-672	172.41	MH-648	164.43	0.06	134	Circle	PVC	8 inch	1,324	8	0.6	
P-676	MH-675	186.46	MH-516	185.16	0.008	164	Circle	PVC	10 inch	875	4	0.4	
P-679	MH-677	125.79	MH-678	121.09	0.017	269	Circle	Concrete	8 inch	717	1	0.1	
P-680	MH-678	121.09	MH-53	110.25	0.037	293	Circle	Concrete	8 inch	1,043	2	0.2	
P-681	MH-101	-8.25	WW-MAIN	-10.67	0.033	74	Circle	PVC	36 inch	54,134	3,097	5.7	
P-682	MH-1136	26	WW-PIONEER	22	0.045	88	Circle	PVC	30 inch	39,248	25	0.1	
P-683	MH-681	109	MH-682	83.64	0.078	324	Circle	Concrete	8 inch	1,517	1	0.1	
P-684	MH-682	83.28	MH-61	72.78	0.048	219	Circle	Concrete	8 inch	1,188	2	0.1	
P-685	MH-387	125.12	WW-COPPER	122.5	0.114	23	Circle	PVC	30 inch	62,131	18	0	
P-686	MH-461	134.77	WW-CEDAR	134.3	0.009	51	Circle	PVC	8 inch	521	223	42.8	
P-687	MH-324	107.47	WW-CHURCH	107	0.004	111	Circle	PVC	8 inch	353	50	14.3	
P-688	MH-687	93.91	MH-223	85.51	0.06	141	Circle	Concrete	8 inch	1,324	1	0.1	
P-689	MH-1467	32.47	WW-TAYLOR	32	0.47	1	Circle	PVC	30 inch	126,204	14	0	
P-690	MH-689	95.43	MH-221	94.51	0.004	217	Circle	Concrete	8 inch	353	1	0.4	
P-691	MH-730	74.48	W-LINDSTRO	74.46	0.02	1	Circle	PVC	30 inch	26,034	12	0	

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P-693	MH-691	99.5	MH-692	80.2	0.102	190	Circle	Concrete	8 inch	1,729	1	0.1	
P-694	MH-419	189	MH-421	188.5	0.003	192	Circle	PVC	8 inch	277	21	7.6	
P-695	MH-95	-10.76	MH-97	-11.33	0.004	152	Circle	Asbestos Cement	14 inch	1,746	93	5.4	
P-696	MH-694	82.5	MH-1473	71.2	0.05	224	Circle	Concrete	8 inch	1,218	1	0.1	
P-697	MH-278	115.9	MH-213	113.3	0.163	16	Circle	Concrete	8 inch	2,186	8	0.4	
P-698	MH-417	194	MH-419	189	0.056	90	Circle	PVC	8 inch	1,278	19	1.5	
P-699	MH-697	113	MH-698	105.3	0.022	351	Circle	PVC	8 inch	803	1	0.2	
P-700	MH-421	188.5	MH-423	187.5	0.004	285	Circle	PVC	8 inch	321	23	7.2	
P-701	MH-698	105.2	MH-700	103.2	0.005	426	Circle	Concrete	8 inch	372	3	0.8	
P-702	MH-700	103.1	MH-692	80.1	0.052	442	Circle	Concrete	8 inch	1,237	4	0.3	
P-703	MH-692	80	MH-1473	71.3	0.053	164	Circle	Concrete	8 inch	1,249	7	0.6	
P-704	MH-1365	-7.65	MH-1364	-7.98	0.006	60	Circle	PVC	27 inch	13,401	2,585	19.3	
P-705	MH-1473	71.1	MH-704	27.8	0.115	378	Circle	Concrete	8 inch	1,836	10	0.5	
P-706	MH-423	187.5	MH-425	186	0.004	400	Circle	PVC	8 inch	332	25	7.5	
P-707	MH-704	27.6	MH-706	25.43	0.005	413	Circle	Concrete	10 inch	713	682	95.7	
P-708	MH-425	186	MH-427	185	0.004	269	Circle	PVC	8 inch	331	29	8.7	
P-709	MH-706	25.33	MH-708	24.28	0.005	229	Circle	Concrete	10 inch	666	684	102.7	
P-710	MH-427	185	MH-429	182.6	0.008	308	Circle	PVC	8 inch	479	40	8.4	
P-711	MH-708	24.18	MH-710	24.03	0.005	31	Circle	Concrete	10 inch	684	685	100.1	
P-712	MH-429	182.5	MH-431	181.58	0.005	170	Circle	PVC	8 inch	399	44	11.1	
P-713	MH-710	23.93	MH-712	21.93	0.005	400	Circle	Concrete	10 inch	695	686	98.7	
P-714	MH-712	21.83	MH-71	20.38	0.005	289	Circle	Concrete	10 inch	697	721	103.5	
P-715	MH-431	181.48	MH-433	180.06	0.004	372	Circle	PVC	8 inch	335	61	18.3	
P-716	MH-715	28.38	MH-69	26.84	0.004	383	Circle	Concrete	8 inch	344	1	0.4	
P-717	MH-433	172.5	MH-435	170.19	0.006	392	Circle	PVC	8 inch	416	63	15.2	
P-718	MH-435	170.09	MH-437	169.7	0.004	91	Circle	PVC	8 inch	355	65	18.4	
P-719	MH-717	79.2	MH-718	79	0.006	32	Circle	PVC	8 inch	429	2	0.4	
P-720	MH-437	169.7	MH-439	169.13	0.005	112	Circle	PVC	8 inch	387	86	22.3	
P-721	MH-718	79	MH-720	78.72	0.008	33	Circle	PVC	8 inch	500	3	0.6	
P-722	MH-439	169.13	MH-441	167.9	0.007	175	Circle	PVC	8 inch	455	88	19.4	
P-723	MH-720	78.71	MH-722	77.97	0.007	104	Circle	PVC	8 inch	457	5	1	
P-724	MH-441	167.9	MH-443	164.82	0.013	244	Circle	PVC	8 inch	609	131	21.4	
P-725	MH-722	77.87	MH-724	77.29	0.009	64	Circle	PVC	8 inch	516	6	1.2	
P-726	MH-443	164.72	MH-445	157.16	0.027	280	Circle	PVC	8 inch	891	132	14.9	
P-728	MH-445	149.66	MH-447	149.1	0.012	47	Circle	PVC	8 inch	592	146	24.6	
P-729	MH-447	149	MH-449	145.9	0.014	217	Circle	PVC	8 inch	648	161	24.9	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-730	MH-449	145.8	MH-451	144.66	0.004	258	Circle	PVC	8 inch	361	163	45.3	
P-731	MH-724	76.31	MH-730	74.48	0.091	20	Circle	PVC	8 inch	1,641	8	0.5	
P-732	MH-451	144.56	MH-453	137.93	0.022	308	Circle	PVC	8 inch	796	171	21.5	
P-733	MH-453	137.93	MH-455	136.8	0.004	265	Circle	PVC	8 inch	354	177	49.9	
P-734	MH-732	76.9	MH-733	75.6	0.004	325	Circle	PVC	8 inch	343	2	0.4	
P-735	MH-733	75.5	MH-730	74.48	0.004	256	Circle	PVC	8 inch	342	3	0.9	
P-736	MH-455	136.7	MH-457	136.1	0.003	175	Circle	PVC	8 inch	318	179	56.2	
P-737	MH-457	136.1	MH-459	135.92	0.004	51	Circle	PVC	8 inch	322	194	60.2	
P-738	MH-736	87.23	MH-737	86.66	0.005	107	Circle	Steel	8 inch	396	279	70.6	
P-739	MH-1035	-2.61	MH-1393	-2.72	0.002	50	Circle	PVC	10 inch	600	3	0.5	
P-740	MH-737	86.34	MH-739	86.01	0.005	60	Circle	PVC	8 inch	402	281	69.7	
P-741	MH-284	121.91	MH-282	120.84	0.004	274	Circle	Concrete	8 inch	339	3	0.8	
P-742	MH-739	86.01	MH-741	84.65	0.004	305	Circle	PVC	8 inch	362	282	77.8	
P-743	MH-282	120.84	MH-280	116.32	0.02	224	Circle	PVC	8 inch	770	4	0.5	
P-744	MH-741	84.1	MH-743	83.26	0.004	237	Circle	PVC	10 inch	585	347	59.2	
P-745	MH-280	116.32	MH-278	115.58	0.005	154	Circle	PVC	8 inch	376	6	1.5	
P-746	MH-743	83.18	MH-745	82.48	0.003	252	Circle	PVC	10 inch	518	348	67.1	
P-747	MH-1393	-2.82	MH-75	-4.53	0.009	187	Circle	Concrete	8 inch	519	4	0.9	
P-748	MH-745	82.4	MH-747	81.84	0.002	243	Circle	PVC	10 inch	472	349	73.9	
P-749	MH-71	19.67	MH-1391	10.5	0.064	144	Circle	Concrete	12 inch	4,035	1,852	45.9	
P-750	MH-749	82.17	MH-747	82.01	0.005	35	Circle	PVC	8 inch	367	8	2.3	
P-751	MH-676	-1	MH-75	-4.43	0.017	206	Circle	PVC	12 inch	2,682	1	0.1	
P-752	MH-751	83.7	MH-749	82.27	0.019	74	Circle	PVC	8 inch	754	7	1	
P-753	MH-63	66.1	MH-1417	64.57	0.005	313	Circle	PVC	15 inch	2,635	396	15	
P-754	MH-753	89	MH-751	83.8	0.016	331	Circle	PVC	8 inch	680	6	0.9	
P-755	MH-1417	64.47	MH-225	57.05	0.047	157	Circle	PVC	15 inch	8,194	1,122	13.7	
P-756	MH-755	91.9	MH-753	89.1	0.018	160	Circle	PVC	8 inch	717	4	0.5	
P-757	MH-225	56.95	MH-67	42	0.126	119	Circle	PVC	8 inch	1,922	1,123	58.4	
P-758	MH-757	95	MH-755	92	0.024	123	Circle	PVC	8 inch	847	2	0.3	
P-759	MH-221	94.41	MH-223	85.51	0.031	291	Circle	PVC	8 inch	948	720	75.9	
P-760	MH-759	98	MH-757	95.1	0.027	108	Circle	PVC	8 inch	889	1	0.1	
P-762	MH-761	91	MH-753	89.1	0.015	127	Circle	PVC	8 inch	663	1	0.2	
P-765	MH-763	107.25	MH-764	95.23	0.049	245	Circle	PVC	8 inch	1,201	1	0.1	
P-767	MH-764	95.13	MH-766	92.22	0.015	190	Circle	PVC	8 inch	671	2	0.4	
P-770	MH-768	84.93	MH-741	84.65	0.007	40	Circle	PVC	8 inch	454	23	5.2	
P-771	MH-1648	114	MH-686	106.68	0.042	174	Circle	PVC	8 inch	1,446	1	0.1	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-772	MH-688	167.17	MH-1092	163.64	0.034	105	Circle	PVC	8 inch	1,293	7	0.6	
P-773	MH-771	93.33	MH-772	92.99	0.004	76	Circle	PVC	8 inch	363	1	0.3	
P-774	MH-1469	171.83	MH-688	167.32	0.028	164	Circle	PVC	8 inch	1,169	5	0.5	
P-775	MH-690	177.29	MH-1469	171.88	0.029	187	Circle	PVC	8 inch	1,199	4	0.3	
P-776	MH-1470	178.04	MH-690	177.39	0.002	347	Circle	PVC	8 inch	305	2	0.6	
P-777	MH-775	99.74	MH-776	98.69	0.005	233	Circle	PVC	8 inch	364	1	0.3	
P-778	MH-1471	-6.7	MH-1198	-7.61	0.003	344	Circle	Concrete	12 inch	822	135	16.5	
P-779	MH-776	98.69	MH-778	98.22	0.004	131	Circle	PVC	8 inch	325	2	0.7	
P-781	MH-778	98.22	MH-780	97.09	0.004	298	Circle	PVC	8 inch	334	4	1.1	
P-782	MH-695	-4.03	MH-1472	-4.93	0.004	222	Circle	PVC	10 inch	814	3	0.4	
P-783	MH-780	96.99	MH-782	90.47	0.023	278	Circle	PVC	8 inch	831	5	0.6	
P-784	MH-1474	65.06	MH-65	43.1	0.097	227	Circle	Concrete	8 inch	1,687	1	0.1	
P-785	MH-782	90.47	MH-784	89.85	0.007	85	Circle	PVC	8 inch	463	6	1.3	
P-786	MH-699	202.25	MH-1475	194.94	0.049	148	Circle	PVC	8 inch	1,567	6	0.4	
P-787	MH-784	89.75	MH-786	88.85	0.005	199	Circle	PVC	8 inch	365	7	2	
P-788	MH-701	205.13	MH-1476	203.15	0.011	183	Circle	PVC	8 inch	733	2	0.3	
P-789	MH-786	88.8	MH-788	88	0.003	298	Circle	PVC	8 inch	281	8	3	
P-790	MH-703	196.33	MH-702	196.06	0.004	67	Circle	PVC	8 inch	448	4	0.9	
P-791	MH-788	87.9	MH-790	87.03	0.007	121	Circle	PVC	8 inch	460	10	2.1	
P-792	MH-1475	194.84	MH-417	194.1	0.004	186	Circle	PVC	8 inch	445	17	3.9	
P-793	MH-790	86.93	MH-792	86.55	0.004	85	Circle	PVC	8 inch	363	11	3	
P-794	MH-1478	38.88	MH-705	32.71	0.015	412	Circle	PVC	15 inch	4,612	661	14.3	
P-795	MH-792	86.28	MH-794	85.19	0.004	309	Circle	PVC	10 inch	584	12	2.1	
P-796	MH-794	85.11	MH-741	84.31	0.003	297	Circle	PVC	10 inch	510	40	7.9	
P-798	MH-797	86.83	MH-794	85.65	0.006	201	Circle	PVC	8 inch	416	27	6.5	
P-799	MH-709	61.63	MH-1479	55.94	0.014	398	Circle	PVC	15 inch	4,506	387	8.6	
P-800	MH-747	81.74	MH-799	81.25	0.003	173	Circle	PVC	10 inch	523	359	68.5	
P-801	MH-711	65.46	MH-1480	64.21	0.005	252	Circle	PVC	15 inch	2,654	385	14.5	
P-802	MH-799	81.28	MH-801	80.99	0.006	46	Circle	PVC	8 inch	431	362	84.1	
P-803	MH-1481	210.13	MH-413	207.36	0.012	238	Circle	PVC	8 inch	761	2	0.3	
P-804	MH-801	80.65	MH-803	79.19	0.005	300	Circle	PVC	8 inch	378	363	96	
P-806	MH-803	80.55	MH-805	79.16	0.005	279	Circle	PVC	8 inch	383	375	98.1	
P-808	MH-805	79.06	MH-807	77.63	0.005	285	Circle	PVC	8 inch	384	377	98	
P-810	MH-807	77.53	MH-809	68.78	0.029	300	Circle	PVC	8 inch	926	380	41	
P-812	MH-809	68.1	MH-811	66.85	0.008	155	Circle	PVC	8 inch	487	381	78.3	
P-820	MH-817	55.15	MH-819	54.68	0.003	175	Circle	PVC	12 inch	829	392	47.4	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-822	MH-819	54.58	MH-821	53.51	0.004	302	Circle	PVC	12 inch	952	409	42.9	
P-826	MH-823	51.85	MH-825	50.43	0.005	296	Circle	PVC	8 inch	376	633	168.5	
P-828	MH-825	50.37	MH-827	48.23	0.009	246	Circle	PVC	8 inch	506	634	125.4	
P-830	MH-827	48.23	MH-829	47.76	0.011	42	Circle	PVC	8 inch	574	639	111.4	
P-832	MH-829	47.71	MH-831	45.52	0.007	300	Circle	PVC	8 inch	463	641	138.3	
P-840	MH-837	31.9	MH-839	28.41	0.015	239	Circle	Concrete	10 inch	1,188	668	56.2	
P-842	MH-839	28.32	MH-841	27.63	0.006	116	Circle	PVC	10 inch	758	670	88.3	
P-843	MH-841	27.53	MH-704	27.3	0.005	46	Circle	PVC	10 inch	695	671	96.5	
P-845	MH-844	68.3	MH-811	66.85	0.005	276	Circle	PVC	8 inch	393	1	0.3	
P-848	MH-846	82.12	MH-847	81.71	0.008	53	Circle	PVC	8 inch	477	1	0.3	
P-850	MH-847	81.71	MH-849	71.09	0.078	136	Circle	PVC	8 inch	1,516	2	0.2	
P-852	MH-849	80.95	MH-851	80.69	0.004	65	Circle	PVC	8 inch	343	4	1	
P-853	MH-851	80.59	MH-803	79.29	0.004	324	Circle	PVC	8 inch	344	5	1.4	
P-856	MH-854	81.7	MH-855	81.15	0.004	149	Circle	PVC	8 inch	330	1	0.4	
P-858	MH-855	81.15	MH-857	80.36	0.005	150	Circle	PVC	8 inch	394	4	0.9	
P-860	MH-857	80.36	MH-859	79.83	0.008	66	Circle	PVC	8 inch	486	5	1	
P-861	MH-859	79.58	MH-803	79.29	0.004	68	Circle	PVC	8 inch	354	6	1.7	
P-863	MH-862	81.5	MH-855	81.15	0.003	100	Circle	PVC	8 inch	321	1	0.4	
P-866	MH-864	83.22	MH-865	82.97	0.002	128	Circle	PVC	8 inch	240	1	0.5	
P-867	MH-865	82.87	MH-799	81.42	0.006	253	Circle	PVC	8 inch	411	2	0.6	
P-870	MH-868	82.98	MH-869	81.93	0.008	138	Circle	PVC	8 inch	473	1	0.3	
P-871	MH-869	81.83	MH-807	76.84	0.018	281	Circle	PVC	8 inch	723	2	0.3	
P-874	MH-872	114	MH-873	106.35	0.048	160	Circle	PVC	8 inch	1,186	1	0.1	
P-876	MH-873	106.25	MH-875	94.71	0.037	310	Circle	PVC	8 inch	1,046	4	0.4	
P-878	MH-875	94.61	MH-877	86.76	0.042	186	Circle	PVC	8 inch	1,114	8	0.7	
P-880	MH-877	86.66	MH-879	58.71	0.11	255	Circle	PVC	8 inch	1,796	9	0.5	
P-882	MH-879	58.61	MH-881	56.75	0.017	112	Circle	PVC	8 inch	699	11	1.6	
P-883	MH-881	56.65	MH-819	55.01	0.012	140	Circle	PVC	8 inch	587	15	2.6	
P-886	MH-884	60.5	MH-885	58.23	0.008	300	Circle	PVC	8 inch	472	1	0.3	
P-887	MH-885	58.13	MH-881	56.75	0.005	273	Circle	PVC	8 inch	386	3	0.6	
P-889	MH-888	60.28	MH-879	58.71	0.01	160	Circle	PVC	8 inch	537	1	0.2	
P-891	MH-890	109.05	MH-873	106.35	0.009	313	Circle	PVC	8 inch	504	1	0.2	
P-894	MH-892	102	MH-893	96.51	0.038	144	Circle	PVC	8 inch	1,059	1	0.1	
P-895	MH-893	96.41	MH-875	94.71	0.005	330	Circle	PVC	8 inch	389	3	0.6	
P-898	MH-896	65.5	MH-897	63.1	0.015	165	Circle	PVC	8 inch	654	1	0.2	
P-900	MH-897	63	MH-899	59	0.018	217	Circle	PVC	8 inch	736	3	0.3	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-901	MH-899	58.9	MH-827	48.33	0.081	131	Circle	PVC	8 inch	1,541	4	0.2	
P-904	MH-902	105	MH-903	104	0.01	103	Circle	PVC	8 inch	534	1	0.2	
P-906	MH-903	103.9	MH-905	102.67	0.01	122	Circle	PVC	8 inch	545	3	0.5	
P-908	MH-907	110	MH-905	102.67	0.035	208	Circle	PVC	8 inch	1,018	1	0.1	
P-911	MH-909	113	MH-910	109	0.044	91	Circle	PVC	8 inch	1,137	1	0.1	
P-912	MH-910	108.9	MH-905	102.65	0.013	474	Circle	PVC	8 inch	623	3	0.4	
P-914	MH-905	102.55	MH-913	101.85	0.005	135	Circle	PVC	8 inch	391	8	1.9	
P-916	MH-913	101.75	MH-915	85.11	0.049	338	Circle	PVC	8 inch	1,203	9	0.7	
P-918	MH-915	85.01	MH-917	71.6	0.082	163	Circle	PVC	8 inch	1,556	14	0.9	
P-920	MH-917	71.5	MH-919	66.18	0.066	81	Circle	PVC	8 inch	1,390	15	1.1	
P-921	MH-919	66.08	MH-831	45.52	0.108	190	Circle	PVC	8 inch	1,784	16	0.9	
P-924	MH-922	104.5	MH-923	98.1	0.043	148	Circle	PVC	8 inch	1,128	1	0.1	
P-926	MH-923	98	MH-925	92.1	0.055	107	Circle	PVC	8 inch	1,274	3	0.2	
P-927	MH-925	92	MH-915	85.11	0.033	212	Circle	PVC	8 inch	978	4	0.4	
P-930	MH-928	115.97	MH-929	103.16	0.042	303	Circle	PVC	8 inch	1,115	1	0.1	
P-932	MH-929	102.98	MH-931	85.22	0.059	301	Circle	PVC	8 inch	1,317	3	0.2	
P-934	MH-931	85.05	MH-933	59.9	0.085	297	Circle	PVC	8 inch	1,578	4	0.2	
P-935	MH-933	59.25	MH-837	32	0.09	302	Circle	PVC	8 inch	1,629	5	0.3	
P-938	MH-936	0	MH-937	-1.9	0.026	73	Circle	PVC	6 inch	406	1	0.4	
P-940	MH-937	-1.9	MH-939	-3.27	0.009	153	Circle	PVC	8 inch	513	3	0.6	
P-942	MH-939	-3.27	MH-941	-4.78	0.004	372	Circle	Concrete	8 inch	346	7	2.1	
P-944	MH-941	-4.78	MH-943	-5.91	0.004	284	Circle	Concrete	8 inch	342	9	2.6	
P-945	MH-943	-5.91	MH-83	-6.43	0.003	157	Circle	PVC	8 inch	406	14	3.6	
P-947	MH-946	-4.52	MH-81	-6.37	0.01	186	Circle	Concrete	8 inch	541	3	0.5	
P-950	MH-948	-0.39	MH-949	-1.85	0.004	364	Circle	Concrete	8 inch	343	1	0.4	
P-951	MH-949	-1.85	MH-943	-2.41	0.004	140	Circle	Concrete	8 inch	343	3	0.9	
P-954	MH-952	-2.68	MH-953	-3.09	0.004	102	Circle	Concrete	8 inch	344	1	0.4	
P-955	MH-953	-3.09	MH-939	-3.27	0.003	52	Circle	Concrete	8 inch	319	3	0.9	
P-958	MH-956	146	MH-957	141	0.014	363	Circle	PVC	8 inch	637	3	0.5	
P-960	MH-957	140.9	MH-959	134.4	0.025	265	Circle	PVC	8 inch	849	7	0.8	
P-962	MH-959	134.3	MH-961	116.3	0.097	185	Circle	PVC	8 inch	1,692	10	0.6	
P-964	MH-961	116.2	MH-963	99.2	0.139	122	Circle	PVC	8 inch	2,025	14	0.7	
P-966	MH-963	99.1	MH-965	90.1	0.049	185	Circle	PVC	8 inch	1,196	17	1.5	
P-968	MH-965	90	MH-967	87.11	0.02	144	Circle	PVC	8 inch	768	21	2.7	
P-970	MH-967	87.01	MH-969	80.01	0.073	96	Circle	PVC	8 inch	1,465	38	2.6	
P-972	MH-969	79.91	MH-971	72.91	0.084	83	Circle	PVC	8 inch	1,575	42	2.7	

Existing - Peak Hour Flow - Pipe Capacity Table

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P-974	MH-971	72.81	MH-973	68.81	0.058	69	Circle	PVC	8 inch	1,306	45	3.5	
P-976	MH-973	68.71	MH-975	68.31	0.004	106	Circle	Concrete	8 inch	333	49	14.6	
P-978	MH-975	68.11	MH-977	50.88	0.059	291	Circle	Concrete	8 inch	1,320	56	4.2	
P-980	MH-977	50.78	MH-979	44.86	0.035	170	Circle	Concrete	8 inch	1,012	59	5.8	
P-982	MH-979	44.76	MH-981	34.76	0.065	154	Circle	Concrete	8 inch	1,382	70	5	
P-984	MH-983	41.7	MH-981	34.86	0.025	274	Circle	Concrete	8 inch	857	634	74	
P-986	MH-985	42.75	MH-983	41.7	0.004	259	Circle	Concrete	8 inch	345	631	182.7	
P-988	MH-987	44.07	MH-985	42.75	0.004	332	Circle	Concrete	8 inch	342	627	183.4	
P-990	MH-989	44.67	MH-987	44.07	0.004	153	Circle	Concrete	8 inch	340	624	183.7	
P-992	MH-991	64.02	MH-989	49.06	0.08	187	Circle	Concrete	8 inch	1,534	22	1.4	
P-994	MH-993	86.96	MH-991	64.02	0.075	305	Circle	Concrete	8 inch	1,487	7	0.5	
P-996	MH-995	104.94	MH-993	86.96	0.057	313	Circle	Concrete	8 inch	1,300	5	0.4	
P-998	MH-997	106.03	MH-995	104.94	0.004	275	Circle	Concrete	8 inch	341	4	1.1	
P-1000	MH-999	107.12	MH-997	106.03	0.004	267	Circle	Concrete	8 inch	347	2	0.5	
P-1003	MH-1001	147	MH-1002	145.1	0.013	149	Circle	PVC	6 inch	284	2	0.6	
P-1005	MH-1002	145	MH-1004	141.1	0.02	199	Circle	PVC	6 inch	353	4	1	
P-1007	MH-1004	141	MH-1006	137.1	0.012	335	Circle	PVC	6 inch	272	5	2	
P-1009	MH-1006	137	MH-1008	119.1	0.105	170	Circle	PVC	6 inch	817	7	0.9	
P-1011	MH-1008	119	MH-1010	101.1	0.077	232	Circle	Concrete	8 inch	1,506	9	0.6	
P-1013	MH-1010	101	MH-1012	95.1	0.016	360	Circle	Concrete	8 inch	694	11	1.6	
P-1014	MH-1012	95	MH-991	64.12	0.129	240	Circle	Concrete	8 inch	1,945	13	0.6	
P-1017	MH-1015	140.2	MH-1016	125.2	0.041	366	Circle	PVC	8 inch	1,098	3	0.3	
P-1019	MH-1016	125.1	MH-1018	114.1	0.06	182	Circle	PVC	8 inch	1,333	7	0.5	
P-1020	MH-1018	114	MH-967	90.11	0.152	157	Circle	PVC	8 inch	2,116	14	0.7	
P-1022	MH-1021	116	MH-1018	114.1	0.014	139	Circle	PVC	8 inch	634	3	0.5	
P-1024	MH-1023	74.08	MH-975	68.21	0.049	120	Circle	Concrete	8 inch	1,200	3	0.3	
P-1027	MH-1025	60.8	MH-1026	47.9	0.06	215	Circle	Concrete	8 inch	1,328	3	0.3	
P-1028	MH-1026	47.8	MH-979	44.86	0.026	115	Circle	Concrete	8 inch	867	7	0.8	
P-1038	MH-1037	-2.39	MH-1035	-2.51	0.001	100	Circle	Concrete	8 inch	188	1	0.8	
P-1041	MH-1040	46.14	MH-989	44.67	0.004	378	Circle	Concrete	8 inch	338	600	177.5	
P-1043	MH-1042	47.6	MH-1040	46.14	0.004	412	Circle	Concrete	8 inch	323	599	185.4	
P-1045	MH-1044	47.9	MH-1042	47.77	0.005	24	Circle	Concrete	8 inch	399	61	15.3	
P-1047	MH-1046	62.95	MH-1044	47.9	0.08	188	Circle	Concrete	8 inch	1,534	59	3.9	
P-1049	MH-1048	90	MH-1046	62.95	0.075	361	Circle	Concrete	8 inch	1,485	58	3.9	
P-1051	MH-1050	97.4	MH-1048	90.1	0.08	91	Circle	PVC	8 inch	1,536	56	3.6	
P-1053	MH-1052	101.85	MH-1050	97.5	0.014	309	Circle	PVC	8 inch	643	54	8.4	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1055	MH-1054	103.3	MH-1052	101.95	0.005	293	Circle	PVC	8 inch	368	52	14.2	
P-1057	MH-1056	104.69	MH-1054	103.41	0.005	262	Circle	PVC	8 inch	379	50	13.3	
P-1059	MH-1058	105.68	MH-1056	104.79	0.005	182	Circle	PVC	8 inch	379	31	8.1	
P-1061	MH-1060	107.95	MH-1058	105.78	0.011	200	Circle	PVC	8 inch	565	29	5.1	
P-1063	MH-1062	109.62	MH-1060	108.05	0.015	108	Circle	PVC	8 inch	654	27	4.1	
P-1065	MH-1064	111.09	MH-1062	109.72	0.012	119	Circle	PVC	8 inch	582	23	4	
P-1067	MH-1066	121.38	MH-1064	117.66	0.023	161	Circle	PVC	8 inch	824	22	2.6	
P-1069	MH-1068	126.77	MH-1066	121.45	0.048	111	Circle	PVC	8 inch	1,187	18	1.5	
P-1071	MH-1070	130.46	MH-1068	126.87	0.035	104	Circle	PVC	8 inch	1,008	16	1.6	
P-1073	MH-1072	147.43	MH-1070	130.56	0.059	284	Circle	PVC	8 inch	1,322	13	1	
P-1075	MH-1074	152.23	MH-1072	147.53	0.039	119	Circle	PVC	8 inch	1,078	9	0.8	
P-1077	MH-1076	154.76	MH-1074	152.33	0.026	95	Circle	PVC	8 inch	867	7	0.8	
P-1079	MH-1078	163.77	MH-1076	154.86	0.041	217	Circle	PVC	8 inch	1,099	5	0.5	
P-1081	MH-1080	168.28	MH-1078	163.87	0.05	89	Circle	PVC	8 inch	1,207	4	0.3	
P-1083	MH-1082	171.73	MH-1080	168.38	0.019	180	Circle	PVC	8 inch	740	2	0.2	
P-1085	MH-1084	148.87	MH-1072	147.53	0.005	270	Circle	PVC	8 inch	382	2	0.5	
P-1087	MH-1086	131.21	MH-1070	130.56	0.005	138	Circle	PVC	8 inch	372	2	0.5	
P-1089	MH-1088	123.26	MH-1066	121.48	0.005	357	Circle	PVC	8 inch	383	2	0.5	
P-1091	MH-1090	111.09	MH-1062	109.72	0.009	149	Circle	PVC	8 inch	520	2	0.3	
P-1094	MH-1092	163.51	MH-1093	160	0.022	156	Circle	PVC	8 inch	814	9	1.1	
P-1096	MH-1093	159.9	MH-1095	130.9	0.091	319	Circle	PVC	8 inch	1,635	11	0.7	
P-1098	MH-1095	130.9	MH-1097	129.22	0.016	105	Circle	PVC	8 inch	686	13	1.8	
P-1100	MH-1097	129.12	MH-1099	125.24	0.035	112	Circle	PVC	8 inch	1,009	14	1.4	
P-1102	MH-1099	125.14	MH-1101	112.58	0.031	399	Circle	PVC	8 inch	962	16	1.7	
P-1103	MH-1101	112.48	MH-1056	104.79	0.021	358	Circle	PVC	8 inch	795	18	2.3	
P-1106	MH-1104	100.83	MH-1105	100.03	0.003	251	Circle	PVC	8 inch	306	1	0.4	
P-1108	MH-1105	99.93	MH-1107	98.45	0.006	264	Circle	PVC	8 inch	406	5	1.3	
P-1110	MH-1107	98.35	MH-1109	97.31	0.006	182	Circle	PVC	8 inch	410	6	1.6	
P-1112	MH-1109	97.21	MH-1111	92.31	0.021	237	Circle	PVC	8 inch	780	8	1	
P-1114	MH-1111	92.21	MH-1113	75.59	0.053	313	Circle	PVC	8 inch	1,250	9	0.7	
P-1116	MH-1113	75.58	MH-1115	38.31	0.129	289	Circle	PVC	8 inch	1,948	10	0.5	
P-1118	MH-1115	38.21	MH-1117	27.27	0.219	50	Circle	PVC	8 inch	2,537	11	0.5	
P-1120	MH-1119	30.96	MH-1117	27.27	0.009	410	Circle	PVC	8 inch	515	9	1.7	
P-1122	MH-1121	35.79	MH-1119	31.06	0.012	397	Circle	PVC	8 inch	592	8	1.3	
P-1124	MH-1123	52.08	MH-1121	35.89	0.083	194	Circle	PVC	8 inch	1,567	6	0.4	
P-1126	MH-1125	76.4	MH-1123	52.18	0.12	202	Circle	PVC	8 inch	1,878	5	0.3	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1128	MH-1127	95.6	MH-1125	76.5	0.071	268	Circle	PVC	8 inch	1,448	3	0.2	
P-1130	MH-1129	99.66	MH-1127	95.7	0.017	228	Circle	PVC	8 inch	715	1	0.2	
P-1132	MH-1131	80.16	MH-1125	76.5	0.026	143	Circle	PVC	8 inch	868	1	0.1	
P-1135	MH-1133	26.93	MH-1134	26.21	0.003	212	Circle	PVC	8 inch	316	1	0.4	
P-1137	MH-1134	26.11	MH-1136	26	0.003	34	Circle	PVC	8 inch	308	24	7.8	
P-1138	MH-1117	27.17	MH-1134	26.21	0.008	126	Circle	PVC	8 inch	473	22	4.6	
P-1140	MH-1139	-4.25	MH-87	-6.14	0.012	152	Circle	PVC	8 inch	605	3	0.4	
P-1142	MH-1141	-4	MH-87	-6.14	0.013	164	Circle	PVC	8 inch	620	3	0.4	
P-1145	MH-1143	-2.18	MH-1144	-4.18	0.01	201	Circle	PVC	8 inch	541	3	0.5	
P-1148	MH-1146	-8.5	MH-91	-9.48	0.004	268	Circle	Concrete	8 inch	328	26	8	
P-1151	MH-1149	-0.52	MH-1150	-1.92	0.01	145	Circle	PVC	8 inch	533	3	0.5	
P-1157	MH-1155	5	MH-1156	2.88	0.039	54	Circle	PVC	6 inch	499	3	0.5	
P-1158	MH-1156	2.88	MH-1150	-1.92	0.041	118	Circle	PVC	6 inch	508	8	1.6	
P-1160	MH-1159	2.7	MH-1156	2.3	0.007	61	Circle	PVC	6 inch	204	3	1.3	
P-1163	MH-1161	1	MH-1162	-2.1	0.016	197	Circle	PVC	8 inch	680	3	0.4	
P-1165	MH-1162	-2	MH-1164	-6.1	0.017	246	Circle	PVC	8 inch	700	5	0.8	
P-1167	MH-1166	-4	MH-1164	-6.1	0.009	234	Circle	PVC	8 inch	514	5	1	
P-1169	MH-1168	-2	MH-1166	-4.1	0.025	83	Circle	PVC	8 inch	863	3	0.3	
P-1170	MH-1164	-6	MH-95	-10.76	0.013	367	Circle	PVC	8 inch	618	13	2.1	
P-1173	MH-1171	0.3	MH-1172	-0.49	0.004	176	Circle	PVC	8 inch	363	3	0.7	
P-1175	MH-1172	-0.59	MH-1174	-1.82	0.005	272	Circle	PVC	8 inch	365	5	1.4	
P-1177	MH-1174	-1.92	MH-1176	-2.85	0.005	205	Circle	PVC	8 inch	365	8	2.2	
P-1179	MH-1176	-2.95	MH-1178	-4.46	0.004	358	Circle	PVC	8 inch	352	11	3	
P-1181	MH-1178	-4.41	MH-1180	-5.76	0.006	229	Circle	Concrete	8 inch	416	13	3.2	
P-1182	MH-1180	-5.61	MH-101	-7.95	0.009	267	Circle	Concrete	12 inch	1,497	16	1.1	
P-1185	MH-1183	0.65	MH-1184	-1.1	0.006	300	Circle	Concrete	8 inch	414	2	0.4	
P-1187	MH-1184	-1.1	MH-1186	-1.21	0	234	Circle	PVC	6 inch	55	3	5.9	
P-1189	MH-1186	-1.21	MH-1188	-2.08	0.003	287	Circle	Concrete	8 inch	299	8	2.7	
P-1191	MH-1188	-2.08	MH-1190	-2.96	0.003	288	Circle	Concrete	8 inch	300	111	37.1	
P-1193	MH-1190	-2.96	MH-1192	-3.84	0.003	307	Circle	Concrete	8 inch	290	119	41.1	
P-1195	MH-1192	-4.44	MH-1194	-5.77	0.004	305	Circle	Concrete	12 inch	1,056	123	11.6	
P-1197	MH-1194	-5.77	MH-1196	-6.16	0.005	83	Circle	Concrete	12 inch	1,096	126	11.5	
P-1201	MH-1198	-7.61	MH-1200	-8.16	0.005	115	Circle	Concrete	12 inch	1,106	137	12.4	
P-1203	MH-1200	-8.16	MH-1202	-8.84	0.004	174	Circle	Concrete	12 inch	1,000	147	14.7	
P-1205	MH-1202	-8.84	MH-1204	-9.26	0.004	107	Circle	Concrete	12 inch	1,002	148	14.8	
P-1207	MH-1204	-9.26	MH-1206	-10.15	0.004	229	Circle	Concrete	12 inch	997	158	15.8	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1209	MH-1206	-10.28	MH-1208	-11.02	0.002	388	Circle	Concrete	15 inch	1,266	378	29.9	
P-1211	MH-1208	-11.02	MH-1210	-11.68	0.002	365	Circle	Concrete	15 inch	1,233	384	31.1	
P-1212	MH-1210	-11.68	MH-99	-12.3	0.002	313	Circle	Concrete	15 inch	1,290	386	29.9	
P-1215	MH-1213	1.5	MH-1214	-0.07	0.013	125	Circle	PVC	6 inch	282	2	0.6	
P-1217	MH-1214	-0.17	MH-1216	-0.95	0.004	196	Circle	PVC	8 inch	342	5	1.4	
P-1219	MH-1216	-1.05	MH-1218	-2.39	0.005	283	Circle	PVC	8 inch	373	6	1.7	
P-1220	MH-1218	-2.49	MH-1204	-2.76	0.005	56	Circle	PVC	8 inch	377	8	2.1	
P-1222	MH-1221	3.82	MH-1214	-0.07	0.108	36	Circle	PVC	6 inch	828	2	0.2	
P-1224	MH-1223	-2.56	MH-1208	-4.66	0.006	324	Circle	Concrete	8 inch	437	3	0.6	
P-1227	MH-1225	0.26	MH-1226	-0.5	0.004	206	Circle	Concrete	8 inch	329	2	0.5	
P-1228	MH-1226	-0.58	MH-1186	-1.21	0.003	200	Circle	Corrugated HDPE (Smooth Interior)	8 inch	304	3	1.1	
P-1231	MH-1229	-0.42	MH-1230	-1.24	0.004	193	Circle	Concrete	8 inch	354	2	0.5	
P-1232	MH-1230	-1.24	MH-1188	-2.08	0.004	210	Circle	Concrete	8 inch	343	3	0.9	
P-1235	MH-1233	1	MH-1234	-0.9	0.008	240	Circle	Concrete	8 inch	483	2	0.3	
P-1236	MH-1234	-1	MH-1190	-2.96	0.012	164	Circle	Concrete	8 inch	593	6	1.1	
P-1239	MH-1237	4	MH-1238	1.1	0.012	238	Circle	Concrete	8 inch	599	2	0.3	
P-1240	MH-1238	1	MH-1234	-0.9	0.012	158	Circle	Concrete	8 inch	595	3	0.5	
P-1242	MH-1241	0.28	MH-1192	-3.84	0.037	112	Circle	Concrete	8 inch	1,040	2	0.2	
P-1244	MH-1243	0.09	MH-1194	-1.89	0.018	109	Circle	Concrete	8 inch	731	2	0.2	
P-1247	MH-1245	-1.63	MH-1246	-2.16	0.004	121	Circle	Concrete	8 inch	359	2	0.4	
P-1249	MH-1246	-2.36	MH-1248	-2.8	0.004	112	Circle	Concrete	8 inch	340	3	0.9	
P-1251	MH-1248	-2.8	MH-1250	-4.05	0.004	313	Circle	Concrete	8 inch	343	5	1.4	
P-1253	MH-1250	-4.05	MH-1252	-5.29	0.004	318	Circle	Concrete	8 inch	339	6	1.9	
P-1254	MH-1252	-5.39	MH-1200	-7.16	0.012	152	Circle	Concrete	8 inch	585	8	1.4	
P-1257	MH-1255	0.79	MH-1256	-0.38	0.003	376	Circle	Concrete	8 inch	303	3	1.2	
P-1259	MH-1256	-1.38	MH-1258	-2.53	0.004	290	Circle	Concrete	8 inch	342	10	3.1	
P-1261	MH-1258	-2.53	MH-1260	-3.4	0.003	284	Circle	Concrete	8 inch	300	21	7	
P-1263	MH-1260	-3.4	MH-1262	-3.89	0.003	170	Circle	Concrete	8 inch	291	38	13.1	
P-1265	MH-1262	-3.89	MH-1264	-4.25	0.003	122	Circle	Concrete	8 inch	295	52	17.7	
P-1267	MH-1264	-4.25	MH-1266	-4.41	0.004	38	Circle	Concrete	8 inch	352	56	15.8	
P-1269	MH-1266	-4.41	MH-1268	-4.74	0.003	110	Circle	Concrete	8 inch	297	59	19.9	
P-1271	MH-1268	-4.74	MH-1270	-5.54	0.003	262	Circle	Concrete	8 inch	300	70	23.2	
P-1273	MH-1270	-5.54	MH-1272	-5.95	0.003	119	Circle	Concrete	8 inch	318	97	30.6	
P-1275	MH-1272	-5.95	MH-1274	-6.47	0.004	143	Circle	Concrete	8 inch	327	104	31.9	
P-1277	MH-1274	-6.47	MH-1276	-6.99	0.003	199	Circle	Concrete	8 inch	277	177	63.9	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1279	MH-1276	-6.99	MH-1278	-7.89	0.003	302	Circle	Concrete	8 inch	296	201	67.8	
P-1281	MH-1278	-7.89	MH-1280	-8.25	0.003	128	Circle	Concrete	8 inch	288	211	73.4	
P-1283	MH-1280	-8.25	MH-1282	-9.45	0.003	393	Circle	Concrete	8 inch	300	214	71.6	
P-1284	MH-1282	-9.45	MH-1206	-9.62	0.004	38	Circle	Concrete	8 inch	363	218	60.1	
P-1287	MH-1285	-1.93	MH-1286	-3.35	0.006	242	Circle	Concrete	8 inch	415	3	0.8	
P-1288	MH-1286	-3.35	MH-1278	-4.64	0.004	291	Circle	Concrete	8 inch	361	7	1.9	
P-1291	MH-1289	0	MH-1290	-0.89	0.006	140	Circle	PVC	6 inch	201	17	8.3	
P-1292	MH-1290	-0.99	MH-1276	-6.99	0.018	330	Circle	PVC	8 inch	731	20	2.7	
P-1294	MH-1293	0.28	MH-1256	-1.38	0.005	339	Circle	Concrete	8 inch	380	3	0.9	
P-1296	MH-1295	-1.54	MH-1258	-2.53	0.003	341	Circle	Concrete	8 inch	292	3	1.2	
P-1298	MH-1297	-0.58	MH-1258	-2.53	0.005	383	Circle	Concrete	8 inch	387	3	0.9	
P-1301	MH-1299	-0.93	MH-1300	-1.93	0.004	237	Circle	Concrete	8 inch	352	3	1	
P-1303	MH-1300	-1.93	MH-1302	-2.33	0.003	139	Circle	Concrete	8 inch	291	7	2.4	
P-1304	MH-1302	-2.4	MH-1260	-3.4	0.003	341	Circle	Concrete	8 inch	294	10	3.6	
P-1306	MH-1305	-1.76	MH-1260	-3.4	0.005	316	Circle	Concrete	8 inch	391	3	0.9	
P-1309	MH-1307	-0.48	MH-1308	-2.64	0.006	341	Circle	Concrete	8 inch	432	3	0.8	
P-1310	MH-1308	-2.64	MH-1262	-5.89	0.112	29	Circle	Concrete	8 inch	1,816	7	0.4	
P-1312	MH-1311	-1.75	MH-1262	-5.89	0.021	197	Circle	Concrete	8 inch	786	3	0.4	
P-1314	MH-1313	0.21	MH-1268	-4.74	0.014	357	Circle	Concrete	8 inch	639	3	0.5	
P-1316	MH-1315	0.12	MH-1268	-0.92	0.004	263	Circle	Concrete	8 inch	341	3	1	
P-1319	MH-1317	-0.02	MH-1318	-0.88	0.004	209	Circle	Concrete	8 inch	348	3	1	
P-1321	MH-1318	-0.88	MH-1320	-1.48	0.003	202	Circle	Concrete	8 inch	296	7	2.4	
P-1323	MH-1320	-1.48	MH-1322	-1.92	0.003	126	Circle	Concrete	8 inch	320	10	3.3	
P-1325	MH-1322	-1.92	MH-1324	-3.01	0.003	317	Circle	Concrete	8 inch	318	14	4.4	
P-1327	MH-1324	-3.01	MH-1326	-4.06	0.004	272	Circle	Concrete	8 inch	337	17	5.2	
P-1328	MH-1326	-4.06	MH-1270	-5.5	0.004	374	Circle	Concrete	8 inch	337	24	7.2	
P-1330	MH-1329	-3.13	MH-1326	-4.06	0.004	230	Circle	Concrete	8 inch	345	3	1	
P-1332	MH-1331	-4.3	MH-1272	-5.95	0.004	390	Circle	PVC	8 inch	353	3	1	
P-1334	MH-1333	-7.38	MH-1146	-8.13	0.008	98	Circle	PVC	8 inch	474	24	5	
P-1335	MH-1144	-4.28	MH-1333	-7.28	0.01	300	Circle	PVC	8 inch	542	5	1	
P-1337	MH-1336	-4.28	MH-1333	-7.28	0.01	301	Circle	PVC	8 inch	541	16	2.9	
P-1338	MH-1150	-2.02	MH-1336	-4.18	0.01	209	Circle	PVC	8 inch	551	13	2.4	
P-1342	MH-1341	105.7	MH-215	105.58	0.011	11	Circle	Steel	8 inch	566	1	0.2	
P-1347	MH-93	-10.48	MH-95	-10.76	0.002	167	Circle	Asbestos Cement	14 inch	1,167	78	6.7	
P-1348	MH-772	92.89	MH-766	92.22	0.007	103	Circle	PVC	8 inch	437	2	0.5	
P-1349	MH-241	120	MH-207	119.06	0.049	19	Circle	PVC	18 inch	10,486	17	0.2	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1351	MH-766	92.22	MH-768	91.58	0.003	188	Circle	PVC	8 inch	316	6	1.9	
P-1356	MH-1355	122.87	MH-284	121.91	0.004	218	Circle	Concrete	8 inch	360	1	0.4	
P-1361	MH-1360	224	MH-181	214.41	0.064	150	Circle	PVC	8 inch	1,371	2	0.1	
P-1377	MH-1363	-8.01	MH-1362	-8.2	0.001	241	Circle	PVC	27 inch	5,074	2,591	51.1	
P-1378	MH-1364	-7.98	MH-1363	-7.91	0	268	Circle	PVC	27 inch	2,920	2,588	88.6	
P-1380	MH-1366	-6.85	MH-1365	-7.55	0.001	598	Circle	PVC	27 inch	6,182	2,583	41.8	
P-1381	MH-1367	-6.31	MH-1366	-6.75	0.001	305	Circle	PVC	27 inch	6,863	2,580	37.6	
P-1382	MH-1368	-5.89	MH-1367	-6.21	0.001	374	Circle	PVC	27 inch	5,286	2,578	48.8	
P-1383	MH-1369	-5.46	MH-1368	-5.89	0.001	292	Circle	PVC	27 inch	6,934	2,575	37.1	
P-1384	MH-1370	-5.08	MH-1369	-5.46	0.001	338	Circle	PVC	27 inch	6,059	2,572	42.5	
P-1385	MH-1371	-4.76	MH-1370	-5.08	0.002	158	Circle	PVC	27 inch	8,132	2,570	31.6	
P-1386	MH-1372	-4.51	MH-1371	-4.66	0	386	Circle	PVC	27 inch	3,562	2,567	72.1	
P-1387	MH-1373	-4.49	MH-1372	-4.51	0	160	Circle	PVC	27 inch	2,020	2,566	127	
P-1388	MH-1374	-2.16	MH-1373	-4.29	0.012	179	Circle	PVC	24 inch	11,075	2,564	23.2	
P-1389	MH-1375	4.94	MH-1374	-2.26	0.015	479	Circle	PVC	18 inch	5,780	2,563	44.3	
P-1390	MH-981	34.6	MH-1375	5.04	0.1	297	Circle	Corrugated HDPE (Smooth Interior)	18 inch	16,113	707	4.4	
P-1392	MH-1391	10.4	MH-1375	5.15	0.059	89	Circle	Corrugated HDPE (Smooth Interior)	12 inch	4,207	1,854	44.1	
P-1410	MH-1409	130.66	MH-391	129.5	0.009	123	Circle	PVC	12 inch	1,553	0	0	
P-1422	MH-223	85.41	MH-1421	72.4	0.098	133	Circle	Concrete	8 inch	1,696	723	42.6	
P-1425	MH-1421	72.06	MH-1417	69.69	0.049	48	Circle	PVC	8 inch	1,205	724	60.1	
P-1429	MH-1428	188.2	MH-675	186.64	0.004	390	Circle	PVC	10 inch	622	2	0.3	
P-1431	MH-821	53.41	MH-1430	52.33	0.004	301	Circle	PVC	12 inch	958	631	65.8	
P-1434	MH-1430	52.23	MH-823	52.21	0.003	6	Circle	PVC	12 inch	923	632	68.4	
P-1440	MH-1436	55.3	MH-817	55.25	0.003	16	Circle	PVC	12 inch	894	391	43.8	
P-1446	MH-1444	56.11	MH-1436	55.4	0.006	114	Circle	PVC	12 inch	1,262	390	30.9	
P-1455	MH-1450	45.71	MH-1451	40.8	0.047	105	Circle	PVC	6 inch	545	2	0.3	
P-1456	MH-1449	53.16	MH-1448	35.4	0.072	246	Circle	PVC	8 inch	1,457.23	1.55	0.1	
P-1457	MH-1448	35.3	MH-1447	34.51	0.005	157	Circle	PVC	8 inch	384.71	3.1	0.8	
P-1458	MH-1447	34.41	MH-1454	33.93	0.005	104	Circle	PVC	8 inch	368.45	4.66	1.3	
P-1459	MH-1454	33.83	MH-1453	33.37	0.005	91	Circle	PVC	8 inch	385.6	6.21	1.6	
P-1460	MH-1453	33.27	MH-1452	33.09	0.005	36	Circle	PVC	8 inch	383.49	7.76	2	
P-1468	MH-1452	32.99	MH-1467	32.47	0.01	52	Circle	PVC	8 inch	542.34	9.31	1.7	
P-1469	MH-1451	40.7	MH-1467	40.2	0.01	50	Circle	PVC	8 inch	542.34	3.1	0.6	
P-1520	MH-1362	-8.2	MH-101	-8.25	0.004	14	Circle	PVC	18 inch	2,817.40	2,593.38	92	

Existing - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1524	MH-686	106.58	MH-1105	103.56	0.011	285	Circle	PVC	8 inch	725.77	2.54	0.4	
P-1525	MH-1196	-6.16	MH-1471	-6.6	0.007	60	Circle	Concrete	12 inch	1,369.31	127.32	9.3	
P-1526	MH-693	-6.03	MH-1471	-6.6	0.005	115	Circle	PVC	10 inch	899.98	6.4	0.7	
P-1527	MH-1472	-5.03	MH-693	-5.93	0.004	225	Circle	PVC	10 inch	808.49	4.8	0.6	
P-1528	MH-696	2.23	MH-695	-3.93	0.024	258	Circle	PVC	8 inch	1,089.43	1.6	0.1	
P-1529	MH-413	207.26	MH-1475	194.94	0.052	235	Circle	PVC	8 inch	1,614.32	3.84	0.2	
P-1530	MH-1476	203.05	MH-699	202.35	0.011	66	Circle	PVC	8 inch	726.1	3.84	0.5	
P-1531	MH-702	195.96	MH-1475	194.94	0.004	256	Circle	PVC	8 inch	445.04	5.76	1.3	
P-1532	MH-1477	197.73	MH-703	196.43	0.004	325	Circle	PVC	8 inch	445.91	1.92	0.4	
P-1533	MH-705	32.48	MH-837	32	0.007	64	Circle	PVC	15 inch	3,264.01	661.88	20.3	
P-1534	MH-1478	38.98	MH-707	45.12	0.016	393	Circle	PVC	15 inch	4,710.96	659.38	14	
P-1535	MH-831	45.42	MH-707	45.22	0.005	38	Circle	PVC	15 inch	2,734.29	658.13	24.1	
P-1536	MH-1479	55.84	MH-1444	55.74	0.005	19	Circle	PVC	15 inch	2,734.29	388.68	14.2	
P-1537	MH-1480	64.1	MH-709	61.73	0.01	249	Circle	PVC	15 inch	3,677.02	386.18	10.5	
P-1538	MH-811	65.75	MH-711	65.56	0.005	37	Circle	PVC	15 inch	2,700.83	383.78	14.2	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-21	MH-19	234.62	MH-20	228.59	0.046	131	Circle	PVC	8 inch	1,164	1	0.1	
P-23	MH-20	228.49	MH-22	215.96	0.06	209	Circle	PVC	8 inch	1,328	2	0.1	
P-26	MH-22	215.86	MH-25	188.81	0.117	232	Circle	PVC	8 inch	1,852	3	0.1	
P-28	MH-25	179.83	MH-27	164.06	0.145	109	Circle	PVC	8 inch	2,063	4	0.2	
P-30	MH-27	164.06	MH-29	151.94	0.098	124	Circle	PVC	8 inch	1,696	5	0.3	
P-32	MH-29	151.84	MH-31	139.99	0.119	100	Circle	PVC	8 inch	1,867	6	0.3	
P-34	MH-31	139.99	MH-33	139.89	0.001	113	Circle	PVC	8 inch	161	7	4.3	
P-36	MH-33	139.89	MH-35	133.12	0.041	166	Circle	PVC	8 inch	1,095	8	0.7	
P-38	MH-35	133.02	MH-37	127.2	0.03	195	Circle	PVC	8 inch	937	9	0.9	
P-40	MH-37	126	MH-39	121.64	0.023	186	Circle	PVC	8 inch	830	10	1.2	
P-42	MH-39	121.54	MH-41	120.21	0.005	271	Circle	PVC	8 inch	380	13	3.4	
P-44	MH-41	120.11	MH-43	118.75	0.005	267	Circle	PVC	8 inch	387	17	4.3	
P-46	MH-43	118.65	MH-45	118.22	0.005	84	Circle	PVC	8 inch	388	18	4.7	
P-48	MH-45	118.12	MH-47	117.06	0.005	211	Circle	PVC	8 inch	384	19	5	
P-50	MH-47	116.96	MH-49	116.8	0.009	18	Circle	PVC	8 inch	511	20	3.9	
P-52	MH-49	117.07	MH-51	114.49	0.018	147	Circle	Concrete	8 inch	719	386	53.7	
P-54	MH-51	114.49	MH-53	110.02	0.016	277	Circle	Concrete	8 inch	689	387	56.2	
P-56	MH-53	110.02	MH-55	106.76	0.065	50	Circle	Concrete	8 inch	1,385	390	28.1	
P-58	MH-55	106.76	MH-57	95.81	0.07	157	Circle	Concrete	8 inch	1,432	390	27.3	
P-60	MH-57	95.81	MH-59	85.38	0.083	125	Circle	Concrete	8 inch	1,567	391	25	
P-62	MH-59	85.38	MH-61	72.78	0.093	136	Circle	Concrete	8 inch	1,651	392	23.8	
P-64	MH-61	72.78	MH-63	66.2	0.076	87	Circle	Concrete	8 inch	1,492	395	26.5	
P-68	MH-65	43	MH-67	41.96	0.004	249	Circle	Concrete	8 inch	351	3	0.8	
P-70	MH-67	41.86	MH-69	26.74	0.075	202	Circle	Concrete	8 inch	1,484	524	35.3	
P-72	MH-69	26.74	MH-71	19.77	0.071	98	Circle	Concrete	8 inch	1,446	527	36.4	
P-78	MH-75	-4.53	MH-77	-5.51	0.004	253	Circle	Asbestos Cement	14 inch	1,774	7	0.4	
P-80	MH-77	-5.51	MH-79	-6.29	0.002	363	Circle	Cast iron	14 inch	1,211	9	0.7	
P-82	MH-79	-6.29	MH-81	-6.72	0.001	409	Circle	Asbestos Cement	14 inch	924	10	1.1	
P-84	MH-81	-6.72	MH-83	-7.12	0.003	132	Circle	Asbestos Cement	14 inch	1,569	16	1	
P-86	MH-83	-7.12	MH-85	-7.95	0.003	297	Circle	Asbestos Cement	14 inch	1,507	33	2.2	
P-88	MH-85	-7.95	MH-87	-8.58	0.002	323	Circle	Asbestos Cement	14 inch	1,259	35	2.8	
P-90	MH-87	-8.27	MH-89	-9.07	0.002	343	Circle	Asbestos Cement	14 inch	1,377	43	3.1	
P-92	MH-89	-9.07	MH-91	-10.11	0.003	342	Circle	Asbestos Cement	14 inch	1,572	46	2.9	
P-94	MH-91	-10.11	MH-93	-10.32	0.001	284	Circle	PVC	15 inch	1,025	75	7.3	2014
P-100	MH-97	-11.33	MH-99	-12.08	0.003	291	Circle	PVC	15 inch	1,913	96	5	2014
P-102	MH-99	-13.2	MH-101	-13.29	0	245	Circle	PVC	24 inch	2,530	485	19.2	2014

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-104	MH-103	190.8	MH-25	188.81	0.017	119	Circle	PVC	8 inch	701	1	0.1	
P-124	MH-122	240.58	MH-123	237.2	0.01	343	Circle	PVC	8 inch	538	1	0.2	
P-126	MH-123	237.2	MH-125	225.96	0.037	305	Circle	PVC	8 inch	1,041	349	33.5	
P-128	MH-125	225.8	MH-127	206.99	0.047	400	Circle	PVC	8 inch	1,176	350	29.7	
P-130	MH-127	206.87	MH-129	196.08	0.027	400	Circle	PVC	8 inch	891	350	39.3	
P-132	MH-129	196.08	MH-131	184.48	0.032	362	Circle	PVC	8 inch	971	351	36.2	
P-134	MH-131	184.38	MH-133	183.38	0.024	42	Circle	PVC	8 inch	837	352	42.1	
P-136	MH-133	182.62	MH-135	174.75	0.025	314	Circle	PVC	15 inch	4,590	353	7.7	
P-138	MH-135	174.68	MH-137	173.14	0.005	327	Circle	PVC	15 inch	1,990	354	17.8	
P-140	MH-137	173.06	MH-139	171.81	0.005	252	Circle	PVC	15 inch	2,042	355	17.4	
P-142	MH-139	171.74	MH-141	169.66	0.005	401	Circle	PVC	15 inch	2,088	356	17	
P-144	MH-141	169.58	MH-143	168.74	0.004	205	Circle	PVC	15 inch	1,856	356	19.2	
P-146	MH-143	168.72	MH-145	167.22	0.005	291	Circle	PVC	15 inch	2,082	357	17.2	
P-148	MH-145	167.18	MH-147	139.79	0.069	397	Circle	PVC	15 inch	7,615	358	4.7	
P-150	MH-147	139.66	MH-149	136.31	0.01	336	Circle	PVC	15 inch	2,895	359	12.4	
P-152	MH-149	136.22	MH-151	135.04	0.012	100	Circle	PVC	15 inch	3,149	360	11.4	
P-154	MH-151	134.87	MH-153	131.93	0.022	134	Circle	PVC	15 inch	4,294	361	8.4	
P-156	MH-153	131.83	MH-155	131.09	0.007	100	Circle	PVC	15 inch	3,242	363	11.2	
P-158	MH-155	130.99	MH-157	122.09	0.036	249	Circle	PVC	15 inch	7,126	364	5.1	
P-159	MH-157	122.09	MH-49	117.19	0.016	310	Circle	PVC	15 inch	4,738	365	7.7	
P-162	MH-160	132.95	MH-161	132.4	0.002	242	Circle	PVC	12 inch	762	1	0.1	
P-163	MH-161	132.4	MH-153	132.25	0.002	72	Circle	PVC	12 inch	730	2	0.2	
P-166	MH-164	123.49	MH-165	122.73	0.004	191	Circle	PVC	8 inch	342	1	0.3	
P-168	MH-165	122.63	MH-167	122.15	0.004	124	Circle	PVC	8 inch	337	2	0.5	
P-169	MH-167	122.05	MH-39	120.77	0.004	328	Circle	PVC	8 inch	339	3	0.8	
P-172	MH-170	122.82	MH-171	121.62	0.004	301	Circle	PVC	8 inch	342	1	0.3	
P-174	MH-171	121.52	MH-173	120.85	0.004	167	Circle	PVC	8 inch	344	2	0.5	
P-175	MH-173	120.85	MH-41	120.21	0.002	286	Circle	PVC	8 inch	257	3	1	
P-178	MH-176	224.22	MH-177	222.68	0.005	305	Circle	PVC	8 inch	385	2	0.5	
P-180	MH-177	222.68	MH-179	218.82	0.013	308	Circle	PVC	8 inch	607	4	0.7	
P-182	MH-179	218.82	MH-181	214.41	0.018	239	Circle	PVC	8 inch	737	6	0.8	
P-184	MH-181	214.41	MH-183	202.48	0.056	212	Circle	PVC	8 inch	1,287	10	0.8	
P-186	MH-183	202.48	MH-185	194.44	0.039	206	Circle	PVC	8 inch	1,071	12	1.1	
P-188	MH-185	194.44	MH-187	161.6	0.699	47	Circle	PVC	8 inch	4,533	14	0.3	
P-190	MH-187	191.6	MH-189	190.78	0.005	162	Circle	PVC	8 inch	386	16	4.2	
P-192	MH-189	190.78	MH-191	184.15	0.042	157	Circle	PVC	8 inch	1,115	18	1.6	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-194	MH-191	184.15	MH-193	161.51	0.081	279	Circle	PVC	8 inch	1,545	20	1.3	
P-196	MH-193	161.51	MH-195	154.32	0.171	42	Circle	PVC	8 inch	2,244	22	1	
P-198	MH-195	154.32	MH-197	143.68	0.083	128	Circle	PVC	8 inch	2,033	24	1.2	2014
P-200	MH-197	143.58	MH-199	141	0.031	84	Circle	PVC	8 inch	1,236	26	2.1	2014
P-202	MH-199	139.9	MH-201	131.1	0.027	324	Circle	PVC	8 inch	1,162	28	2.4	2014
P-204	MH-201	131	MH-203	124.76	0.013	476	Circle	PVC	8 inch	807	30	3.7	2014
P-206	MH-203	124.66	MH-205	119.6	0.018	276	Circle	PVC	8 inch	955	36	3.8	2014
P-208	MH-205	119.5	MH-207	119.06	0.019	23	Circle	PVC	8 inch	975	38	3.8	2014
P-210	MH-207	118.96	MH-209	117.37	0.006	263	Circle	PVC	12 inch	1,616	88	5.5	2014
P-212	MH-209	117.27	MH-211	115.62	0.006	275	Circle	PVC	12 inch	1,610	90	5.6	2014
P-214	MH-211	115.52	MH-213	113.3	0.006	366	Circle	PVC	12 inch	1,619	98	6.1	2014
P-216	MH-213	113.2	MH-215	105.58	0.027	278	Circle	PVC	12 inch	2,647	108	4.1	
P-218	MH-215	105.48	MH-217	101.95	0.01	353	Circle	PVC	12 inch	1,599	111	6.9	
P-220	MH-217	101.7	MH-219	101.6	0.007	15	Circle	PVC	12 inch	1,306	112	8.6	
P-222	MH-219	101.5	MH-221	94.51	0.097	72	Circle	Concrete	8 inch	1,690	114	6.7	
P-230	MH-228	126.83	MH-229	125.31	0.005	308	Circle	Concrete	8 inch	381	1	0.4	
P-232	MH-229	123.21	MH-231	123.14	0	409	Circle	Concrete	8 inch	71	3	4	
P-234	MH-231	123.04	MH-233	119.5	0.017	205	Circle	PVC	8 inch	713	4	0.6	
P-236	MH-233	119.4	MH-235	116.1	0.015	218	Circle	PVC	8 inch	667	6	0.8	
P-237	MH-235	116	MH-211	115.62	0.013	30	Circle	PVC	8 inch	610	7	1.1	
P-240	MH-238	132	MH-239	130.1	0.015	126	Circle	PVC	8 inch	666	14	2.2	
P-242	MH-239	130	MH-241	120.1	0.029	337	Circle	PVC	8 inch	930	16	1.7	
P-247	MH-245	244.65	MH-246	240.69	0.011	365	Circle	PVC	8 inch	565	1	0.2	
P-249	MH-246	240.59	MH-248	230.55	0.102	98	Circle	PVC	8 inch	1,736	3	0.2	
P-251	MH-248	230.45	MH-250	219.1	0.028	400	Circle	PVC	8 inch	914	4	0.5	
P-253	MH-250	210.6	MH-252	208.76	0.006	288	Circle	PVC	8 inch	434	10	2.3	
P-255	MH-252	208.66	MH-254	194.58	0.054	263	Circle	PVC	8 inch	1,255	11	0.9	
P-257	MH-254	194.48	MH-256	182.94	0.05	230	Circle	PVC	8 inch	1,215	13	1	
P-259	MH-256	182.84	MH-258	181.42	0.004	360	Circle	PVC	8 inch	341	14	4.1	
P-261	MH-258	181.32	MH-260	161.9	0.071	272	Circle	PVC	10 inch	2,627	15	0.6	
P-263	MH-260	161.8	MH-262	147.91	0.131	106	Circle	PVC	10 inch	3,560	17	0.5	
P-265	MH-262	147.66	MH-264	134.16	0.042	320	Circle	PVC	10 inch	2,020	24	1.2	
P-267	MH-264	134.06	MH-266	125.91	0.025	324	Circle	PVC	10 inch	1,560	25	1.6	
P-269	MH-266	125.71	MH-268	124.75	0.004	271	Circle	Steel	12 inch	952	27	2.8	
P-271	MH-268	124.5	MH-270	123.36	0.004	307	Circle	Steel	12 inch	974	28	2.9	
P-273	MH-270	123.26	MH-272	121.9	0.003	401	Circle	Steel	12 inch	931	29	3.2	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-275	MH-272	121.8	MH-274	120.44	0.003	401	Circle	Steel	12 inch	931	31	3.3	
P-276	MH-274	120.34	MH-207	119.06	0.003	375	Circle	Steel	12 inch	934	32	3.5	
P-279	MH-277	124	MH-278	116	0.017	464	Circle	PVC	6 inch	331	1	0.4	
P-288	MH-286	127.72	MH-287	126.43	0.004	300	Circle	PVC	8 inch	356	2	0.6	
P-289	MH-287	126.43	MH-203	124.76	0.006	300	Circle	PVC	8 inch	405	4	1	
P-292	MH-290	160.16	MH-291	160.04	0.005	23	Circle	PVC	8 inch	392	1	0.4	
P-294	MH-291	159.94	MH-293	153.99	0.048	125	Circle	PVC	8 inch	1,183	3	0.2	
P-295	MH-293	153.43	MH-262	145.67	0.031	253	Circle	PVC	8 inch	950	6	0.6	
P-297	MH-296	154.4	MH-293	153.53	0.031	28	Circle	PVC	8 inch	956	1	0.1	
P-300	MH-298	223.33	MH-299	213.27	0.04	253	Circle	PVC	8 inch	1,081	1	0.1	
P-302	MH-299	213.17	MH-301	212.79	0.004	93	Circle	PVC	8 inch	347	3	0.8	
P-303	MH-301	212.69	MH-250	210.7	0.013	159	Circle	PVC	8 inch	607	4	0.7	
P-306	MH-304	126.25	MH-43	118.75	0.025	304	Circle	PVC	8 inch	852	1	0.1	
P-309	MH-307	143.9	MH-308	141.24	0.03	90	Circle	PVC	8 inch	932	2	0.2	
P-311	MH-308	141.2	MH-310	125.96	0.049	312	Circle	PVC	8 inch	1,199	3	0.3	
P-313	MH-310	125.74	MH-312	116.72	0.032	282	Circle	PVC	8 inch	970	230	23.7	
P-315	MH-312	116.62	MH-314	116.19	0.007	58	Circle	PVC	8 inch	467	232	49.6	
P-317	MH-314	116.14	MH-316	113.49	0.014	189	Circle	PVC	8 inch	642	233	36.3	
P-319	MH-316	113.26	MH-318	109.89	0.015	227	Circle	PVC	8 inch	661	243	36.7	
P-321	MH-318	109.82	MH-320	109.48	0.006	54	Circle	PVC	8 inch	430	251	58.2	
P-323	MH-320	109.45	MH-322	108.34	0.005	220	Circle	PVC	8 inch	385	252	65.5	
P-328	MH-326	135.65	MH-327	129.51	0.038	162	Circle	PVC	8 inch	1,056	222	21.1	
P-330	MH-327	129.35	MH-329	127.37	0.025	78	Circle	PVC	8 inch	864	224	25.9	
P-331	MH-329	127.3	MH-310	125.92	0.011	124	Circle	PVC	8 inch	572	226	39.4	
P-334	MH-332	155.87	MH-333	148.67	0.05	145	Circle	PVC	8 inch	1,209	2	0.1	
P-336	MH-333	148.6	MH-335	134.6	0.063	223	Circle	PVC	8 inch	1,359	3	0.2	
P-338	MH-335	134.54	MH-337	129.68	0.032	150	Circle	PVC	8 inch	976	5	0.5	
P-340	MH-337	129.66	MH-339	118.75	0.053	206	Circle	PVC	8 inch	1,248	6	0.5	
P-341	MH-339	118.72	MH-316	113.43	0.056	94	Circle	PVC	8 inch	1,287	8	0.6	
P-344	MH-342	151.34	MH-343	149.82	0.022	69	Circle	PVC	8 inch	805	2	0.2	
P-346	MH-343	149.65	MH-345	134.49	0.057	264	Circle	PVC	8 inch	1,300	3	0.2	
P-348	MH-345	134.49	MH-347	127.94	0.043	151	Circle	PVC	8 inch	1,130	5	0.4	
P-349	MH-347	127.84	MH-318	109.89	0.079	227	Circle	PVC	8 inch	1,525	6	0.4	
P-352	MH-350	144	MH-351	141.69	0.025	92	Circle	PVC	8 inch	859	2	0.2	
P-354	MH-351	141.61	MH-353	133.61	0.04	201	Circle	PVC	8 inch	1,082	3	0.3	
P-356	MH-353	133.6	MH-355	126.19	0.028	269	Circle	PVC	8 inch	900	5	0.5	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-358	MH-355	126.15	MH-357	120.57	0.03	187	Circle	PVC	8 inch	937	6	0.7	
P-360	MH-357	120.26	MH-359	116.05	0.03	142	Circle	PVC	8 inch	934	9	1	
P-361	MH-359	115.93	MH-322	108.45	0.057	132	Circle	PVC	8 inch	1,291	11	0.9	
P-363	MH-362	124.05	MH-357	120.22	0.023	170	Circle	PVC	8 inch	814	2	0.2	
P-366	MH-364	142.26	MH-365	134.78	0.034	221	Circle	PVC	8 inch	998	2	0.2	
P-368	MH-365	134.73	MH-367	128.57	0.027	231	Circle	PVC	8 inch	886	3	0.4	
P-369	MH-367	128.57	MH-322	108.47	0.097	207	Circle	PVC	8 inch	1,690	5	0.3	
P-372	MH-370	230.75	MH-371	224.6	0.079	78	Circle	PVC	8 inch	1,523	1	0	
P-374	MH-371	224.43	MH-373	201.79	0.081	278	Circle	PVC	8 inch	1,548	1	0.1	
P-376	MH-373	201.7	MH-375	196.85	0.016	301	Circle	PVC	8 inch	688	2	0.2	
P-378	MH-375	196.72	MH-377	179.76	0.068	249	Circle	PVC	8 inch	1,415	3	0.2	
P-380	MH-377	179.56	MH-379	155.67	0.089	267	Circle	PVC	8 inch	1,622	3	0.2	
P-382	MH-379	155.55	MH-381	139.74	0.108	147	Circle	PVC	8 inch	1,779	4	0.2	
P-384	MH-381	139.43	MH-383	131.82	0.035	219	Circle	PVC	12 inch	2,981	9	0.3	
P-386	MH-383	131.66	MH-385	131.33	0.016	20	Circle	PVC	12 inch	2,054	18	0.9	
P-388	MH-385	131.26	MH-387	125.21	0.098	62	Circle	PVC	12 inch	4,995	18	0.4	
P-390	MH-389	125.59	MH-387	125.21	0.007	58	Circle	PVC	12 inch	1,294	0	0	
P-392	MH-391	131.26	MH-385	130.79	0.011	42	Circle	PVC	12 inch	1,692	0	0	
P-394	MH-393	197.93	MH-375	196.75	0.009	128	Circle	PVC	8 inch	521	1	0.1	
P-397	MH-395	226.27	MH-396	221.56	0.044	106	Circle	PVC	8 inch	1,143	1	0	
P-399	MH-396	221.36	MH-398	216.32	0.048	106	Circle	PVC	8 inch	1,183	1	0.1	
P-401	MH-398	216.08	MH-400	212.33	0.046	81	Circle	PVC	8 inch	1,167	2	0.1	
P-403	MH-400	212.21	MH-402	194.02	0.046	399	Circle	PVC	8 inch	1,158	2	0.2	
P-405	MH-402	193.84	MH-404	179.16	0.045	327	Circle	PVC	8 inch	1,149	3	0.3	
P-407	MH-404	179.02	MH-406	161.08	0.053	338	Circle	PVC	8 inch	1,249	4	0.3	
P-408	MH-406	161	MH-381	139.74	0.055	387	Circle	PVC	8 inch	1,271	5	0.4	
P-410	MH-409	165.94	MH-406	161.08	0.014	350	Circle	PVC	8 inch	639	1	0.1	
P-412	MH-411	198.2	MH-402	193.94	0.029	145	Circle	PVC	8 inch	930	1	0.1	
P-467	MH-465	179.62	MH-466	178.85	0.007	112	Circle	PVC	8 inch	450	1	0.1	
P-469	MH-466	178.85	MH-468	171.09	0.032	239	Circle	PVC	8 inch	977	1	0.1	
P-471	MH-468	170.92	MH-470	160.08	0.037	293	Circle	PVC	8 inch	1,043	2	0.1	
P-473	MH-470	159.94	MH-472	159.08	0.005	159	Circle	PVC	8 inch	399	2	0.5	
P-475	MH-472	159.03	MH-474	158.19	0.006	146	Circle	PVC	8 inch	411	3	0.6	
P-477	MH-474	157.88	MH-476	156.37	0.004	359	Circle	PVC	8 inch	352	6	1.6	
P-479	MH-476	156.21	MH-478	155.85	0.005	71	Circle	PVC	8 inch	386	6	1.6	
P-481	MH-478	155.85	MH-480	155.15	0.004	180	Circle	PVC	8 inch	338	7	1.9	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-483	MH-480	155.02	MH-482	154.72	0.005	64	Circle	PVC	8 inch	371	7	1.9	
P-485	MH-482	154.72	MH-484	152.33	0.035	69	Circle	PVC	8 inch	1,009	8	0.7	
P-487	MH-484	152.33	MH-486	146.91	0.022	244	Circle	PVC	8 inch	808	8	1	
P-489	MH-486	146.6	MH-488	138.64	0.031	256	Circle	PVC	12 inch	2,820	9	0.3	
P-490	MH-488	138.5	MH-383	131.82	0.035	193	Circle	PVC	12 inch	2,975	9	0.3	
P-493	MH-491	191.11	MH-492	182.09	0.032	282	Circle	PVC	8 inch	970	1	0.1	
P-495	MH-492	181.98	MH-494	180.01	0.007	282	Circle	PVC	8 inch	453	1	0.2	
P-497	MH-494	179.94	MH-496	179	0.006	150	Circle	PVC	8 inch	429	2	0.3	
P-499	MH-496	178.93	MH-498	174.07	0.021	230	Circle	PVC	8 inch	788	2	0.3	
P-500	MH-498	173.93	MH-474	158.13	0.061	260	Circle	PVC	8 inch	1,337	3	0.2	
P-513	MH-511	186.12	MH-512	183.48	0.01	276	Circle	PVC	8 inch	530	2	0.4	
P-515	MH-512	183.18	MH-514	181.06	0.006	382	Circle	PVC	8 inch	404	4	1	
P-517	MH-514	180.95	MH-516	179.74	0.007	166	Circle	PVC	8 inch	463	8	1.7	
P-519	MH-516	185.06	MH-518	183.46	0.004	401	Circle	PVC	10 inch	621	13	2.2	
P-520	MH-518	183.36	MH-431	181.58	0.004	399	Circle	PVC	10 inch	657	15	2.3	
P-523	MH-521	193	MH-522	190.1	0.011	268	Circle	PVC	8 inch	564	2	0.3	
P-525	MH-522	190	MH-524	189.1	0.014	65	Circle	PVC	8 inch	638	4	0.6	
P-527	MH-524	189	MH-526	187.1	0.008	250	Circle	PVC	8 inch	473	8	1.6	
P-528	MH-526	187	MH-427	185	0.008	249	Circle	PVC	8 inch	486	10	2	
P-530	MH-529	190.75	MH-524	189.1	0.016	101	Circle	PVC	8 inch	693	2	0.3	
P-532	MH-531	192.81	MH-514	189.44	0.01	343	Circle	PVC	8 inch	538	2	0.4	
P-534	MH-533	189	MH-425	187.6	0.008	173	Circle	PVC	8 inch	488	2	0.4	
P-536	MH-535	186.97	MH-429	182.6	0.013	348	Circle	PVC	8 inch	608	2	0.3	
P-539	MH-537	181.15	MH-538	179.99	0.005	211	Circle	PVC	8 inch	402	2	0.5	
P-541	MH-538	179.89	MH-540	177.66	0.01	218	Circle	PVC	8 inch	549	4	0.7	
P-543	MH-540	177.56	MH-542	177.25	0.005	58	Circle	PVC	8 inch	397	6	1.5	
P-545	MH-542	177.15	MH-544	175.1	0.015	141	Circle	PVC	8 inch	654	8	1.2	
P-547	MH-544	175	MH-546	172.2	0.009	324	Circle	PVC	8 inch	504	10	1.9	
P-548	MH-546	171.98	MH-437	169.85	0.006	345	Circle	PVC	8 inch	426	19	4.5	
P-551	MH-549	180.72	MH-550	178.72	0.021	97	Circle	PVC	8 inch	779	2	0.2	
P-553	MH-550	178.62	MH-552	177.73	0.006	148	Circle	PVC	8 inch	421	4	0.9	
P-555	MH-552	177.63	MH-554	176.62	0.006	169	Circle	PVC	8 inch	419	6	1.4	
P-556	MH-554	176.52	MH-546	172.2	0.016	278	Circle	PVC	8 inch	676	8	1.1	
P-559	MH-557	202.17	MH-558	201.77	0.005	76	Circle	PVC	8 inch	393	2	0.5	
P-561	MH-558	201.77	MH-560	199.93	0.005	400	Circle	PVC	8 inch	368	4	1	
P-563	MH-560	199.83	MH-562	195.7	0.012	346	Circle	PVC	8 inch	593	17	2.9	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-565	MH-562	196.23	MH-564	195.93	0.004	77	Circle	PVC	8 inch	339	19	5.7	
P-567	MH-564	195.83	MH-566	194.35	0.004	375	Circle	PVC	8 inch	341	21	6.2	
P-569	MH-566	194.23	MH-568	193.79	0.005	86	Circle	PVC	8 inch	388	23	5.9	
P-571	MH-568	193.79	MH-570	192.42	0.005	288	Circle	PVC	8 inch	374	25	6.7	
P-573	MH-570	199.35	MH-572	176.21	0.062	373	Circle	PVC	8 inch	1,351	36	2.7	
P-575	MH-572	176.11	MH-574	173.45	0.009	281	Circle	PVC	8 inch	528	38	7.3	
P-576	MH-574	173.35	MH-441	171.25	0.005	400	Circle	PVC	8 inch	393	40	10.3	
P-579	MH-577	252.92	MH-578	241.07	0.049	240	Circle	PVC	8 inch	1,205	2	0.2	
P-581	MH-578	240.97	MH-580	227.6	0.088	152	Circle	PVC	8 inch	1,608	4	0.2	
P-583	MH-580	227.5	MH-582	202.51	0.062	400	Circle	PVC	8 inch	1,356	8	0.6	
P-584	MH-582	202.41	MH-570	199.45	0.052	57	Circle	PVC	8 inch	1,236	10	0.8	
P-586	MH-585	233.68	MH-580	227.6	0.035	174	Circle	PVC	8 inch	1,014	2	0.2	
P-589	MH-587	234.47	MH-588	214.64	0.118	168	Circle	PVC	8 inch	1,863	2	0.1	
P-591	MH-588	214.54	MH-590	213.28	0.027	47	Circle	PVC	8 inch	888	4	0.4	
P-593	MH-590	213.18	MH-592	209.06	0.02	210	Circle	PVC	8 inch	760	6	0.8	
P-595	MH-592	208.96	MH-594	208.37	0.005	109	Circle	PVC	8 inch	399	8	1.9	
P-596	MH-594	208.27	MH-560	203.62	0.058	80	Circle	PVC	8 inch	1,308	10	0.7	
P-598	MH-597	226.56	MH-560	203.62	0.08	287	Circle	PVC	8 inch	1,533	2	0.1	
P-601	MH-599	158.18	MH-600	156.69	0.004	393	Circle	PVC	8 inch	334	2	0.6	
P-603	MH-600	156.59	MH-602	154.76	0.012	158	Circle	PVC	8 inch	584	4	0.7	
P-605	MH-602	154.66	MH-604	154.21	0.015	31	Circle	PVC	8 inch	653	6	0.9	
P-607	MH-604	154.11	MH-606	152.05	0.074	28	Circle	PVC	8 inch	1,471	8	0.5	
P-609	MH-606	152.05	MH-608	149.86	0.012	188	Circle	PVC	8 inch	585	10	1.6	
P-610	MH-608	149.86	MH-445	149.66	0.005	41	Circle	PVC	8 inch	379	12	3	
P-613	MH-611	163.36	MH-612	161.87	0.106	14	Circle	PVC	6 inch	822	2	0.2	
P-615	MH-612	161.77	MH-614	154.19	0.032	239	Circle	PVC	8 inch	966	6	0.6	
P-617	MH-614	154.09	MH-616	153.13	0.004	243	Circle	PVC	8 inch	341	8	2.3	
P-619	MH-616	153.03	MH-618	152.46	0.005	125	Circle	PVC	8 inch	366	12	3.1	
P-620	MH-618	152.36	MH-447	149.04	0.026	128	Circle	PVC	8 inch	873	13	1.5	
P-623	MH-621	154.04	MH-622	140.78	0.044	304	Circle	PVC	8 inch	1,133	2	0.2	
P-624	MH-622	140.62	MH-453	137.71	0.037	78	Circle	PVC	8 inch	1,048	4	0.4	
P-627	MH-625	143.5	MH-626	139.83	0.009	400	Circle	PVC	8 inch	519	2	0.4	
P-629	MH-626	139.75	MH-628	136.93	0.033	86	Circle	PVC	8 inch	982	10	1	
P-631	MH-628	136.87	MH-630	136.04	0.008	107	Circle	PVC	8 inch	478	12	2.4	
P-632	MH-630	135.99	MH-457	135.25	0.007	104	Circle	PVC	8 inch	457	13	2.9	
P-635	MH-633	157.79	MH-634	156.13	0.011	153	Circle	PVC	8 inch	565	2	0.3	

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P-637	MH-634	156.04	MH-636	146.32	0.028	348	Circle	PVC	8 inch	906	4	0.4	
P-638	MH-636	146.26	MH-626	139.92	0.034	187	Circle	PVC	8 inch	999	6	0.6	
P-640	MH-639	164.36	MH-612	161.87	0.035	72	Circle	PVC	6 inch	468	2	0.4	
P-642	MH-641	159.22	MH-616	153.13	0.055	110	Circle	PVC	8 inch	1,276	2	0.2	
P-645	MH-643	169.21	MH-644	167.81	0.007	196	Circle	PVC	8 inch	458	2	0.4	
P-647	MH-644	167.26	MH-646	165.55	0.007	252	Circle	PVC	8 inch	447	4	0.9	
P-649	MH-646	166.72	MH-648	164.43	0.013	172	Circle	PVC	8 inch	626	6	0.9	
P-651	MH-648	164.33	MH-650	162.57	0.007	244	Circle	PVC	8 inch	461	15	3.3	
P-653	MH-650	162.47	MH-652	158.81	0.015	240	Circle	PVC	8 inch	670	17	2.6	
P-655	MH-652	158.71	MH-654	143.06	0.043	360	Circle	PVC	8 inch	1,131	19	1.7	
P-657	MH-654	142.96	MH-656	140.35	0.029	90	Circle	PVC	8 inch	924	21	2.3	
P-663	MH-661	156.46	MH-662	154.06	0.02	118	Circle	PVC	8 inch	773	2	0.2	
P-665	MH-662	153.96	MH-664	144.93	0.024	374	Circle	PVC	8 inch	843	4	0.5	
P-666	MH-664	144.84	MH-451	144.31	0.013	42	Circle	PVC	8 inch	609	6	0.9	
P-669	MH-667	199.97	MH-668	196.79	0.028	113	Circle	PVC	8 inch	910	2	0.2	
P-671	MH-668	196.69	MH-670	180.94	0.059	267	Circle	PVC	8 inch	1,317	4	0.3	
P-673	MH-670	180.84	MH-672	172.51	0.067	124	Circle	PVC	8 inch	1,406	6	0.4	
P-674	MH-672	172.41	MH-648	164.43	0.06	134	Circle	PVC	8 inch	1,324	8	0.6	
P-676	MH-675	186.46	MH-516	185.16	0.008	164	Circle	PVC	10 inch	875	4	0.4	
P-679	MH-677	125.79	MH-678	121.09	0.017	269	Circle	Concrete	8 inch	717	1	0.1	
P-680	MH-678	121.09	MH-53	110.25	0.037	293	Circle	Concrete	8 inch	1,043	2	0.2	
P-681	MH-101	-8.25	WW-MAIN	-10.67	0.033	74	Circle	PVC	36 inch	70,374	2,763	3.9	2014
P-682	MH-1136	26	WW-PIONEER	22	0.045	88	Circle	PVC	30 inch	39,248	25	0.1	
P-683	MH-681	109	MH-682	83.64	0.078	324	Circle	Concrete	8 inch	1,517	1	0.1	
P-684	MH-682	83.28	MH-61	72.78	0.048	219	Circle	Concrete	8 inch	1,188	2	0.1	
P-685	MH-387	125.12	WW-COPPER	122.5	0.114	23	Circle	PVC	30 inch	62,131	18	0	
P-688	MH-687	93.91	MH-223	85.51	0.06	141	Circle	Concrete	8 inch	1,324	1	0.1	
P-689	MH-1467	32.47	WW-TAYLOR	32	0.47	1	Circle	PVC	30 inch	126,204	14	0	
P-690	MH-689	95.43	MH-221	94.51	0.004	217	Circle	Concrete	8 inch	353	1	0.4	
P-691	MH-730	74.48	'W-LINDSTRO	74.46	0.02	1	Circle	PVC	30 inch	26,034	12	0	
P-693	MH-691	99.5	MH-692	80.2	0.102	190	Circle	Concrete	8 inch	1,729	1	0.1	
P-694	MH-419	189	MH-421	188.5	0.003	192	Circle	PVC	8 inch	277	21	7.6	
P-695	MH-95	-10.76	MH-97	-11.33	0.004	152	Circle	PVC	15 inch	2,308	93	4.1	2014
P-696	MH-694	82.5	MH-1473	71.2	0.05	224	Circle	Concrete	8 inch	1,218	1	0.1	
P-697	MH-278	115.9	MH-213	113.3	0.163	16	Circle	Concrete	8 inch	2,186	8	0.4	
P-698	MH-417	194	MH-419	189	0.056	90	Circle	PVC	8 inch	1,278	19	1.5	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-699	MH-697	113	MH-698	105.3	0.022	351	Circle	PVC	8 inch	803	1	0.2	
P-700	MH-421	188.5	MH-423	187.5	0.004	285	Circle	PVC	8 inch	321	23	7.2	
P-701	MH-698	105.2	MH-700	103.2	0.005	426	Circle	Concrete	8 inch	372	3	0.8	
P-702	MH-700	103.1	MH-692	80.1	0.052	442	Circle	Concrete	8 inch	1,237	4	0.3	
P-703	MH-692	80	MH-1473	71.3	0.053	164	Circle	Concrete	8 inch	1,249	7	0.6	
P-704	MH-1365	-7.65	MH-1364	-7.98	0.006	60	Circle	PVC	36 inch	28,860	2,251	7.8	2014
P-705	MH-1473	71.1	MH-704	27.8	0.115	378	Circle	Concrete	8 inch	1,836	10	0.5	
P-706	MH-423	187.5	MH-425	186	0.004	400	Circle	PVC	8 inch	332	25	7.5	
P-707	MH-704	27.6	MH-706	25.43	0.005	413	Circle	PVC	15 inch	2,732	952	34.8	2014
P-708	MH-425	186	MH-427	185	0.004	269	Circle	PVC	8 inch	331	29	8.7	
P-709	MH-706	25.33	MH-708	24.28	0.005	229	Circle	PVC	15 inch	2,552	953	37.3	2014
P-710	MH-427	185	MH-429	182.6	0.008	308	Circle	PVC	8 inch	479	40	8.4	
P-711	MH-708	24.18	MH-710	24.03	0.005	31	Circle	PVC	15 inch	2,622	954	36.4	2014
P-712	MH-429	182.5	MH-431	181.58	0.005	170	Circle	PVC	8 inch	399	44	11.1	
P-713	MH-710	23.93	MH-712	21.93	0.005	400	Circle	PVC	15 inch	2,665	956	35.9	2014
P-714	MH-712	21.83	MH-71	20.38	0.005	289	Circle	PVC	15 inch	2,670	990	37.1	2014
P-715	MH-431	181.48	MH-433	180.06	0.004	372	Circle	PVC	8 inch	335	61	18.3	
P-716	MH-715	28.38	MH-69	26.84	0.004	383	Circle	Concrete	8 inch	344	1	0.4	
P-717	MH-433	172.5	MH-435	170.19	0.006	392	Circle	PVC	8 inch	416	63	15.2	
P-718	MH-435	170.09	MH-437	169.7	0.004	91	Circle	PVC	8 inch	355	65	18.4	
P-719	MH-717	79.2	MH-718	79	0.006	32	Circle	PVC	8 inch	429	2	0.4	
P-720	MH-437	169.7	MH-439	169.13	0.005	112	Circle	PVC	8 inch	387	86	22.3	
P-721	MH-718	79	MH-720	78.72	0.008	33	Circle	PVC	8 inch	500	3	0.6	
P-722	MH-439	169.13	MH-441	167.9	0.007	175	Circle	PVC	8 inch	455	88	19.4	
P-723	MH-720	78.71	MH-722	77.97	0.007	104	Circle	PVC	8 inch	457	5	1	
P-724	MH-441	167.9	MH-443	164.82	0.013	244	Circle	PVC	8 inch	609	131	21.4	
P-725	MH-722	77.87	MH-724	77.29	0.009	64	Circle	PVC	8 inch	516	6	1.2	
P-726	MH-443	164.72	MH-445	157.16	0.027	280	Circle	PVC	8 inch	891	132	14.9	
P-728	MH-445	149.66	MH-447	149.1	0.012	47	Circle	PVC	8 inch	592	146	24.6	
P-729	MH-447	149	MH-449	145.9	0.014	217	Circle	PVC	8 inch	648	161	24.9	
P-730	MH-449	145.8	MH-451	144.66	0.004	258	Circle	PVC	8 inch	361	163	45.3	
P-731	MH-724	76.31	MH-730	74.48	0.091	20	Circle	PVC	8 inch	1,641	8	0.5	
P-732	MH-451	144.56	MH-453	137.93	0.022	308	Circle	PVC	8 inch	796	171	21.5	
P-733	MH-453	137.93	MH-455	136.8	0.004	265	Circle	PVC	8 inch	354	177	49.9	
P-734	MH-732	76.9	MH-733	75.6	0.004	325	Circle	PVC	8 inch	343	2	0.4	
P-735	MH-733	75.5	MH-730	74.48	0.004	256	Circle	PVC	8 inch	342	3	0.9	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-736	MH-455	136.7	MH-457	136.1	0.003	175	Circle	PVC	8 inch	318	179	56.2	
P-737	MH-457	136.1	MH-459	135.92	0.004	51	Circle	PVC	8 inch	322	194	60.2	
P-738	MH-736	87.23	MH-737	86.66	0.005	107	Circle	PVC	12 inch	1,517	279	18.4	2014
P-739	MH-1035	-2.61	MH-1393	-2.72	0.002	50	Circle	PVC	10 inch	600	3	0.5	
P-740	MH-737	86.34	MH-739	86.01	0.005	60	Circle	PVC	12 inch	1,542	281	18.2	2014
P-741	MH-284	121.91	MH-282	120.84	0.004	274	Circle	Concrete	8 inch	339	3	0.8	
P-742	MH-739	86.01	MH-741	84.65	0.004	305	Circle	PVC	12 inch	1,388	282	20.3	2014
P-743	MH-282	120.84	MH-280	116.32	0.02	224	Circle	PVC	8 inch	770	4	0.5	
P-744	MH-741	84.1	MH-743	83.26	0.004	237	Circle	PVC	15 inch	2,244	616	27.5	2014
P-745	MH-280	116.32	MH-278	115.58	0.005	154	Circle	PVC	8 inch	376	6	1.5	
P-746	MH-743	83.18	MH-745	82.48	0.003	252	Circle	PVC	15 inch	1,986	617	31.1	2014
P-747	MH-1393	-2.82	MH-75	-4.53	0.009	187	Circle	Concrete	8 inch	519	4	0.9	
P-748	MH-745	82.4	MH-747	81.84	0.002	243	Circle	PVC	15 inch	1,809	619	34.2	2014
P-749	MH-71	19.67	MH-1391	10.5	0.064	144	Circle	Concrete	12 inch	4,035	1,518	37.6	
P-750	MH-749	82.17	MH-747	82.01	0.005	35	Circle	PVC	8 inch	367	8	2.3	
P-751	MH-676	-1	MH-75	-4.43	0.017	206	Circle	PVC	12 inch	2,682	1	0.1	
P-752	MH-751	83.7	MH-749	82.27	0.019	74	Circle	PVC	8 inch	754	7	1	
P-753	MH-63	66.1	MH-1417	64.57	0.005	313	Circle	PVC	15 inch	2,635	396	15	
P-754	MH-753	89	MH-751	83.8	0.016	331	Circle	PVC	8 inch	680	6	0.9	
P-755	MH-1417	64.47	MH-225	57.05	0.047	157	Circle	PVC	15 inch	8,194	518	6.3	
P-756	MH-755	91.9	MH-753	89.1	0.018	160	Circle	PVC	8 inch	717	4	0.5	
P-757	MH-225	56.95	MH-67	42	0.126	119	Circle	PVC	8 inch	1,922	520	27	
P-758	MH-757	95	MH-755	92	0.024	123	Circle	PVC	8 inch	847	2	0.3	
P-759	MH-221	94.41	MH-223	85.51	0.031	291	Circle	PVC	8 inch	948	116	12.3	
P-760	MH-759	98	MH-757	95.1	0.027	108	Circle	PVC	8 inch	889	1	0.1	
P-762	MH-761	91	MH-753	89.1	0.015	127	Circle	PVC	8 inch	663	1	0.2	
P-765	MH-763	107.25	MH-764	95.23	0.049	245	Circle	PVC	8 inch	1,201	1	0.1	
P-767	MH-764	95.13	MH-766	92.22	0.015	190	Circle	PVC	8 inch	671	2	0.4	
P-770	MH-768	84.93	MH-741	84.65	0.007	40	Circle	PVC	8 inch	454	23	5.2	
P-771	MH-1648	114	MH-686	106.68	0.042	174	Circle	PVC	8 inch	1,446	1	0.1	
P-772	MH-688	167.17	MH-1092	163.64	0.034	105	Circle	PVC	8 inch	1,293	7	0.6	
P-773	MH-771	93.33	MH-772	92.99	0.004	76	Circle	PVC	8 inch	363	1	0.3	
P-774	MH-1469	171.83	MH-688	167.32	0.028	164	Circle	PVC	8 inch	1,169	5	0.5	
P-775	MH-690	177.29	MH-1469	171.88	0.029	187	Circle	PVC	8 inch	1,199	4	0.3	
P-776	MH-1470	178.04	MH-690	177.39	0.002	347	Circle	PVC	8 inch	305	2	0.6	
P-777	MH-775	99.74	MH-776	98.69	0.005	233	Circle	PVC	8 inch	364	1	0.3	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-778	MH-1471	-6.7	MH-1198	-7.61	0.003	344	Circle	PVC	12 inch	1,069	135	12.7	2014
P-779	MH-776	98.69	MH-778	98.22	0.004	131	Circle	PVC	8 inch	325	2	0.7	
P-781	MH-778	98.22	MH-780	97.09	0.004	298	Circle	PVC	8 inch	334	4	1.1	
P-782	MH-695	-4.03	MH-1472	-4.93	0.004	222	Circle	PVC	10 inch	814	3	0.4	
P-783	MH-780	96.99	MH-782	90.47	0.023	278	Circle	PVC	8 inch	831	5	0.6	
P-784	MH-1474	65.06	MH-65	43.1	0.097	227	Circle	Concrete	8 inch	1,687	1	0.1	
P-785	MH-782	90.47	MH-784	89.85	0.007	85	Circle	PVC	8 inch	463	6	1.3	
P-786	MH-699	202.25	MH-1475	194.94	0.049	148	Circle	PVC	8 inch	1,567	6	0.4	
P-787	MH-784	89.75	MH-786	88.85	0.005	199	Circle	PVC	8 inch	365	7	2	
P-788	MH-701	205.13	MH-1476	203.15	0.011	183	Circle	PVC	8 inch	733	2	0.3	
P-789	MH-786	88.8	MH-788	88	0.003	298	Circle	PVC	8 inch	281	8	3	
P-790	MH-703	196.33	MH-702	196.06	0.004	67	Circle	PVC	8 inch	448	4	0.9	
P-791	MH-788	87.9	MH-790	87.03	0.007	121	Circle	PVC	8 inch	460	10	2.1	
P-792	MH-1475	194.84	MH-417	194.1	0.004	186	Circle	PVC	8 inch	445	17	3.9	
P-793	MH-790	86.93	MH-792	86.55	0.004	85	Circle	PVC	8 inch	363	11	3	
P-794	MH-1478	38.88	MH-705	32.71	0.015	412	Circle	PVC	15 inch	4,612	930	20.2	
P-795	MH-792	86.28	MH-794	85.19	0.004	309	Circle	PVC	10 inch	584	282	48.2	
P-796	MH-794	85.11	MH-741	84.31	0.003	297	Circle	PVC	10 inch	510	310	60.7	
P-798	MH-797	86.83	MH-794	85.65	0.006	201	Circle	PVC	8 inch	416	27	6.5	
P-799	MH-709	61.63	MH-1479	55.94	0.014	398	Circle	PVC	15 inch	4,506	657	14.6	
P-800	MH-747	81.74	MH-799	81.25	0.003	173	Circle	PVC	15 inch	2,006	628	31.3	2014
P-801	MH-711	65.46	MH-1480	64.21	0.005	252	Circle	PVC	15 inch	2,654	655	24.7	
P-802	MH-799	81.28	MH-801	80.99	0.006	46	Circle	PVC	15 inch	2,993	632	21.1	2014
P-803	MH-1481	210.13	MH-413	207.36	0.012	238	Circle	PVC	8 inch	761	2	0.3	
P-804	MH-801	80.65	MH-803	79.19	0.005	300	Circle	PVC	15 inch	2,629	633	24.1	2014
P-806	MH-803	80.55	MH-805	79.16	0.005	279	Circle	PVC	15 inch	2,660	645	24.2	2014
P-808	MH-805	79.06	MH-807	77.63	0.005	285	Circle	PVC	15 inch	2,670	646	24.2	2014
P-810	MH-807	77.53	MH-809	68.78	0.029	300	Circle	PVC	15 inch	6,437	650	10.1	2014
P-812	MH-809	68.1	MH-811	66.85	0.008	155	Circle	PVC	15 inch	3,385	651	19.2	2014
P-820	MH-817	55.15	MH-819	54.68	0.003	175	Circle	PVC	15 inch	1,953	662	33.9	2014
P-822	MH-819	54.58	MH-821	53.51	0.004	302	Circle	PVC	15 inch	2,243	678	30.2	2014
P-826	MH-823	51.85	MH-825	50.43	0.005	296	Circle	PVC	15 inch	2,610	903	34.6	2014
P-828	MH-825	50.37	MH-827	48.23	0.009	246	Circle	PVC	15 inch	3,515	904	25.7	2014
P-830	MH-827	48.23	MH-829	47.76	0.011	42	Circle	PVC	15 inch	3,987	909	22.8	2014
P-832	MH-829	47.71	MH-831	45.52	0.007	300	Circle	PVC	15 inch	3,220	910	28.3	2014
P-840	MH-837	31.9	MH-839	28.41	0.015	239	Circle	PVC	15 inch	4,554	938	20.6	2014

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P-842	MH-839	28.32	MH-841	27.63	0.006	116	Circle	PVC	15 inch	2,907	939	32.3	2014
P-843	MH-841	27.53	MH-704	27.3	0.005	46	Circle	PVC	15 inch	2,665	940	35.3	2014
P-845	MH-844	68.3	MH-811	66.85	0.005	276	Circle	PVC	8 inch	393	1	0.3	
P-848	MH-846	82.12	MH-847	81.71	0.008	53	Circle	PVC	8 inch	477	1	0.3	
P-850	MH-847	81.71	MH-849	71.09	0.078	136	Circle	PVC	8 inch	1,516	2	0.2	
P-852	MH-849	80.95	MH-851	80.69	0.004	65	Circle	PVC	8 inch	343	4	1	
P-853	MH-851	80.59	MH-803	79.29	0.004	324	Circle	PVC	8 inch	344	5	1.4	
P-856	MH-854	81.7	MH-855	81.15	0.004	149	Circle	PVC	8 inch	330	1	0.4	
P-858	MH-855	81.15	MH-857	80.36	0.005	150	Circle	PVC	8 inch	394	4	0.9	
P-860	MH-857	80.36	MH-859	79.83	0.008	66	Circle	PVC	8 inch	486	5	1	
P-861	MH-859	79.58	MH-803	79.29	0.004	68	Circle	PVC	8 inch	354	6	1.7	
P-863	MH-862	81.5	MH-855	81.15	0.003	100	Circle	PVC	8 inch	321	1	0.4	
P-866	MH-864	83.22	MH-865	82.97	0.002	128	Circle	PVC	8 inch	240	1	0.5	
P-867	MH-865	82.87	MH-799	81.42	0.006	253	Circle	PVC	8 inch	411	2	0.6	
P-870	MH-868	82.98	MH-869	81.93	0.008	138	Circle	PVC	8 inch	473	1	0.3	
P-871	MH-869	81.83	MH-807	76.84	0.018	281	Circle	PVC	8 inch	723	2	0.3	
P-874	MH-872	114	MH-873	106.35	0.048	160	Circle	PVC	8 inch	1,186	1	0.1	
P-876	MH-873	106.25	MH-875	94.71	0.037	310	Circle	PVC	8 inch	1,046	4	0.4	
P-878	MH-875	94.61	MH-877	86.76	0.042	186	Circle	PVC	8 inch	1,114	8	0.7	
P-880	MH-877	86.66	MH-879	58.71	0.11	255	Circle	PVC	8 inch	1,796	9	0.5	
P-882	MH-879	58.61	MH-881	56.75	0.017	112	Circle	PVC	8 inch	699	11	1.6	
P-883	MH-881	56.65	MH-819	55.01	0.012	140	Circle	PVC	8 inch	587	15	2.6	
P-886	MH-884	60.5	MH-885	58.23	0.008	300	Circle	PVC	8 inch	472	1	0.3	
P-887	MH-885	58.13	MH-881	56.75	0.005	273	Circle	PVC	8 inch	386	3	0.6	
P-889	MH-888	60.28	MH-879	58.71	0.01	160	Circle	PVC	8 inch	537	1	0.2	
P-891	MH-890	109.05	MH-873	106.35	0.009	313	Circle	PVC	8 inch	504	1	0.2	
P-894	MH-892	102	MH-893	96.51	0.038	144	Circle	PVC	8 inch	1,059	1	0.1	
P-895	MH-893	96.41	MH-875	94.71	0.005	330	Circle	PVC	8 inch	389	3	0.6	
P-898	MH-896	65.5	MH-897	63.1	0.015	165	Circle	PVC	8 inch	654	1	0.2	
P-900	MH-897	63	MH-899	59	0.018	217	Circle	PVC	8 inch	736	3	0.3	
P-901	MH-899	58.9	MH-827	48.33	0.081	131	Circle	PVC	8 inch	1,541	4	0.2	
P-904	MH-902	105	MH-903	104	0.01	103	Circle	PVC	8 inch	534	1	0.2	
P-906	MH-903	103.9	MH-905	102.67	0.01	122	Circle	PVC	8 inch	545	3	0.5	
P-908	MH-907	110	MH-905	102.67	0.035	208	Circle	PVC	8 inch	1,018	1	0.1	
P-911	MH-909	113	MH-910	109	0.044	91	Circle	PVC	8 inch	1,137	1	0.1	
P-912	MH-910	108.9	MH-905	102.65	0.013	474	Circle	PVC	8 inch	623	3	0.4	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-914	MH-905	102.55	MH-913	101.85	0.005	135	Circle	PVC	8 inch	391	8	1.9	
P-916	MH-913	101.75	MH-915	85.11	0.049	338	Circle	PVC	8 inch	1,203	9	0.7	
P-918	MH-915	85.01	MH-917	71.6	0.082	163	Circle	PVC	8 inch	1,556	14	0.9	
P-920	MH-917	71.5	MH-919	66.18	0.066	81	Circle	PVC	8 inch	1,390	15	1.1	
P-921	MH-919	66.08	MH-831	45.52	0.108	190	Circle	PVC	8 inch	1,784	16	0.9	
P-924	MH-922	104.5	MH-923	98.1	0.043	148	Circle	PVC	8 inch	1,128	1	0.1	
P-926	MH-923	98	MH-925	92.1	0.055	107	Circle	PVC	8 inch	1,274	3	0.2	
P-927	MH-925	92	MH-915	85.11	0.033	212	Circle	PVC	8 inch	978	4	0.4	
P-930	MH-928	115.97	MH-929	103.16	0.042	303	Circle	PVC	8 inch	1,115	1	0.1	
P-932	MH-929	102.98	MH-931	85.22	0.059	301	Circle	PVC	8 inch	1,317	3	0.2	
P-934	MH-931	85.05	MH-933	59.9	0.085	297	Circle	PVC	8 inch	1,578	4	0.2	
P-935	MH-933	59.25	MH-837	32	0.09	302	Circle	PVC	8 inch	1,629	5	0.3	
P-938	MH-936	0	MH-937	-1.9	0.026	73	Circle	PVC	6 inch	406	1	0.4	
P-940	MH-937	-1.9	MH-939	-3.27	0.009	153	Circle	PVC	8 inch	513	3	0.6	
P-942	MH-939	-3.27	MH-941	-4.78	0.004	372	Circle	Concrete	8 inch	346	7	2.1	
P-944	MH-941	-4.78	MH-943	-5.91	0.004	284	Circle	Concrete	8 inch	342	9	2.6	
P-945	MH-943	-5.91	MH-83	-6.43	0.003	157	Circle	PVC	8 inch	406	14	3.6	
P-947	MH-946	-4.52	MH-81	-6.37	0.01	186	Circle	Concrete	8 inch	541	3	0.5	
P-950	MH-948	-0.39	MH-949	-1.85	0.004	364	Circle	Concrete	8 inch	343	1	0.4	
P-951	MH-949	-1.85	MH-943	-2.41	0.004	140	Circle	Concrete	8 inch	343	3	0.9	
P-954	MH-952	-2.68	MH-953	-3.09	0.004	102	Circle	Concrete	8 inch	344	1	0.4	
P-955	MH-953	-3.09	MH-939	-3.27	0.003	52	Circle	Concrete	8 inch	319	3	0.9	
P-958	MH-956	146	MH-957	141	0.014	363	Circle	PVC	8 inch	637	3	0.5	
P-960	MH-957	140.9	MH-959	134.4	0.025	265	Circle	PVC	8 inch	849	7	0.8	
P-962	MH-959	134.3	MH-961	116.3	0.097	185	Circle	PVC	8 inch	1,692	10	0.6	
P-964	MH-961	116.2	MH-963	99.2	0.139	122	Circle	PVC	8 inch	2,025	14	0.7	
P-966	MH-963	99.1	MH-965	90.1	0.049	185	Circle	PVC	8 inch	1,196	17	1.5	
P-968	MH-965	90	MH-967	87.11	0.02	144	Circle	PVC	8 inch	768	21	2.7	
P-970	MH-967	87.01	MH-969	80.01	0.073	96	Circle	PVC	8 inch	1,465	38	2.6	
P-972	MH-969	79.91	MH-971	72.91	0.084	83	Circle	PVC	8 inch	1,575	42	2.7	
P-974	MH-971	72.81	MH-973	68.81	0.058	69	Circle	PVC	8 inch	1,306	45	3.5	
P-976	MH-973	68.71	MH-975	68.31	0.004	106	Circle	Concrete	8 inch	333	49	14.6	
P-978	MH-975	68.11	MH-977	50.88	0.059	291	Circle	Concrete	8 inch	1,320	56	4.2	
P-980	MH-977	50.78	MH-979	44.86	0.035	170	Circle	Concrete	8 inch	1,012	59	5.8	
P-982	MH-979	44.76	MH-981	34.76	0.065	154	Circle	Concrete	8 inch	1,382	70	5	
P-984	MH-983	41.7	MH-981	34.86	0.025	274	Circle	PVC	15 inch	5,955	634	10.7	2014

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-986	MH-985	42.75	MH-983	41.7	0.004	259	Circle	PVC	15 inch	2,400	631	26.3	2014
P-988	MH-987	44.07	MH-985	42.75	0.004	332	Circle	PVC	15 inch	2,377	627	26.4	2014
P-990	MH-989	44.67	MH-987	44.07	0.004	153	Circle	PVC	15 inch	2,360	624	26.4	2014
P-992	MH-991	64.02	MH-989	49.06	0.08	187	Circle	Concrete	8 inch	1,534	22	1.4	
P-994	MH-993	86.96	MH-991	64.02	0.075	305	Circle	Concrete	8 inch	1,487	7	0.5	
P-996	MH-995	104.94	MH-993	86.96	0.057	313	Circle	Concrete	8 inch	1,300	5	0.4	
P-998	MH-997	106.03	MH-995	104.94	0.004	275	Circle	Concrete	8 inch	341	4	1.1	
P-1000	MH-999	107.12	MH-997	106.03	0.004	267	Circle	Concrete	8 inch	347	2	0.5	
P-1003	MH-1001	147	MH-1002	145.1	0.013	149	Circle	PVC	6 inch	284	2	0.6	
P-1005	MH-1002	145	MH-1004	141.1	0.02	199	Circle	PVC	6 inch	353	4	1	
P-1007	MH-1004	141	MH-1006	137.1	0.012	335	Circle	PVC	6 inch	272	5	2	
P-1009	MH-1006	137	MH-1008	119.1	0.105	170	Circle	PVC	6 inch	817	7	0.9	
P-1011	MH-1008	119	MH-1010	101.1	0.077	232	Circle	Concrete	8 inch	1,506	9	0.6	
P-1013	MH-1010	101	MH-1012	95.1	0.016	360	Circle	Concrete	8 inch	694	11	1.6	
P-1014	MH-1012	95	MH-991	64.12	0.129	240	Circle	Concrete	8 inch	1,945	13	0.6	
P-1017	MH-1015	140.2	MH-1016	125.2	0.041	366	Circle	PVC	8 inch	1,098	3	0.3	
P-1019	MH-1016	125.1	MH-1018	114.1	0.06	182	Circle	PVC	8 inch	1,333	7	0.5	
P-1020	MH-1018	114	MH-967	90.11	0.152	157	Circle	PVC	8 inch	2,116	14	0.7	
P-1022	MH-1021	116	MH-1018	114.1	0.014	139	Circle	PVC	8 inch	634	3	0.5	
P-1024	MH-1023	74.08	MH-975	68.21	0.049	120	Circle	Concrete	8 inch	1,200	3	0.3	
P-1027	MH-1025	60.8	MH-1026	47.9	0.06	215	Circle	Concrete	8 inch	1,328	3	0.3	
P-1028	MH-1026	47.8	MH-979	44.86	0.026	115	Circle	Concrete	8 inch	867	7	0.8	
P-1038	MH-1037	-2.39	MH-1035	-2.51	0.001	100	Circle	Concrete	8 inch	188	1	0.8	
P-1041	MH-1040	46.14	MH-989	44.67	0.004	378	Circle	PVC	15 inch	2,350	600	25.5	2014
P-1043	MH-1042	47.6	MH-1040	46.14	0.004	412	Circle	PVC	15 inch	2,244	599	26.7	2014
P-1045	MH-1044	47.9	MH-1042	47.77	0.005	24	Circle	Concrete	8 inch	399	61	15.3	
P-1047	MH-1046	62.95	MH-1044	47.9	0.08	188	Circle	Concrete	8 inch	1,534	59	3.9	
P-1049	MH-1048	90	MH-1046	62.95	0.075	361	Circle	Concrete	8 inch	1,485	58	3.9	
P-1051	MH-1050	97.4	MH-1048	90.1	0.08	91	Circle	PVC	8 inch	1,536	56	3.6	
P-1053	MH-1052	101.85	MH-1050	97.5	0.014	309	Circle	PVC	8 inch	643	54	8.4	
P-1055	MH-1054	103.3	MH-1052	101.95	0.005	293	Circle	PVC	8 inch	368	52	14.2	
P-1057	MH-1056	104.69	MH-1054	103.41	0.005	262	Circle	PVC	8 inch	379	50	13.3	
P-1059	MH-1058	105.68	MH-1056	104.79	0.005	182	Circle	PVC	8 inch	379	31	8.1	
P-1061	MH-1060	107.95	MH-1058	105.78	0.011	200	Circle	PVC	8 inch	565	29	5.1	
P-1063	MH-1062	109.62	MH-1060	108.05	0.015	108	Circle	PVC	8 inch	654	27	4.1	
P-1065	MH-1064	111.09	MH-1062	109.72	0.012	119	Circle	PVC	8 inch	582	23	4	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1067	MH-1066	121.38	MH-1064	117.66	0.023	161	Circle	PVC	8 inch	824	22	2.6	
P-1069	MH-1068	126.77	MH-1066	121.45	0.048	111	Circle	PVC	8 inch	1,187	18	1.5	
P-1071	MH-1070	130.46	MH-1068	126.87	0.035	104	Circle	PVC	8 inch	1,008	16	1.6	
P-1073	MH-1072	147.43	MH-1070	130.56	0.059	284	Circle	PVC	8 inch	1,322	13	1	
P-1075	MH-1074	152.23	MH-1072	147.53	0.039	119	Circle	PVC	8 inch	1,078	9	0.8	
P-1077	MH-1076	154.76	MH-1074	152.33	0.026	95	Circle	PVC	8 inch	867	7	0.8	
P-1079	MH-1078	163.77	MH-1076	154.86	0.041	217	Circle	PVC	8 inch	1,099	5	0.5	
P-1081	MH-1080	168.28	MH-1078	163.87	0.05	89	Circle	PVC	8 inch	1,207	4	0.3	
P-1083	MH-1082	171.73	MH-1080	168.38	0.019	180	Circle	PVC	8 inch	740	2	0.2	
P-1085	MH-1084	148.87	MH-1072	147.53	0.005	270	Circle	PVC	8 inch	382	2	0.5	
P-1087	MH-1086	131.21	MH-1070	130.56	0.005	138	Circle	PVC	8 inch	372	2	0.5	
P-1089	MH-1088	123.26	MH-1066	121.48	0.005	357	Circle	PVC	8 inch	383	2	0.5	
P-1091	MH-1090	111.09	MH-1062	109.72	0.009	149	Circle	PVC	8 inch	520	2	0.3	
P-1094	MH-1092	163.51	MH-1093	160	0.022	156	Circle	PVC	8 inch	814	9	1.1	
P-1096	MH-1093	159.9	MH-1095	130.9	0.091	319	Circle	PVC	8 inch	1,635	11	0.7	
P-1098	MH-1095	130.9	MH-1097	129.22	0.016	105	Circle	PVC	8 inch	686	13	1.8	
P-1100	MH-1097	129.12	MH-1099	125.24	0.035	112	Circle	PVC	8 inch	1,009	14	1.4	
P-1102	MH-1099	125.14	MH-1101	112.58	0.031	399	Circle	PVC	8 inch	962	16	1.7	
P-1103	MH-1101	112.48	MH-1056	104.79	0.021	358	Circle	PVC	8 inch	795	18	2.3	
P-1106	MH-1104	100.83	MH-1105	100.03	0.003	251	Circle	PVC	8 inch	306	1	0.4	
P-1108	MH-1105	99.93	MH-1107	98.45	0.006	264	Circle	PVC	8 inch	406	5	1.3	
P-1110	MH-1107	98.35	MH-1109	97.31	0.006	182	Circle	PVC	8 inch	410	6	1.6	
P-1112	MH-1109	97.21	MH-1111	92.31	0.021	237	Circle	PVC	8 inch	780	8	1	
P-1114	MH-1111	92.21	MH-1113	75.59	0.053	313	Circle	PVC	8 inch	1,250	9	0.7	
P-1116	MH-1113	75.58	MH-1115	38.31	0.129	289	Circle	PVC	8 inch	1,948	10	0.5	
P-1118	MH-1115	38.21	MH-1117	27.27	0.219	50	Circle	PVC	8 inch	2,537	11	0.5	
P-1120	MH-1119	30.96	MH-1117	27.27	0.009	410	Circle	PVC	8 inch	515	9	1.7	
P-1122	MH-1121	35.79	MH-1119	31.06	0.012	397	Circle	PVC	8 inch	592	8	1.3	
P-1124	MH-1123	52.08	MH-1121	35.89	0.083	194	Circle	PVC	8 inch	1,567	6	0.4	
P-1126	MH-1125	76.4	MH-1123	52.18	0.12	202	Circle	PVC	8 inch	1,878	5	0.3	
P-1128	MH-1127	95.6	MH-1125	76.5	0.071	268	Circle	PVC	8 inch	1,448	3	0.2	
P-1130	MH-1129	99.66	MH-1127	95.7	0.017	228	Circle	PVC	8 inch	715	1	0.2	
P-1132	MH-1131	80.16	MH-1125	76.5	0.026	143	Circle	PVC	8 inch	868	1	0.1	
P-1135	MH-1133	26.93	MH-1134	26.21	0.003	212	Circle	PVC	8 inch	316	1	0.4	
P-1137	MH-1134	26.11	MH-1136	26	0.003	34	Circle	PVC	8 inch	308	24	7.8	
P-1138	MH-1117	27.17	MH-1134	26.21	0.008	126	Circle	PVC	8 inch	473	22	4.6	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-1140	MH-1139	-4.25	MH-87	-6.14	0.012	152	Circle	PVC	8 inch	605	3	0.4	
P-1142	MH-1141	-4	MH-87	-6.14	0.013	164	Circle	PVC	8 inch	620	3	0.4	
P-1145	MH-1143	-2.18	MH-1144	-4.18	0.01	201	Circle	PVC	8 inch	541	3	0.5	
P-1148	MH-1146	-8.5	MH-91	-9.48	0.004	268	Circle	Concrete	8 inch	328	26	8	
P-1151	MH-1149	-0.52	MH-1150	-1.92	0.01	145	Circle	PVC	8 inch	533	3	0.5	
P-1157	MH-1155	5	MH-1156	2.88	0.039	54	Circle	PVC	6 inch	499	3	0.5	
P-1158	MH-1156	2.88	MH-1150	-1.92	0.041	118	Circle	PVC	6 inch	508	8	1.6	
P-1160	MH-1159	2.7	MH-1156	2.3	0.007	61	Circle	PVC	6 inch	204	3	1.3	
P-1163	MH-1161	1	MH-1162	-2.1	0.016	197	Circle	PVC	8 inch	884	3	0.3	2014
P-1165	MH-1162	-2	MH-1164	-6.1	0.017	246	Circle	PVC	8 inch	910	5	0.6	2014
P-1167	MH-1166	-4	MH-1164	-6.1	0.009	234	Circle	PVC	8 inch	668	5	0.8	2014
P-1169	MH-1168	-2	MH-1166	-4.1	0.025	83	Circle	PVC	8 inch	1,121	3	0.2	2014
P-1170	MH-1164	-6	MH-95	-10.76	0.013	367	Circle	PVC	8 inch	803	13	1.6	2014
P-1173	MH-1171	0.3	MH-1172	-0.49	0.004	176	Circle	PVC	8 inch	472	3	0.6	2014
P-1175	MH-1172	-0.59	MH-1174	-1.82	0.005	272	Circle	PVC	8 inch	474	5	1.1	2014
P-1177	MH-1174	-1.92	MH-1176	-2.85	0.005	205	Circle	PVC	8 inch	475	8	1.7	2014
P-1179	MH-1176	-2.95	MH-1178	-4.46	0.004	358	Circle	PVC	8 inch	458	11	2.3	2014
P-1181	MH-1178	-4.41	MH-1180	-5.76	0.006	229	Circle	PVC	8 inch	541	13	2.4	2014
P-1182	MH-1180	-5.61	MH-101	-7.95	0.009	267	Circle	PVC	12 inch	1,946	16	0.8	2014
P-1185	MH-1183	0.65	MH-1184	-1.1	0.006	300	Circle	PVC	8 inch	538	2	0.3	2014
P-1187	MH-1184	-1.1	MH-1186	-1.21	0	234	Circle	PVC	8 inch	153	3	2.1	2014
P-1189	MH-1186	-1.21	MH-1188	-2.08	0.003	287	Circle	PVC	8 inch	388	8	2.1	2014
P-1191	MH-1188	-2.08	MH-1190	-2.96	0.003	288	Circle	PVC	8 inch	390	111	28.6	2014
P-1193	MH-1190	-2.96	MH-1192	-3.84	0.003	307	Circle	PVC	8 inch	377	119	31.6	2014
P-1195	MH-1192	-4.44	MH-1194	-5.77	0.004	305	Circle	PVC	12 inch	1,373	123	8.9	2014
P-1197	MH-1194	-5.77	MH-1196	-6.16	0.005	83	Circle	PVC	12 inch	1,425	126	8.8	2014
P-1201	MH-1198	-7.61	MH-1200	-8.16	0.005	115	Circle	PVC	12 inch	1,438	137	9.5	2014
P-1203	MH-1200	-8.16	MH-1202	-8.84	0.004	174	Circle	PVC	12 inch	1,299	147	11.3	2014
P-1205	MH-1202	-8.84	MH-1204	-9.26	0.004	107	Circle	PVC	12 inch	1,302	148	11.4	2014
P-1207	MH-1204	-9.26	MH-1206	-10.15	0.004	229	Circle	PVC	12 inch	1,296	158	12.2	2014
P-1209	MH-1206	-10.28	MH-1208	-11.02	0.002	388	Circle	PVC	15 inch	1,646	378	23	2014
P-1211	MH-1208	-11.02	MH-1210	-11.68	0.002	365	Circle	PVC	15 inch	1,603	384	23.9	2014
P-1212	MH-1210	-11.68	MH-99	-12.3	0.002	313	Circle	PVC	15 inch	1,677	386	23	2014
P-1215	MH-1213	1.5	MH-1214	-0.07	0.013	125	Circle	PVC	8 inch	790	2	0.2	2014
P-1217	MH-1214	-0.17	MH-1216	-0.95	0.004	196	Circle	PVC	8 inch	445	5	1.1	2014
P-1219	MH-1216	-1.05	MH-1218	-2.39	0.005	283	Circle	PVC	8 inch	485	6	1.3	2014

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

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P-1220	MH-1218	-2.49	MH-1204	-2.76	0.005	56	Circle	PVC	8 inch	490	8	1.6	2014
P-1222	MH-1221	3.82	MH-1214	-0.07	0.108	36	Circle	PVC	8 inch	2,318	2	0.1	2014
P-1224	MH-1223	-2.56	MH-1208	-4.66	0.006	324	Circle	PVC	8 inch	568	3	0.5	2014
P-1227	MH-1225	0.26	MH-1226	-0.5	0.004	206	Circle	PVC	8 inch	428	2	0.4	2014
P-1228	MH-1226	-0.58	MH-1186	-1.21	0.003	200	Circle	PVC	8 inch	396	3	0.8	2014
P-1231	MH-1229	-0.42	MH-1230	-1.24	0.004	193	Circle	PVC	8 inch	460	2	0.3	2014
P-1232	MH-1230	-1.24	MH-1188	-2.08	0.004	210	Circle	PVC	8 inch	446	3	0.7	2014
P-1235	MH-1233	1	MH-1234	-0.9	0.008	240	Circle	PVC	8 inch	627	2	0.3	2014
P-1236	MH-1234	-1	MH-1190	-2.96	0.012	164	Circle	PVC	8 inch	771	6	0.8	2014
P-1239	MH-1237	4	MH-1238	1.1	0.012	238	Circle	PVC	8 inch	778	2	0.2	2014
P-1240	MH-1238	1	MH-1234	-0.9	0.012	158	Circle	PVC	8 inch	773	3	0.4	2014
P-1242	MH-1241	0.28	MH-1192	-3.84	0.037	112	Circle	PVC	8 inch	1,352	2	0.1	2014
P-1244	MH-1243	0.09	MH-1194	-1.89	0.018	109	Circle	PVC	8 inch	950	2	0.2	2014
P-1247	MH-1245	-1.63	MH-1246	-2.16	0.004	121	Circle	PVC	8 inch	467	2	0.3	2014
P-1249	MH-1246	-2.36	MH-1248	-2.8	0.004	112	Circle	PVC	8 inch	442	3	0.7	2014
P-1251	MH-1248	-2.8	MH-1250	-4.05	0.004	313	Circle	PVC	8 inch	446	5	1.1	2014
P-1253	MH-1250	-4.05	MH-1252	-5.29	0.004	318	Circle	PVC	8 inch	440	6	1.5	2014
P-1254	MH-1252	-5.39	MH-1200	-7.16	0.012	152	Circle	PVC	8 inch	761	8	1.1	2014
P-1257	MH-1255	0.79	MH-1256	-0.38	0.003	376	Circle	PVC	8 inch	393	3	0.9	2014
P-1259	MH-1256	-1.38	MH-1258	-2.53	0.004	290	Circle	PVC	8 inch	444	10	2.4	2014
P-1261	MH-1258	-2.53	MH-1260	-3.4	0.003	284	Circle	PVC	8 inch	390	21	5.4	2014
P-1263	MH-1260	-3.4	MH-1262	-3.89	0.003	170	Circle	PVC	8 inch	379	38	10.1	2014
P-1265	MH-1262	-3.89	MH-1264	-4.25	0.003	122	Circle	PVC	8 inch	383	52	13.6	2014
P-1267	MH-1264	-4.25	MH-1266	-4.41	0.004	38	Circle	PVC	8 inch	457	56	12.2	2014
P-1269	MH-1266	-4.41	MH-1268	-4.74	0.003	110	Circle	PVC	8 inch	386	59	15.3	2014
P-1271	MH-1268	-4.74	MH-1270	-5.54	0.003	262	Circle	PVC	8 inch	390	70	17.9	2014
P-1273	MH-1270	-5.54	MH-1272	-5.95	0.003	119	Circle	PVC	8 inch	414	97	23.5	2014
P-1275	MH-1272	-5.95	MH-1274	-6.47	0.004	143	Circle	PVC	12 inch	1,254	104	8.3	2014
P-1277	MH-1274	-6.47	MH-1276	-6.99	0.003	199	Circle	PVC	12 inch	1,063	177	16.7	2014
P-1279	MH-1276	-6.99	MH-1278	-7.89	0.003	302	Circle	PVC	12 inch	1,135	201	17.7	2014
P-1281	MH-1278	-7.89	MH-1280	-8.25	0.003	128	Circle	PVC	12 inch	1,102	211	19.1	2014
P-1283	MH-1280	-8.25	MH-1282	-9.45	0.003	393	Circle	PVC	12 inch	1,149	214	18.7	2014
P-1284	MH-1282	-9.45	MH-1206	-9.62	0.004	38	Circle	PVC	12 inch	1,390	218	15.7	2014
P-1287	MH-1285	-1.93	MH-1286	-3.35	0.006	242	Circle	PVC	8 inch	540	3	0.6	2014
P-1288	MH-1286	-3.35	MH-1278	-4.64	0.004	291	Circle	PVC	8 inch	469	7	1.5	2014
P-1291	MH-1289	0	MH-1290	-0.89	0.006	140	Circle	PVC	8 inch	562	17	3	2014

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1292	MH-1290	-0.99	MH-1276	-6.99	0.018	330	Circle	PVC	8 inch	951	20	2.1	2014
P-1294	MH-1293	0.28	MH-1256	-1.38	0.005	339	Circle	PVC	8 inch	493	3	0.7	2014
P-1296	MH-1295	-1.54	MH-1258	-2.53	0.003	341	Circle	PVC	8 inch	380	3	0.9	2014
P-1298	MH-1297	-0.58	MH-1258	-2.53	0.005	383	Circle	PVC	8 inch	503	3	0.7	2014
P-1301	MH-1299	-0.93	MH-1300	-1.93	0.004	237	Circle	PVC	8 inch	458	3	0.8	2014
P-1303	MH-1300	-1.93	MH-1302	-2.33	0.003	139	Circle	PVC	8 inch	378	7	1.8	2014
P-1304	MH-1302	-2.4	MH-1260	-3.4	0.003	341	Circle	PVC	8 inch	382	10	2.7	2014
P-1306	MH-1305	-1.76	MH-1260	-3.4	0.005	316	Circle	PVC	8 inch	508	3	0.7	2014
P-1309	MH-1307	-0.48	MH-1308	-2.64	0.006	341	Circle	PVC	8 inch	561	3	0.6	2014
P-1310	MH-1308	-2.64	MH-1262	-5.89	0.112	29	Circle	PVC	8 inch	2,360	7	0.3	2014
P-1312	MH-1311	-1.75	MH-1262	-5.89	0.021	197	Circle	PVC	8 inch	1,022	3	0.3	2014
P-1314	MH-1313	0.21	MH-1268	-4.74	0.014	357	Circle	PVC	8 inch	830	3	0.4	2014
P-1316	MH-1315	0.12	MH-1268	-0.92	0.004	263	Circle	PVC	8 inch	443	3	0.8	2014
P-1319	MH-1317	-0.02	MH-1318	-0.88	0.004	209	Circle	PVC	8 inch	452	3	0.8	2014
P-1321	MH-1318	-0.88	MH-1320	-1.48	0.003	202	Circle	PVC	8 inch	384	7	1.8	2014
P-1323	MH-1320	-1.48	MH-1322	-1.92	0.003	126	Circle	PVC	8 inch	417	10	2.5	2014
P-1325	MH-1322	-1.92	MH-1324	-3.01	0.003	317	Circle	PVC	8 inch	413	14	3.4	2014
P-1327	MH-1324	-3.01	MH-1326	-4.06	0.004	272	Circle	PVC	8 inch	438	17	4	2014
P-1328	MH-1326	-4.06	MH-1270	-5.5	0.004	374	Circle	PVC	8 inch	437	24	5.6	2014
P-1330	MH-1329	-3.13	MH-1326	-4.06	0.004	230	Circle	PVC	8 inch	448	3	0.8	2014
P-1332	MH-1331	-4.3	MH-1272	-5.95	0.004	390	Circle	PVC	8 inch	459	3	0.8	2014
P-1334	MH-1333	-7.38	MH-1146	-8.13	0.008	98	Circle	PVC	8 inch	474	24	5	
P-1335	MH-1144	-4.28	MH-1333	-7.28	0.01	300	Circle	PVC	8 inch	542	5	1	
P-1337	MH-1336	-4.28	MH-1333	-7.28	0.01	301	Circle	PVC	8 inch	541	16	2.9	
P-1338	MH-1150	-2.02	MH-1336	-4.18	0.01	209	Circle	PVC	8 inch	551	13	2.4	
P-1342	MH-1341	105.7	MH-215	105.58	0.011	11	Circle	Steel	8 inch	566	1	0.2	
P-1347	MH-93	-10.48	MH-95	-10.76	0.002	167	Circle	PVC	15 inch	1,543	78	5	2014
P-1348	MH-772	92.89	MH-766	92.22	0.007	103	Circle	PVC	8 inch	437	2	0.5	
P-1349	MH-241	120	MH-207	119.06	0.049	19	Circle	PVC	18 inch	10,486	17	0.2	
P-1351	MH-766	92.22	MH-768	91.58	0.003	188	Circle	PVC	8 inch	316	6	1.9	
P-1356	MH-1355	122.87	MH-284	121.91	0.004	218	Circle	Concrete	8 inch	360	1	0.4	
P-1361	MH-1360	224	MH-181	214.41	0.064	150	Circle	PVC	8 inch	1,371	2	0.1	
P-1377	MH-1363	-8.01	MH-1362	-8.2	0.001	241	Circle	PVC	36 inch	10,927	2,257	20.7	2014
P-1378	MH-1364	-7.98	MH-1363	-7.91	0	268	Circle	PVC	36 inch	6,289	2,254	35.8	2014
P-1380	MH-1366	-6.85	MH-1365	-7.55	0.001	598	Circle	PVC	36 inch	13,314	2,249	16.9	2014
P-1381	MH-1367	-6.31	MH-1366	-6.75	0.001	305	Circle	PVC	27 inch	6,863	2,246	32.7	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1382	MH-1368	-5.89	MH-1367	-6.21	0.001	374	Circle	PVC	27 inch	5,286	2,243	42.4	
P-1383	MH-1369	-5.46	MH-1368	-5.89	0.001	292	Circle	PVC	27 inch	6,934	2,241	32.3	
P-1384	MH-1370	-5.08	MH-1369	-5.46	0.001	338	Circle	PVC	27 inch	6,059	2,238	36.9	
P-1385	MH-1371	-4.76	MH-1370	-5.08	0.002	158	Circle	PVC	27 inch	8,132	2,236	27.5	
P-1386	MH-1372	-4.51	MH-1371	-4.66	0	386	Circle	PVC	42 inch	11,572	2,233	19.3	2014
P-1387	MH-1373	-4.49	MH-1372	-4.51	0	160	Circle	PVC	42 inch	6,563	2,231	34	2014
P-1388	MH-1374	-2.16	MH-1373	-4.29	0.012	179	Circle	PVC	24 inch	11,075	2,230	20.1	
P-1389	MH-1375	4.94	MH-1374	-2.26	0.015	479	Circle	PVC	18 inch	5,780	2,228	38.6	
P-1390	MH-981	34.6	MH-1375	5.04	0.1	297	Circle	Corrugated HDPE (Smooth Interior)	18 inch	16,113	707	4.4	
P-1392	MH-1391	10.4	MH-1375	5.15	0.059	89	Circle	Corrugated HDPE (Smooth Interior)	12 inch	4,207	1,520	36.1	
P-1410	MH-1409	130.66	MH-391	129.5	0.009	123	Circle	PVC	12 inch	1,553	0	0	
P-1422	MH-223	85.41	MH-1421	72.4	0.098	133	Circle	Concrete	8 inch	1,696	119	7	
P-1425	MH-1421	72.06	MH-1417	69.69	0.049	48	Circle	PVC	8 inch	1,205	121	10	
P-1429	MH-1428	188.2	MH-675	186.64	0.004	390	Circle	PVC	10 inch	622	2	0.3	
P-1431	MH-821	53.41	MH-1430	52.33	0.004	301	Circle	PVC	15 inch	2,258	900	39.9	2014
P-1434	MH-1430	52.23	MH-823	52.21	0.003	6	Circle	PVC	15 inch	2,176	901	41.4	2014
P-1440	MH-1436	55.3	MH-817	55.25	0.003	16	Circle	PVC	15 inch	2,107	661	31.4	2014
P-1446	MH-1444	56.11	MH-1436	55.4	0.006	114	Circle	PVC	15 inch	2,974	659	22.2	2014
P-1455	MH-1450	45.71	MH-1451	40.8	0.047	105	Circle	PVC	6 inch	545	2	0.3	
P-1456	MH-1449	53.16	MH-1448	35.4	0.072	246	Circle	PVC	8 inch	1,457	2	0.1	
P-1457	MH-1448	35.3	MH-1447	34.51	0.005	157	Circle	PVC	8 inch	385	3	0.8	
P-1458	MH-1447	34.41	MH-1454	33.93	0.005	104	Circle	PVC	8 inch	368	5	1.3	
P-1459	MH-1454	33.83	MH-1453	33.37	0.005	91	Circle	PVC	8 inch	386	6	1.6	
P-1460	MH-1453	33.27	MH-1452	33.09	0.005	36	Circle	PVC	8 inch	383	8	2	
P-1468	MH-1452	32.99	MH-1467	32.47	0.01	52	Circle	PVC	8 inch	542.34	9.31	1.7	
P-1469	MH-1451	40.7	MH-1467	40.2	0.01	50	Circle	PVC	8 inch	542.34	3.1	0.6	
P-1520	MH-1362	-8.2	MH-101	-8.25	0.004	14	Circle	PVC	36 inch	23,256.21	2,259.32	9.7	2014
P-1524	MH-686	106.58	MH-1105	103.56	0.011	285	Circle	PVC	8 inch	725.77	2.54	0.4	
P-1525	MH-1196	-6.16	MH-1471	-6.6	0.007	60	Circle	PVC	12 inch	1,780.10	127.32	7.2	2014
P-1526	MH-693	-6.03	MH-1471	-6.6	0.005	115	Circle	PVC	10 inch	899.98	6.4	0.7	
P-1527	MH-1472	-5.03	MH-693	-5.93	0.004	225	Circle	PVC	10 inch	808.49	4.8	0.6	
P-1528	MH-696	2.23	MH-695	-3.93	0.024	258	Circle	PVC	8 inch	1,089.43	1.60	0.1	
P-1529	MH-413	207.26	MH-1475	194.94	0.052	235	Circle	PVC	8 inch	1,614.32	3.84	0.2	
P-1530	MH-1476	203.05	MH-699	202.35	0.011	66	Circle	PVC	8 inch	726.10	3.84	0.5	

Existing with Improvements - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1531	MH-702	195.96	MH-1475	194.94	0.004	256	Circle	PVC	8 inch	445.04	5.76	1.3	
P-1532	MH-1477	197.73	MH-703	196.43	0.004	325	Circle	PVC	8 inch	445.91	1.92	0.4	
P-1533	MH-705	32.48	MH-837	32	0.007	64	Circle	PVC	15 inch	3,264.01	931.41	28.5	
P-1534	MH-1478	38.98	MH-707	45.12	0.016	393	Circle	PVC	15 inch	4,710.96	928.91	19.7	
P-1535	MH-831	45.42	MH-707	45.22	0.005	38	Circle	PVC	15 inch	2,734.29	927.66	33.9	
P-1536	MH-1479	55.84	MH-1444	55.74	0.005	19	Circle	PVC	15 inch	2,734.29	658.21	24.1	
P-1537	MH-1480	64.1	MH-709	61.73	0.01	249	Circle	PVC	15 inch	3,677.02	655.71	17.8	
P-1538	MH-811	65.75	MH-711	65.56	0.005	37	Circle	PVC	15 inch	2,700.83	653.31	24.2	
P-1600	MH-656	140.25	MH-1700	133.8	0.087	74	Circle	PVC	12 inch	6,137.04	23.04	0.4	2014
P-1601	MH-658	134.5	MH-1700	133.8	0.009	74	Circle	PVC	12 inch	2,021.75	197.76	9.8	2014
P-1603	MH-1701	132.4	MH-326	131.6	0.012	66	Circle	PVC	12 inch	2,288.59	220.8	9.6	2014
P-1604	MH-1700	133.7	MH-1701	132.5	0.009	128	Circle	PVC	12 inch	2,012.71	220.8	11	2014
P-1605	MH-459	135.4	MH-658	134.6	0.006	140	Circle	PVC	12 inch	1,571.36	195.84	12.5	2014
P-1606	MH-322	104.46	MH-1703	103.55	0.005	180	Circle	PVC	12 inch	1,478.02	269.53	18.2	2014
P-1607	MH-1703	103.45	MH-1704	102.7	0.006	135	Circle	PVC	12 inch	1,549.38	269.53	17.4	2014
P-1608	MH-1704	102.6	MH-1705	101.45	0.005	211	Circle	PVC	12 inch	1,534.63	269.53	17.6	2014
P-1609	MH-1705	101.35	MH-1706	100.05	0.005	240	Circle	PVC	12 inch	1,529.89	269.53	17.6	2014
P-1610	MH-1706	99.95	MH-1707	98.2	0.006	275	Circle	PVC	12 inch	1,658.24	269.53	16.3	2014
P-1611	MH-1707	98.1	MH-1708	96.2	0.007	270	Circle	PVC	12 inch	1,743.77	269.53	15.5	2014
P-1612	MH-1708	96.1	MH-1709	94.4	0.007	231	Circle	PVC	12 inch	1,783.25	269.53	15.1	2014
P-1613	MH-1709	94.3	MH-1710	92.35	0.007	296	Circle	PVC	12 inch	1,687.20	269.53	16	2014
P-1614	MH-1710	92.25	MH-1711	90.7	0.007	238	Circle	PVC	12 inch	1,677.54	269.53	16.1	2014
P-1615	MH-1711	90.6	MH-1712	88.65	0.007	281	Circle	PVC	12 inch	1,731.64	269.53	15.6	2014
P-1616	MH-1712	88.55	MH-792	86.56	0.007	282	Circle	PVC	12 inch	1,746.21	269.53	15.4	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-21	MH-19	234.62	MH-20	228.59	0.046	131	Circle	PVC	8 inch	1,164	1	0.1	
P-23	MH-20	228.49	MH-22	215.96	0.06	209	Circle	PVC	8 inch	1,328	2	0.2	
P-26	MH-22	215.86	MH-25	188.81	0.117	232	Circle	PVC	8 inch	1,852	3	0.2	
P-28	MH-25	179.83	MH-27	164.06	0.145	109	Circle	PVC	8 inch	2,063	6	0.3	
P-30	MH-27	164.06	MH-29	151.94	0.098	124	Circle	PVC	8 inch	1,696	7	0.4	
P-32	MH-29	151.84	MH-31	139.99	0.119	100	Circle	PVC	8 inch	1,867	8	0.4	
P-34	MH-31	139.99	MH-33	139.89	0.001	113	Circle	PVC	8 inch	161	9	5.6	
P-36	MH-33	139.89	MH-35	133.12	0.041	166	Circle	PVC	8 inch	1,095	10	0.9	
P-38	MH-35	133.02	MH-37	127.2	0.03	195	Circle	PVC	8 inch	937	11	1.2	
P-40	MH-37	126	MH-39	121.64	0.023	186	Circle	PVC	8 inch	830	13	1.5	
P-42	MH-39	121.54	MH-41	120.21	0.005	271	Circle	PVC	8 inch	380	17	4.5	
P-44	MH-41	120.11	MH-43	118.75	0.005	267	Circle	PVC	8 inch	387	22	5.6	
P-46	MH-43	118.65	MH-45	118.22	0.005	84	Circle	PVC	8 inch	388	24	6.2	
P-48	MH-45	118.12	MH-47	117.06	0.005	211	Circle	PVC	8 inch	384	25	6.5	
P-50	MH-47	116.96	MH-49	116.8	0.009	18	Circle	PVC	8 inch	511	26	5.1	
P-52	MH-49	117.07	MH-51	114.49	0.018	147	Circle	Concrete	8 inch	719	476	66.2	
P-54	MH-51	114.49	MH-53	110.02	0.016	277	Circle	Concrete	8 inch	689	477	69.2	
P-56	MH-53	110.02	MH-55	106.76	0.065	50	Circle	Concrete	8 inch	1,385	480	34.7	
P-58	MH-55	106.76	MH-57	95.81	0.07	157	Circle	Concrete	8 inch	1,432	481	33.6	
P-60	MH-57	95.81	MH-59	85.38	0.083	125	Circle	Concrete	8 inch	1,567	482	30.8	
P-62	MH-59	85.38	MH-61	72.78	0.093	136	Circle	Concrete	8 inch	1,651	484	29.3	
P-64	MH-61	72.78	MH-63	66.2	0.076	87	Circle	Concrete	8 inch	1,492	487	32.6	
P-68	MH-65	43	MH-67	41.96	0.004	249	Circle	Concrete	8 inch	351	4	1.1	
P-70	MH-67	41.86	MH-69	26.74	0.075	202	Circle	Concrete	8 inch	1,484	672	45.3	
P-72	MH-69	26.74	MH-71	19.77	0.071	98	Circle	Concrete	8 inch	1,446	676	46.7	
P-78	MH-75	-4.53	MH-77	-5.51	0.004	253	Circle	Asbestos Cement	14 inch	1,774	10	0.6	
P-80	MH-77	-5.51	MH-79	-6.29	0.002	363	Circle	Cast iron	14 inch	1,211	12	1	
P-82	MH-79	-6.29	MH-81	-6.72	0.001	409	Circle	Asbestos Cement	14 inch	924	14	1.5	
P-84	MH-81	-6.72	MH-83	-7.12	0.003	132	Circle	Asbestos Cement	14 inch	1,569	21	1.4	
P-86	MH-83	-7.12	MH-85	-7.95	0.003	297	Circle	Asbestos Cement	14 inch	1,507	45	3	
P-88	MH-85	-7.95	MH-87	-8.58	0.002	323	Circle	Asbestos Cement	14 inch	1,259	48	3.8	
P-90	MH-87	-8.27	MH-89	-9.07	0.002	343	Circle	Asbestos Cement	14 inch	1,377	59	4.3	
P-92	MH-89	-9.07	MH-91	-10.11	0.003	342	Circle	Asbestos Cement	14 inch	1,572	63	4	
P-94	MH-91	-10.11	MH-93	-10.32	0.001	284	Circle	PVC	15 inch	1,025	102	10	2014
P-100	MH-97	-11.33	MH-99	-12.08	0.003	291	Circle	PVC	15 inch	1,913	131	6.9	2014
P-102	MH-99	-13.2	MH-101	-13.29	0	245	Circle	PVC	24 inch	2,530	592	23.4	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-104	MH-103	190.8	MH-25	188.81	0.017	119	Circle	PVC	8 inch	701	1	0.2	
P-124	MH-122	240.58	MH-123	237.2	0.01	343	Circle	PVC	8 inch	538	1	0.2	
P-126	MH-123	237.2	MH-125	225.96	0.037	305	Circle	PVC	8 inch	1,041	366	35.2	
P-128	MH-125	225.8	MH-127	206.99	0.047	400	Circle	PVC	8 inch	1,176	368	31.3	
P-130	MH-127	206.87	MH-129	196.08	0.027	400	Circle	PVC	8 inch	891	369	41.4	
P-132	MH-129	196.08	MH-131	184.48	0.032	362	Circle	PVC	8 inch	971	370	38.1	
P-134	MH-131	184.38	MH-133	183.38	0.024	42	Circle	PVC	8 inch	837	385	46	
P-136	MH-133	182.62	MH-135	174.75	0.025	314	Circle	PVC	15 inch	4,590	386	8.4	
P-138	MH-135	174.68	MH-137	173.14	0.005	327	Circle	PVC	15 inch	1,990	387	19.5	
P-140	MH-137	173.06	MH-139	171.81	0.005	252	Circle	PVC	15 inch	2,042	388	19	
P-142	MH-139	171.74	MH-141	169.66	0.005	401	Circle	PVC	15 inch	2,088	424	20.3	
P-144	MH-141	169.58	MH-143	168.74	0.004	205	Circle	PVC	15 inch	1,856	437	23.5	
P-146	MH-143	168.72	MH-145	167.22	0.005	291	Circle	PVC	15 inch	2,082	438	21	
P-148	MH-145	167.18	MH-147	139.79	0.069	397	Circle	PVC	15 inch	7,615	439	5.8	
P-150	MH-147	139.66	MH-149	136.31	0.01	336	Circle	PVC	15 inch	2,895	440	15.2	
P-152	MH-149	136.22	MH-151	135.04	0.012	100	Circle	PVC	15 inch	3,149	441	14	
P-154	MH-151	134.87	MH-153	131.93	0.022	134	Circle	PVC	15 inch	4,294	443	10.3	
P-156	MH-153	131.83	MH-155	131.09	0.007	100	Circle	PVC	15 inch	3,242	446	13.8	
P-158	MH-155	130.99	MH-157	122.09	0.036	249	Circle	PVC	15 inch	7,126	447	6.3	
P-159	MH-157	122.09	MH-49	117.19	0.016	310	Circle	PVC	15 inch	4,738	448	9.5	
P-162	MH-160	132.95	MH-161	132.4	0.002	242	Circle	PVC	12 inch	762	1	0.1	
P-163	MH-161	132.4	MH-153	132.25	0.002	72	Circle	PVC	12 inch	730	2	0.3	
P-166	MH-164	123.49	MH-165	122.73	0.004	191	Circle	PVC	8 inch	342	1	0.3	
P-168	MH-165	122.63	MH-167	122.15	0.004	124	Circle	PVC	8 inch	337	2	0.7	
P-169	MH-167	122.05	MH-39	120.77	0.004	328	Circle	PVC	8 inch	339	3	1	
P-172	MH-170	122.82	MH-171	121.62	0.004	301	Circle	PVC	8 inch	342	1	0.3	
P-174	MH-171	121.52	MH-173	120.85	0.004	167	Circle	PVC	8 inch	344	2	0.7	
P-175	MH-173	120.85	MH-41	120.21	0.002	286	Circle	PVC	8 inch	257	3	1.3	
P-178	MH-176	224.22	MH-177	222.68	0.005	305	Circle	PVC	8 inch	385	17	4.4	
P-180	MH-177	222.68	MH-179	218.82	0.013	308	Circle	PVC	8 inch	607	20	3.3	
P-182	MH-179	218.82	MH-181	214.41	0.018	239	Circle	PVC	8 inch	737	22	3.1	
P-184	MH-181	214.41	MH-183	202.48	0.056	212	Circle	PVC	8 inch	1,287	28	2.2	
P-186	MH-183	202.48	MH-185	194.44	0.039	206	Circle	PVC	8 inch	1,071	30	2.8	
P-188	MH-185	194.44	MH-187	161.6	0.699	47	Circle	PVC	8 inch	4,533	33	0.7	
P-190	MH-187	191.6	MH-189	190.78	0.005	162	Circle	PVC	8 inch	386	36	9.3	
P-192	MH-189	190.78	MH-191	184.15	0.042	157	Circle	PVC	8 inch	1,115	38	3.5	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-194	MH-191	184.15	MH-193	161.51	0.081	279	Circle	PVC	8 inch	1,545	41	2.7	
P-196	MH-193	161.51	MH-195	154.32	0.171	42	Circle	PVC	8 inch	2,244	44	2	
P-198	MH-195	154.32	MH-197	143.68	0.083	128	Circle	PVC	8 inch	2,033	46	2.3	2014
P-200	MH-197	143.58	MH-199	141	0.031	84	Circle	PVC	8 inch	1,236	49	4	2014
P-202	MH-199	139.9	MH-201	131.1	0.027	324	Circle	PVC	8 inch	1,162	52	4.5	2014
P-204	MH-201	131	MH-203	124.76	0.013	476	Circle	PVC	8 inch	807	54	6.7	2014
P-206	MH-203	124.66	MH-205	119.6	0.018	276	Circle	PVC	8 inch	955	62	6.5	2014
P-208	MH-205	119.5	MH-207	119.06	0.019	23	Circle	PVC	8 inch	975	64	6.6	2014
P-210	MH-207	118.96	MH-209	117.37	0.006	263	Circle	PVC	12 inch	1,616	130	8.1	2014
P-212	MH-209	117.27	MH-211	115.62	0.006	275	Circle	PVC	12 inch	1,610	132	8.2	2014
P-214	MH-211	115.52	MH-213	113.3	0.006	366	Circle	PVC	12 inch	1,619	144	8.9	2014
P-216	MH-213	113.2	MH-215	105.58	0.027	278	Circle	PVC	12 inch	2,647	157	5.9	
P-218	MH-215	105.48	MH-217	101.95	0.01	353	Circle	PVC	12 inch	1,599	161	10	
P-220	MH-217	101.7	MH-219	101.6	0.007	15	Circle	PVC	12 inch	1,306	163	12.4	
P-222	MH-219	101.5	MH-221	94.51	0.097	72	Circle	Concrete	8 inch	1,690	164	9.7	
P-230	MH-228	126.83	MH-229	125.31	0.005	308	Circle	Concrete	8 inch	381	2	0.5	
P-232	MH-229	123.21	MH-231	123.14	0	409	Circle	Concrete	8 inch	71	4	5.4	
P-234	MH-231	123.04	MH-233	119.5	0.017	205	Circle	PVC	8 inch	713	6	0.8	
P-236	MH-233	119.4	MH-235	116.1	0.015	218	Circle	PVC	8 inch	667	8	1.1	
P-237	MH-235	116	MH-211	115.62	0.013	30	Circle	PVC	8 inch	610	9	1.6	
P-240	MH-238	132	MH-239	130.1	0.015	126	Circle	PVC	8 inch	666	15	2.3	
P-242	MH-239	130	MH-241	120.1	0.029	337	Circle	PVC	8 inch	930	17	1.8	
P-247	MH-245	244.65	MH-246	240.69	0.011	365	Circle	PVC	8 inch	565	2	0.3	
P-249	MH-246	240.59	MH-248	230.55	0.102	98	Circle	PVC	8 inch	1,736	4	0.2	
P-251	MH-248	230.45	MH-250	219.1	0.028	400	Circle	PVC	8 inch	914	6	0.6	
P-253	MH-250	210.6	MH-252	208.76	0.006	288	Circle	PVC	8 inch	434	13	3.1	
P-255	MH-252	208.66	MH-254	194.58	0.054	263	Circle	PVC	8 inch	1,255	15	1.2	
P-257	MH-254	194.48	MH-256	182.94	0.05	230	Circle	PVC	8 inch	1,215	17	1.4	
P-259	MH-256	182.84	MH-258	181.42	0.004	360	Circle	PVC	8 inch	341	19	5.6	
P-261	MH-258	181.32	MH-260	161.9	0.071	272	Circle	PVC	10 inch	2,627	22	0.8	
P-263	MH-260	161.8	MH-262	147.91	0.131	106	Circle	PVC	10 inch	3,560	24	0.7	
P-265	MH-262	147.66	MH-264	134.16	0.042	320	Circle	PVC	10 inch	2,020	34	1.7	
P-267	MH-264	134.06	MH-266	125.91	0.025	324	Circle	PVC	10 inch	1,560	36	2.3	
P-269	MH-266	125.71	MH-268	124.75	0.004	271	Circle	Steel	12 inch	952	37	3.9	
P-271	MH-268	124.5	MH-270	123.36	0.004	307	Circle	Steel	12 inch	974	39	4	
P-273	MH-270	123.26	MH-272	121.9	0.003	401	Circle	Steel	12 inch	931	41	4.4	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-275	MH-272	121.8	MH-274	120.44	0.003	401	Circle	Steel	12 inch	931	43	4.6	
P-276	MH-274	120.34	MH-207	119.06	0.003	375	Circle	Steel	12 inch	934	45	4.8	
P-279	MH-277	124	MH-278	116	0.017	464	Circle	PVC	6 inch	331	2	0.6	
P-288	MH-286	127.72	MH-287	126.43	0.004	300	Circle	PVC	8 inch	356	3	0.7	
P-289	MH-287	126.43	MH-203	124.76	0.006	300	Circle	PVC	8 inch	405	5	1.3	
P-292	MH-290	160.16	MH-291	160.04	0.005	23	Circle	PVC	8 inch	392	2	0.5	
P-294	MH-291	159.94	MH-293	153.99	0.048	125	Circle	PVC	8 inch	1,183	4	0.3	
P-295	MH-293	153.43	MH-262	145.67	0.031	253	Circle	PVC	8 inch	950	8	0.8	
P-297	MH-296	154.4	MH-293	153.53	0.031	28	Circle	PVC	8 inch	956	2	0.2	
P-300	MH-298	223.33	MH-299	213.27	0.04	253	Circle	PVC	8 inch	1,081	2	0.2	
P-302	MH-299	213.17	MH-301	212.79	0.004	93	Circle	PVC	8 inch	347	4	1.1	
P-303	MH-301	212.69	MH-250	210.7	0.013	159	Circle	PVC	8 inch	607	6	0.9	
P-306	MH-304	126.25	MH-43	118.75	0.025	304	Circle	PVC	8 inch	852	1	0.1	
P-309	MH-307	143.9	MH-308	141.24	0.03	90	Circle	PVC	8 inch	932	2	0.2	
P-311	MH-308	141.2	MH-310	125.96	0.049	312	Circle	PVC	8 inch	1,199	4	0.3	
P-313	MH-310	125.74	MH-312	116.72	0.032	282	Circle	PVC	12 inch	3,718	409	11	2021
P-315	MH-312	116.62	MH-314	116.19	0.007	58	Circle	PVC	12 inch	1,790	411	23	2021
P-317	MH-314	116.14	MH-316	113.49	0.014	189	Circle	PVC	12 inch	2,461	413	16.8	2021
P-319	MH-316	113.26	MH-318	109.89	0.015	227	Circle	PVC	12 inch	2,533	425	16.8	2021
P-321	MH-318	109.82	MH-320	109.48	0.006	54	Circle	PVC	12 inch	1,649	435	26.4	2021
P-323	MH-320	109.45	MH-322	108.34	0.005	220	Circle	PVC	12 inch	1,477	437	29.6	2021
P-328	MH-326	135.65	MH-327	129.51	0.038	162	Circle	PVC	12 inch	4,047	399	9.9	2021
P-330	MH-327	129.35	MH-329	127.37	0.025	78	Circle	PVC	12 inch	3,312	401	12.1	2021
P-331	MH-329	127.3	MH-310	125.92	0.011	124	Circle	PVC	12 inch	2,193	403	18.4	2021
P-334	MH-332	155.87	MH-333	148.67	0.05	145	Circle	PVC	8 inch	1,209	2	0.2	
P-336	MH-333	148.6	MH-335	134.6	0.063	223	Circle	PVC	8 inch	1,359	4	0.3	
P-338	MH-335	134.54	MH-337	129.68	0.032	150	Circle	PVC	8 inch	976	6	0.6	
P-340	MH-337	129.66	MH-339	118.75	0.053	206	Circle	PVC	8 inch	1,248	8	0.6	
P-341	MH-339	118.72	MH-316	113.43	0.056	94	Circle	PVC	8 inch	1,287	10	0.8	
P-344	MH-342	151.34	MH-343	149.82	0.022	69	Circle	PVC	8 inch	805	2	0.2	
P-346	MH-343	149.65	MH-345	134.49	0.057	264	Circle	PVC	8 inch	1,300	4	0.3	
P-348	MH-345	134.49	MH-347	127.94	0.043	151	Circle	PVC	8 inch	1,130	6	0.5	
P-349	MH-347	127.84	MH-318	109.89	0.079	227	Circle	PVC	8 inch	1,525	8	0.5	
P-352	MH-350	144	MH-351	141.69	0.025	92	Circle	PVC	8 inch	859	2	0.2	
P-354	MH-351	141.61	MH-353	133.61	0.04	201	Circle	PVC	8 inch	1,082	4	0.4	
P-356	MH-353	133.6	MH-355	126.19	0.028	269	Circle	PVC	8 inch	900	6	0.7	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-358	MH-355	126.15	MH-357	120.57	0.03	187	Circle	PVC	8 inch	937	8	0.9	
P-360	MH-357	120.26	MH-359	116.05	0.03	142	Circle	PVC	8 inch	934	12	1.3	
P-361	MH-359	115.93	MH-322	108.45	0.057	132	Circle	PVC	8 inch	1,291	14	1.1	
P-363	MH-362	124.05	MH-357	120.22	0.023	170	Circle	PVC	8 inch	814	2	0.2	
P-366	MH-364	142.26	MH-365	134.78	0.034	221	Circle	PVC	8 inch	998	2	0.2	
P-368	MH-365	134.73	MH-367	128.57	0.027	231	Circle	PVC	8 inch	886	4	0.5	
P-369	MH-367	128.57	MH-322	108.47	0.097	207	Circle	PVC	8 inch	1,690	6	0.4	
P-372	MH-370	230.75	MH-371	224.6	0.079	78	Circle	PVC	8 inch	1,523	1	0.1	
P-374	MH-371	224.43	MH-373	201.79	0.081	278	Circle	PVC	8 inch	1,548	2	0.1	
P-376	MH-373	201.7	MH-375	196.85	0.016	301	Circle	PVC	8 inch	688	2	0.3	
P-378	MH-375	196.72	MH-377	179.76	0.068	249	Circle	PVC	8 inch	1,415	4	0.3	
P-380	MH-377	179.56	MH-379	155.67	0.089	267	Circle	PVC	8 inch	1,622	5	0.3	
P-382	MH-379	155.55	MH-381	139.74	0.108	147	Circle	PVC	8 inch	1,779	6	0.3	
P-384	MH-381	139.43	MH-383	131.82	0.035	219	Circle	PVC	12 inch	2,981	14	0.5	
P-386	MH-383	131.66	MH-385	131.33	0.016	20	Circle	PVC	12 inch	2,054	29	1.4	
P-388	MH-385	131.26	MH-387	125.21	0.098	62	Circle	PVC	12 inch	4,995	29	0.6	
P-390	MH-389	125.59	MH-387	125.21	0.007	58	Circle	PVC	12 inch	1,294	26	2	
P-392	MH-391	131.26	MH-385	130.79	0.011	42	Circle	PVC	12 inch	1,692	0	0	
P-394	MH-393	197.93	MH-375	196.75	0.009	128	Circle	PVC	8 inch	521	1	0.2	
P-397	MH-395	226.27	MH-396	221.56	0.044	106	Circle	PVC	8 inch	1,143	1	0.1	
P-399	MH-396	221.36	MH-398	216.32	0.048	106	Circle	PVC	8 inch	1,183	2	0.1	
P-401	MH-398	216.08	MH-400	212.33	0.046	81	Circle	PVC	8 inch	1,167	2	0.2	
P-403	MH-400	212.21	MH-402	194.02	0.046	399	Circle	PVC	8 inch	1,158	3	0.3	
P-405	MH-402	193.84	MH-404	179.16	0.045	327	Circle	PVC	8 inch	1,149	5	0.4	
P-407	MH-404	179.02	MH-406	161.08	0.053	338	Circle	PVC	8 inch	1,249	6	0.4	
P-408	MH-406	161	MH-381	139.74	0.055	387	Circle	PVC	8 inch	1,271	7	0.6	
P-410	MH-409	165.94	MH-406	161.08	0.014	350	Circle	PVC	8 inch	639	1	0.1	
P-412	MH-411	198.2	MH-402	193.94	0.029	145	Circle	PVC	8 inch	930	1	0.1	
P-467	MH-465	179.62	MH-466	178.85	0.007	112	Circle	PVC	8 inch	450	1	0.2	
P-469	MH-466	178.85	MH-468	171.09	0.032	239	Circle	PVC	8 inch	977	2	0.2	
P-471	MH-468	170.92	MH-470	160.08	0.037	293	Circle	PVC	8 inch	1,043	2	0.2	
P-473	MH-470	159.94	MH-472	159.08	0.005	159	Circle	PVC	8 inch	399	3	0.8	
P-475	MH-472	159.03	MH-474	158.19	0.006	146	Circle	PVC	8 inch	411	4	1	
P-477	MH-474	157.88	MH-476	156.37	0.004	359	Circle	PVC	8 inch	352	9	2.5	
P-479	MH-476	156.21	MH-478	155.85	0.005	71	Circle	PVC	8 inch	386	10	2.5	
P-481	MH-478	155.85	MH-480	155.15	0.004	180	Circle	PVC	8 inch	338	10	3.1	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-483	MH-480	155.02	MH-482	154.72	0.005	64	Circle	PVC	8 inch	371	11	3	
P-485	MH-482	154.72	MH-484	152.33	0.035	69	Circle	PVC	8 inch	1,009	12	1.2	
P-487	MH-484	152.33	MH-486	146.91	0.022	244	Circle	PVC	8 inch	808	13	1.6	
P-489	MH-486	146.6	MH-488	138.64	0.031	256	Circle	PVC	12 inch	2,820	14	0.5	
P-490	MH-488	138.5	MH-383	131.82	0.035	193	Circle	PVC	12 inch	2,975	14	0.5	
P-493	MH-491	191.11	MH-492	182.09	0.032	282	Circle	PVC	8 inch	970	1	0.1	
P-495	MH-492	181.98	MH-494	180.01	0.007	282	Circle	PVC	8 inch	453	2	0.4	
P-497	MH-494	179.94	MH-496	179	0.006	150	Circle	PVC	8 inch	429	2	0.6	
P-499	MH-496	178.93	MH-498	174.07	0.021	230	Circle	PVC	8 inch	788	3	0.4	
P-500	MH-498	173.93	MH-474	158.13	0.061	260	Circle	PVC	8 inch	1,337	4	0.3	
P-513	MH-511	186.12	MH-512	183.48	0.01	276	Circle	PVC	8 inch	530	3	0.5	
P-515	MH-512	183.18	MH-514	181.06	0.006	382	Circle	PVC	8 inch	404	6	1.4	
P-517	MH-514	180.95	MH-516	179.74	0.007	166	Circle	PVC	8 inch	463	11	2.4	
P-519	MH-516	185.06	MH-518	183.46	0.004	401	Circle	PVC	10 inch	621	20	3.2	
P-520	MH-518	183.36	MH-431	181.58	0.004	399	Circle	PVC	10 inch	657	22	3.4	
P-523	MH-521	193	MH-522	190.1	0.011	268	Circle	PVC	8 inch	564	3	0.5	
P-525	MH-522	190	MH-524	189.1	0.014	65	Circle	PVC	8 inch	638	6	0.9	
P-527	MH-524	189	MH-526	187.1	0.008	250	Circle	PVC	8 inch	473	11	2.4	
P-528	MH-526	187	MH-427	185	0.008	249	Circle	PVC	8 inch	486	14	2.9	
P-530	MH-529	190.75	MH-524	189.1	0.016	101	Circle	PVC	8 inch	693	3	0.4	
P-532	MH-531	192.81	MH-514	189.44	0.01	343	Circle	PVC	8 inch	538	3	0.5	
P-534	MH-533	189	MH-425	187.6	0.008	173	Circle	PVC	8 inch	488	3	0.6	
P-536	MH-535	186.97	MH-429	182.6	0.013	348	Circle	PVC	8 inch	608	3	0.5	
P-539	MH-537	181.15	MH-538	179.99	0.005	211	Circle	PVC	8 inch	402	3	0.7	
P-541	MH-538	179.89	MH-540	177.66	0.01	218	Circle	PVC	8 inch	549	6	1	
P-543	MH-540	177.56	MH-542	177.25	0.005	58	Circle	PVC	8 inch	397	8	2.1	
P-545	MH-542	177.15	MH-544	175.1	0.015	141	Circle	PVC	8 inch	654	11	1.7	
P-547	MH-544	175	MH-546	172.2	0.009	324	Circle	PVC	8 inch	504	14	2.8	
P-548	MH-546	171.98	MH-437	169.85	0.006	345	Circle	PVC	8 inch	426	28	6.6	
P-551	MH-549	180.72	MH-550	178.72	0.021	97	Circle	PVC	8 inch	779	3	0.4	
P-553	MH-550	178.62	MH-552	177.73	0.006	148	Circle	PVC	8 inch	421	6	1.3	
P-555	MH-552	177.63	MH-554	176.62	0.006	169	Circle	PVC	8 inch	419	8	2	
P-556	MH-554	176.52	MH-546	172.2	0.016	278	Circle	PVC	8 inch	676	11	1.7	
P-559	MH-557	202.17	MH-558	201.77	0.005	76	Circle	PVC	8 inch	393	3	0.7	
P-561	MH-558	201.77	MH-560	199.93	0.005	400	Circle	PVC	8 inch	368	6	1.5	
P-563	MH-560	199.83	MH-562	195.7	0.012	346	Circle	PVC	8 inch	593	25	4.3	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-565	MH-562	196.23	MH-564	195.93	0.004	77	Circle	PVC	8 inch	339	28	8.3	
P-567	MH-564	195.83	MH-566	194.35	0.004	375	Circle	PVC	8 inch	341	31	9.1	
P-569	MH-566	194.23	MH-568	193.79	0.005	86	Circle	PVC	8 inch	388	34	8.7	
P-571	MH-568	193.79	MH-570	192.42	0.005	288	Circle	PVC	8 inch	374	36	9.8	
P-573	MH-570	199.35	MH-572	176.21	0.062	373	Circle	PVC	8 inch	1,351	63	4.7	
P-575	MH-572	176.11	MH-574	173.45	0.009	281	Circle	PVC	8 inch	528	66	12.5	
P-576	MH-574	173.35	MH-441	171.25	0.005	400	Circle	PVC	8 inch	393	69	17.5	
P-579	MH-577	252.92	MH-578	241.07	0.049	240	Circle	PVC	8 inch	1,205	13	1.1	
P-581	MH-578	240.97	MH-580	227.6	0.088	152	Circle	PVC	8 inch	1,608	16	1	
P-583	MH-580	227.5	MH-582	202.51	0.062	400	Circle	PVC	8 inch	1,356	21	1.6	
P-584	MH-582	202.41	MH-570	199.45	0.052	57	Circle	PVC	8 inch	1,236	24	1.9	
P-586	MH-585	233.68	MH-580	227.6	0.035	174	Circle	PVC	8 inch	1,014	3	0.3	
P-589	MH-587	234.47	MH-588	214.64	0.118	168	Circle	PVC	8 inch	1,863	3	0.2	
P-591	MH-588	214.54	MH-590	213.28	0.027	47	Circle	PVC	8 inch	888	6	0.6	
P-593	MH-590	213.18	MH-592	209.06	0.02	210	Circle	PVC	8 inch	760	8	1.1	
P-595	MH-592	208.96	MH-594	208.37	0.005	109	Circle	PVC	8 inch	399	11	2.8	
P-596	MH-594	208.27	MH-560	203.62	0.058	80	Circle	PVC	8 inch	1,308	14	1.1	
P-598	MH-597	226.56	MH-560	203.62	0.08	287	Circle	PVC	8 inch	1,533	3	0.2	
P-601	MH-599	158.18	MH-600	156.69	0.004	393	Circle	PVC	8 inch	334	31	9.2	
P-603	MH-600	156.59	MH-602	154.76	0.012	158	Circle	PVC	8 inch	584	33	5.7	
P-605	MH-602	154.66	MH-604	154.21	0.015	31	Circle	PVC	8 inch	653	36	5.5	
P-607	MH-604	154.11	MH-606	152.05	0.074	28	Circle	PVC	8 inch	1,471	39	2.7	
P-609	MH-606	152.05	MH-608	149.86	0.012	188	Circle	PVC	8 inch	585	42	7.2	
P-610	MH-608	149.86	MH-445	149.66	0.005	41	Circle	PVC	8 inch	379	45	11.8	
P-613	MH-611	163.36	MH-612	161.87	0.106	14	Circle	PVC	6 inch	822	3	0.3	
P-615	MH-612	161.77	MH-614	154.19	0.032	239	Circle	PVC	8 inch	966	8	0.9	
P-617	MH-614	154.09	MH-616	153.13	0.004	243	Circle	PVC	8 inch	341	11	3.3	
P-619	MH-616	153.03	MH-618	152.46	0.005	125	Circle	PVC	8 inch	366	17	4.6	
P-620	MH-618	152.36	MH-447	149.04	0.026	128	Circle	PVC	8 inch	873	20	2.2	
P-623	MH-621	154.04	MH-622	140.78	0.044	304	Circle	PVC	8 inch	1,133	3	0.2	
P-624	MH-622	140.62	MH-453	137.71	0.037	78	Circle	PVC	8 inch	1,048	6	0.5	
P-627	MH-625	143.5	MH-626	139.83	0.009	400	Circle	PVC	8 inch	519	3	0.5	
P-629	MH-626	139.75	MH-628	136.93	0.033	86	Circle	PVC	8 inch	982	14	1.4	
P-631	MH-628	136.87	MH-630	136.04	0.008	107	Circle	PVC	8 inch	478	17	3.5	
P-632	MH-630	135.99	MH-457	135.25	0.007	104	Circle	PVC	8 inch	457	20	4.3	
P-635	MH-633	157.79	MH-634	156.13	0.011	153	Circle	PVC	8 inch	565	3	0.5	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-637	MH-634	156.04	MH-636	146.32	0.028	348	Circle	PVC	8 inch	906	6	0.6	
P-638	MH-636	146.26	MH-626	139.92	0.034	187	Circle	PVC	8 inch	999	8	0.8	
P-640	MH-639	164.36	MH-612	161.87	0.035	72	Circle	PVC	6 inch	468	3	0.6	
P-642	MH-641	159.22	MH-616	153.13	0.055	110	Circle	PVC	8 inch	1,276	3	0.2	
P-645	MH-643	169.21	MH-644	167.81	0.007	196	Circle	PVC	8 inch	458	6	1.4	
P-647	MH-644	167.26	MH-646	165.55	0.007	252	Circle	PVC	8 inch	447	21	4.6	
P-649	MH-646	166.72	MH-648	164.43	0.013	172	Circle	PVC	8 inch	626	23	3.8	
P-651	MH-648	164.33	MH-650	162.57	0.007	244	Circle	PVC	8 inch	461	38	8.1	
P-653	MH-650	162.47	MH-652	158.81	0.015	240	Circle	PVC	8 inch	670	40	6	
P-655	MH-652	158.71	MH-654	143.06	0.043	360	Circle	PVC	8 inch	1,131	46	4	
P-657	MH-654	142.96	MH-656	140.35	0.029	90	Circle	PVC	8 inch	924	48	5.2	
P-663	MH-661	156.46	MH-662	154.06	0.02	118	Circle	PVC	8 inch	773	3	0.4	
P-665	MH-662	153.96	MH-664	144.93	0.024	374	Circle	PVC	8 inch	843	6	0.7	
P-666	MH-664	144.84	MH-451	144.31	0.013	42	Circle	PVC	8 inch	609	8	1.4	
P-669	MH-667	199.97	MH-668	196.79	0.028	113	Circle	PVC	8 inch	910	3	0.3	
P-671	MH-668	196.69	MH-670	180.94	0.059	267	Circle	PVC	8 inch	1,317	6	0.4	
P-673	MH-670	180.84	MH-672	172.51	0.067	124	Circle	PVC	8 inch	1,406	8	0.6	
P-674	MH-672	172.41	MH-648	164.43	0.06	134	Circle	PVC	8 inch	1,324	11	0.8	
P-676	MH-675	186.46	MH-516	185.16	0.008	164	Circle	PVC	10 inch	875	6	0.6	
P-679	MH-677	125.79	MH-678	121.09	0.017	269	Circle	Concrete	8 inch	717	1	0.2	
P-680	MH-678	121.09	MH-53	110.25	0.037	293	Circle	Concrete	8 inch	1,043	2	0.2	
P-681	MH-101	-8.25	WW-MAIN	-10.67	0.033	74	Circle	PVC	36 inch	70,374	3,102	4.4	2014
P-682	MH-1136	26	WW-PIONEER	22	0.045	88	Circle	PVC	30 inch	39,248	50	0.1	
P-683	MH-681	109	MH-682	83.64	0.078	324	Circle	Concrete	8 inch	1,517	1	0.1	
P-684	MH-682	83.28	MH-61	72.78	0.048	219	Circle	Concrete	8 inch	1,188	2	0.2	
P-685	MH-387	125.12	WW-COPPER	122.5	0.114	23	Circle	PVC	30 inch	62,131	55	0.1	
P-688	MH-687	93.91	MH-223	85.51	0.06	141	Circle	Concrete	8 inch	1,324	2	0.1	
P-690	MH-689	95.43	MH-221	94.51	0.004	217	Circle	Concrete	8 inch	353	2	0.5	
P-693	MH-691	99.5	MH-692	80.2	0.102	190	Circle	Concrete	8 inch	1,729	2	0.1	
P-694	MH-419	189	MH-421	188.5	0.003	192	Circle	PVC	8 inch	277	31	11.2	
P-695	MH-95	-10.76	MH-97	-11.33	0.004	152	Circle	PVC	15 inch	2,308	127	5.5	2014
P-696	MH-694	82.5	MH-1473	71.2	0.05	224	Circle	Concrete	8 inch	1,218	2	0.2	
P-697	MH-278	115.9	MH-213	113.3	0.163	16	Circle	Concrete	8 inch	2,186	11	0.5	
P-698	MH-417	194	MH-419	189	0.056	90	Circle	PVC	8 inch	1,278	28	2.2	
P-699	MH-697	113	MH-698	105.3	0.022	351	Circle	PVC	8 inch	803	2	0.2	
P-700	MH-421	188.5	MH-423	187.5	0.004	285	Circle	PVC	8 inch	321	34	10.5	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-701	MH-698	105.2	MH-700	103.2	0.005	426	Circle	Concrete	8 inch	372	4	1	
P-702	MH-700	103.1	MH-692	80.1	0.052	442	Circle	Concrete	8 inch	1,237	6	0.5	
P-703	MH-692	80	MH-1473	71.3	0.053	164	Circle	Concrete	8 inch	1,249	10	0.8	
P-704	MH-1365	-7.65	MH-1364	-7.98	0.006	60	Circle	PVC	36 inch	28,860	2,474	8.6	2014
P-705	MH-1473	71.1	MH-704	27.8	0.115	378	Circle	Concrete	8 inch	1,836	14	0.7	
P-706	MH-423	187.5	MH-425	186	0.004	400	Circle	PVC	8 inch	332	36	11	
P-707	MH-704	27.6	MH-706	25.43	0.005	413	Circle	PVC	15 inch	2,732	899	32.9	2014
P-708	MH-425	186	MH-427	185	0.004	269	Circle	PVC	8 inch	331	42	12.7	
P-709	MH-706	25.33	MH-708	24.28	0.005	229	Circle	PVC	15 inch	2,552	901	35.3	2014
P-710	MH-427	185	MH-429	182.6	0.008	308	Circle	PVC	8 inch	479	59	12.3	
P-711	MH-708	24.18	MH-710	24.03	0.005	31	Circle	PVC	15 inch	2,622	903	34.4	2014
P-712	MH-429	182.5	MH-431	181.58	0.005	170	Circle	PVC	8 inch	399	65	16.2	
P-713	MH-710	23.93	MH-712	21.93	0.005	400	Circle	PVC	15 inch	2,665	904	33.9	2014
P-714	MH-712	21.83	MH-71	20.38	0.005	289	Circle	PVC	15 inch	2,670	939	35.2	2014
P-715	MH-431	181.48	MH-433	180.06	0.004	372	Circle	PVC	8 inch	335	90	26.8	
P-716	MH-715	28.38	MH-69	26.84	0.004	383	Circle	Concrete	8 inch	344	2	0.6	
P-717	MH-433	172.5	MH-435	170.19	0.006	392	Circle	PVC	8 inch	416	93	22.2	
P-718	MH-435	170.09	MH-437	169.7	0.004	91	Circle	PVC	8 inch	355	95	26.9	
P-720	MH-437	169.7	MH-439	169.13	0.005	112	Circle	PVC	8 inch	387	126	32.6	
P-722	MH-439	169.13	MH-441	167.9	0.007	175	Circle	PVC	8 inch	455	129	28.4	
P-724	MH-441	167.9	MH-443	164.82	0.013	244	Circle	PVC	8 inch	609	201	33	
P-726	MH-443	164.72	MH-445	157.16	0.027	280	Circle	PVC	8 inch	891	204	22.9	
P-728	MH-445	149.66	MH-447	149.1	0.012	47	Circle	PVC	8 inch	592	251	42.4	
P-729	MH-447	149	MH-449	145.9	0.014	217	Circle	PVC	8 inch	648	274	42.2	
P-730	MH-449	145.8	MH-451	144.66	0.004	258	Circle	PVC	12 inch	1,382	276	20	2021
P-732	MH-451	144.56	MH-453	137.93	0.022	308	Circle	PVC	12 inch	3,050	288	9.4	2021
P-733	MH-453	137.93	MH-455	136.8	0.004	265	Circle	PVC	12 inch	1,357	296	21.8	2021
P-736	MH-455	136.7	MH-457	136.1	0.003	175	Circle	PVC	12 inch	1,217	299	24.6	2021
P-737	MH-457	136.1	MH-459	135.92	0.004	51	Circle	PVC	12 inch	1,235	321	26	2021
P-738	MH-736	87.23	MH-737	86.66	0.005	107	Circle	PVC	12 inch	1,517	2	0.1	2014
P-739	MH-1035	-2.61	MH-1393	-2.72	0.002	50	Circle	PVC	10 inch	600	4	0.7	
P-740	MH-737	86.34	MH-739	86.01	0.005	60	Circle	PVC	12 inch	1,542	3	0.2	2014
P-741	MH-284	121.91	MH-282	120.84	0.004	274	Circle	Concrete	8 inch	339	4	1.1	
P-742	MH-739	86.01	MH-741	84.65	0.004	305	Circle	PVC	12 inch	1,388	5	0.3	2014
P-743	MH-282	120.84	MH-280	116.32	0.02	224	Circle	PVC	8 inch	770	6	0.7	
P-744	MH-741	84.1	MH-743	83.26	0.004	237	Circle	PVC	15 inch	2,244	581	25.9	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-745	MH-280	116.32	MH-278	115.58	0.005	154	Circle	PVC	8 inch	376	8	2	
P-746	MH-743	83.18	MH-745	82.48	0.003	252	Circle	PVC	15 inch	1,986	583	29.3	2014
P-747	MH-1393	-2.82	MH-75	-4.53	0.009	187	Circle	Concrete	8 inch	519	6	1.2	
P-748	MH-745	82.4	MH-747	81.84	0.002	243	Circle	PVC	15 inch	1,809	643	35.5	2014
P-749	MH-71	19.67	MH-1391	10.5	0.064	144	Circle	Concrete	12 inch	4,035	1,617	40.1	
P-750	MH-749	82.17	MH-747	82.01	0.005	35	Circle	PVC	8 inch	367	11	3.1	
P-751	MH-676	-1	MH-75	-4.43	0.017	206	Circle	PVC	12 inch	2,682	2	0.1	
P-752	MH-751	83.7	MH-749	82.27	0.019	74	Circle	PVC	8 inch	754	10	1.3	
P-753	MH-63	66.1	MH-1417	64.57	0.005	313	Circle	PVC	15 inch	2,635	489	18.6	
P-754	MH-753	89	MH-751	83.8	0.016	331	Circle	PVC	8 inch	680	8	1.2	
P-755	MH-1417	64.47	MH-225	57.05	0.047	157	Circle	PVC	15 inch	8,194	665	8.1	
P-756	MH-755	91.9	MH-753	89.1	0.018	160	Circle	PVC	8 inch	717	5	0.7	
P-757	MH-225	56.95	MH-67	42	0.126	119	Circle	PVC	8 inch	1,922	667	34.7	
P-758	MH-757	95	MH-755	92	0.024	123	Circle	PVC	8 inch	847	3	0.4	
P-759	MH-221	94.41	MH-223	85.51	0.031	291	Circle	PVC	8 inch	948	168	17.7	
P-760	MH-759	98	MH-757	95.1	0.027	108	Circle	PVC	8 inch	889	2	0.2	
P-762	MH-761	91	MH-753	89.1	0.015	127	Circle	PVC	8 inch	663	2	0.2	
P-765	MH-763	107.25	MH-764	95.23	0.049	245	Circle	PVC	8 inch	1,201	2	0.1	
P-767	MH-764	95.13	MH-766	92.22	0.015	190	Circle	PVC	8 inch	671	3	0.5	
P-770	MH-768	84.93	MH-741	84.65	0.007	40	Circle	PVC	8 inch	454	26	5.7	
P-771	MH-1648	114	MH-686	106.68	0.042	174	Circle	PVC	8 inch	1,446	2	0.1	
P-772	MH-688	167.17	MH-1092	163.64	0.034	105	Circle	PVC	8 inch	1,293	10	0.7	
P-773	MH-771	93.33	MH-772	92.99	0.004	76	Circle	PVC	8 inch	363	2	0.4	
P-774	MH-1469	171.83	MH-688	167.32	0.028	164	Circle	PVC	8 inch	1,169	7	0.6	
P-775	MH-690	177.29	MH-1469	171.88	0.029	187	Circle	PVC	8 inch	1,199	5	0.4	
P-776	MH-1470	178.04	MH-690	177.39	0.002	347	Circle	PVC	8 inch	305	2	0.8	
P-777	MH-775	99.74	MH-776	98.69	0.005	233	Circle	PVC	8 inch	364	2	0.4	
P-778	MH-1471	-6.7	MH-1198	-7.61	0.003	344	Circle	PVC	12 inch	1,069	145	13.5	2014
P-779	MH-776	98.69	MH-778	98.22	0.004	131	Circle	PVC	8 inch	325	3	1	
P-781	MH-778	98.22	MH-780	97.09	0.004	298	Circle	PVC	8 inch	334	5	1.4	
P-782	MH-695	-4.03	MH-1472	-4.93	0.004	222	Circle	PVC	10 inch	814	4	0.5	
P-783	MH-780	96.99	MH-782	90.47	0.023	278	Circle	PVC	8 inch	831	6	0.8	
P-784	MH-1474	65.06	MH-65	43.1	0.097	227	Circle	Concrete	8 inch	1,687	2	0.1	
P-785	MH-782	90.47	MH-784	89.85	0.007	85	Circle	PVC	8 inch	463	8	1.7	
P-786	MH-699	202.25	MH-1475	194.94	0.049	148	Circle	PVC	8 inch	1,567	8	0.5	
P-787	MH-784	89.75	MH-786	88.85	0.005	199	Circle	PVC	8 inch	365	10	2.6	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-788	MH-701	205.13	MH-1476	203.15	0.011	183	Circle	PVC	8 inch	733	3	0.4	
P-789	MH-786	88.8	MH-788	88	0.003	298	Circle	PVC	8 inch	281	11	4	
P-790	MH-703	196.33	MH-702	196.06	0.004	67	Circle	PVC	8 inch	448	6	1.3	
P-791	MH-788	87.9	MH-790	87.03	0.007	121	Circle	PVC	8 inch	460	13	2.8	
P-792	MH-1475	194.84	MH-417	194.1	0.004	186	Circle	PVC	8 inch	445	25	5.7	
P-793	MH-790	86.93	MH-792	86.55	0.004	85	Circle	PVC	8 inch	363	14	4	
P-794	MH-1478	38.88	MH-705	32.71	0.015	412	Circle	PVC	15 inch	4,612	870	18.9	
P-795	MH-792	86.28	MH-794	85.19	0.004	309	Circle	PVC	15 inch	2,238	519	23.2	2021
P-796	MH-794	85.11	MH-741	84.31	0.003	297	Circle	PVC	15 inch	1,956	549	28	2021
P-798	MH-797	86.83	MH-794	85.65	0.006	201	Circle	PVC	8 inch	416	28	6.7	
P-799	MH-709	61.63	MH-1479	55.94	0.014	398	Circle	PVC	15 inch	4,506	807	17.9	
P-800	MH-747	81.74	MH-799	81.25	0.003	173	Circle	PVC	15 inch	2,006	656	32.7	2014
P-801	MH-711	65.46	MH-1480	64.21	0.005	252	Circle	PVC	15 inch	2,654	736	27.7	
P-802	MH-799	81.28	MH-801	80.99	0.006	46	Circle	PVC	15 inch	2,993	660	22.1	2014
P-803	MH-1481	210.13	MH-413	207.36	0.012	238	Circle	PVC	8 inch	761	3	0.4	
P-804	MH-801	80.65	MH-803	79.19	0.005	300	Circle	PVC	15 inch	2,629	662	25.2	2014
P-806	MH-803	80.55	MH-805	79.16	0.005	279	Circle	PVC	15 inch	2,660	706	26.5	2014
P-808	MH-805	79.06	MH-807	77.63	0.005	285	Circle	PVC	15 inch	2,670	707	26.5	2014
P-810	MH-807	77.53	MH-809	68.78	0.029	300	Circle	PVC	15 inch	6,437	712	11.1	2014
P-812	MH-809	68.1	MH-811	66.85	0.008	155	Circle	PVC	15 inch	3,385	731	21.6	2014
P-820	MH-817	55.15	MH-819	54.68	0.003	175	Circle	PVC	15 inch	1,953	813	41.6	2014
P-822	MH-819	54.58	MH-821	53.51	0.004	302	Circle	PVC	15 inch	2,243	832	37.1	2014
P-826	MH-823	51.85	MH-825	50.43	0.005	296	Circle	PVC	15 inch	2,610	837	32.1	2014
P-828	MH-825	50.37	MH-827	48.23	0.009	246	Circle	PVC	15 inch	3,515	839	23.9	2014
P-830	MH-827	48.23	MH-829	47.76	0.011	42	Circle	PVC	15 inch	3,987	845	21.2	2014
P-832	MH-829	47.71	MH-831	45.52	0.007	300	Circle	PVC	15 inch	3,220	846	26.3	2014
P-840	MH-837	31.9	MH-839	28.41	0.015	239	Circle	PVC	15 inch	4,554	880	19.3	2014
P-842	MH-839	28.32	MH-841	27.63	0.006	116	Circle	PVC	15 inch	2,907	881	30.3	2014
P-843	MH-841	27.53	MH-704	27.3	0.005	46	Circle	PVC	15 inch	2,665	883	33.1	2014
P-845	MH-844	68.3	MH-811	66.85	0.005	276	Circle	PVC	8 inch	393	2	0.4	
P-848	MH-846	82.12	MH-847	81.71	0.008	53	Circle	PVC	8 inch	477	2	0.3	
P-850	MH-847	81.71	MH-849	71.09	0.078	136	Circle	PVC	8 inch	1,516	3	0.2	
P-852	MH-849	80.95	MH-851	80.69	0.004	65	Circle	PVC	8 inch	343	5	1.4	
P-853	MH-851	80.59	MH-803	79.29	0.004	324	Circle	PVC	8 inch	344	6	1.9	
P-856	MH-854	81.7	MH-855	81.15	0.004	149	Circle	PVC	8 inch	330	2	0.5	
P-858	MH-855	81.15	MH-857	80.36	0.005	150	Circle	PVC	8 inch	394	33	8.3	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-860	MH-857	80.36	MH-859	79.83	0.008	66	Circle	PVC	8 inch	486	34	7	
P-861	MH-859	79.58	MH-803	79.29	0.004	68	Circle	PVC	8 inch	354	36	10.1	
P-863	MH-862	81.5	MH-855	81.15	0.003	100	Circle	PVC	8 inch	321	29	9.2	
P-866	MH-864	83.22	MH-865	82.97	0.002	128	Circle	PVC	8 inch	240	2	0.7	
P-867	MH-865	82.87	MH-799	81.42	0.006	253	Circle	PVC	8 inch	411	3	0.8	
P-870	MH-868	82.98	MH-869	81.93	0.008	138	Circle	PVC	8 inch	473	2	0.3	
P-871	MH-869	81.83	MH-807	76.84	0.018	281	Circle	PVC	8 inch	723	3	0.4	
P-874	MH-872	114	MH-873	106.35	0.048	160	Circle	PVC	8 inch	1,186	2	0.1	
P-876	MH-873	106.25	MH-875	94.71	0.037	310	Circle	PVC	8 inch	1,046	5	0.4	
P-878	MH-875	94.61	MH-877	86.76	0.042	186	Circle	PVC	8 inch	1,114	9	0.8	
P-880	MH-877	86.66	MH-879	58.71	0.11	255	Circle	PVC	8 inch	1,796	11	0.6	
P-882	MH-879	58.61	MH-881	56.75	0.017	112	Circle	PVC	8 inch	699	14	2	
P-883	MH-881	56.65	MH-819	55.01	0.012	140	Circle	PVC	8 inch	587	18	3.1	
P-886	MH-884	60.5	MH-885	58.23	0.008	300	Circle	PVC	8 inch	472	2	0.3	
P-887	MH-885	58.13	MH-881	56.75	0.005	273	Circle	PVC	8 inch	386	3	0.8	
P-889	MH-888	60.28	MH-879	58.71	0.01	160	Circle	PVC	8 inch	537	2	0.3	
P-891	MH-890	109.05	MH-873	106.35	0.009	313	Circle	PVC	8 inch	504	2	0.3	
P-894	MH-892	102	MH-893	96.51	0.038	144	Circle	PVC	8 inch	1,059	2	0.1	
P-895	MH-893	96.41	MH-875	94.71	0.005	330	Circle	PVC	8 inch	389	3	0.8	
P-898	MH-896	65.5	MH-897	63.1	0.015	165	Circle	PVC	8 inch	654	2	0.2	
P-900	MH-897	63	MH-899	59	0.018	217	Circle	PVC	8 inch	736	3	0.4	
P-901	MH-899	58.9	MH-827	48.33	0.081	131	Circle	PVC	8 inch	1,541	5	0.3	
P-904	MH-902	105	MH-903	104	0.01	103	Circle	PVC	8 inch	534	2	0.3	
P-906	MH-903	103.9	MH-905	102.67	0.01	122	Circle	PVC	8 inch	545	3	0.6	
P-908	MH-907	110	MH-905	102.67	0.035	208	Circle	PVC	8 inch	1,018	2	0.1	
P-911	MH-909	113	MH-910	109	0.044	91	Circle	PVC	8 inch	1,137	2	0.1	
P-912	MH-910	108.9	MH-905	102.65	0.013	474	Circle	PVC	8 inch	623	3	0.5	
P-914	MH-905	102.55	MH-913	101.85	0.005	135	Circle	PVC	8 inch	391	9	2.3	
P-916	MH-913	101.75	MH-915	85.11	0.049	338	Circle	PVC	8 inch	1,203	11	0.9	
P-918	MH-915	85.01	MH-917	71.6	0.082	163	Circle	PVC	8 inch	1,556	17	1.1	
P-920	MH-917	71.5	MH-919	66.18	0.066	81	Circle	PVC	8 inch	1,390	18	1.3	
P-921	MH-919	66.08	MH-831	45.52	0.108	190	Circle	PVC	8 inch	1,784	20	1.1	
P-924	MH-922	104.5	MH-923	98.1	0.043	148	Circle	PVC	8 inch	1,128	2	0.1	
P-926	MH-923	98	MH-925	92.1	0.055	107	Circle	PVC	8 inch	1,274	3	0.2	
P-927	MH-925	92	MH-915	85.11	0.033	212	Circle	PVC	8 inch	978	5	0.5	
P-930	MH-928	115.97	MH-929	103.16	0.042	303	Circle	PVC	8 inch	1,115	2	0.1	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-932	MH-929	102.98	MH-931	85.22	0.059	301	Circle	PVC	8 inch	1,317	3	0.2	
P-934	MH-931	85.05	MH-933	59.9	0.085	297	Circle	PVC	8 inch	1,578	5	0.3	
P-935	MH-933	59.25	MH-837	32	0.09	302	Circle	PVC	8 inch	1,629	6	0.4	
P-938	MH-936	0	MH-937	-1.9	0.026	73	Circle	PVC	6 inch	406	2	0.5	
P-940	MH-937	-1.9	MH-939	-3.27	0.009	153	Circle	PVC	8 inch	513	4	0.8	
P-942	MH-939	-3.27	MH-941	-4.78	0.004	372	Circle	Concrete	8 inch	346	10	2.9	
P-944	MH-941	-4.78	MH-943	-5.91	0.004	284	Circle	Concrete	8 inch	342	12	3.5	
P-945	MH-943	-5.91	MH-83	-6.43	0.003	157	Circle	PVC	8 inch	406	20	4.8	
P-947	MH-946	-4.52	MH-81	-6.37	0.01	186	Circle	Concrete	8 inch	541	4	0.7	
P-950	MH-948	-0.39	MH-949	-1.85	0.004	364	Circle	Concrete	8 inch	343	2	0.6	
P-951	MH-949	-1.85	MH-943	-2.41	0.004	140	Circle	Concrete	8 inch	343	4	1.2	
P-954	MH-952	-2.68	MH-953	-3.09	0.004	102	Circle	Concrete	8 inch	344	2	0.6	
P-955	MH-953	-3.09	MH-939	-3.27	0.003	52	Circle	Concrete	8 inch	319	4	1.3	
P-958	MH-956	146	MH-957	141	0.014	363	Circle	PVC	8 inch	637	5	0.8	
P-960	MH-957	140.9	MH-959	134.4	0.025	265	Circle	PVC	8 inch	849	10	1.1	
P-962	MH-959	134.3	MH-961	116.3	0.097	185	Circle	PVC	8 inch	1,692	14	0.9	
P-964	MH-961	116.2	MH-963	99.2	0.139	122	Circle	PVC	8 inch	2,025	19	1	
P-966	MH-963	99.1	MH-965	90.1	0.049	185	Circle	PVC	8 inch	1,196	24	2	
P-968	MH-965	90	MH-967	87.11	0.02	144	Circle	PVC	8 inch	768	29	3.8	
P-970	MH-967	87.01	MH-969	80.01	0.073	96	Circle	PVC	8 inch	1,465	53	3.6	
P-972	MH-969	79.91	MH-971	72.91	0.084	83	Circle	PVC	8 inch	1,575	58	3.7	
P-974	MH-971	72.81	MH-973	68.81	0.058	69	Circle	PVC	8 inch	1,306	63	4.8	
P-976	MH-973	68.71	MH-975	68.31	0.004	106	Circle	Concrete	8 inch	333	67	20.2	
P-978	MH-975	68.11	MH-977	50.88	0.059	291	Circle	Concrete	8 inch	1,320	77	5.8	
P-980	MH-977	50.78	MH-979	44.86	0.035	170	Circle	Concrete	8 inch	1,012	82	8.1	
P-982	MH-979	44.76	MH-981	34.76	0.065	154	Circle	Concrete	8 inch	1,382	96	7	
P-984	MH-983	41.7	MH-981	34.86	0.025	274	Circle	PVC	15 inch	5,955	721	12.1	2014
P-986	MH-985	42.75	MH-983	41.7	0.004	259	Circle	PVC	15 inch	2,400	716	29.8	2014
P-988	MH-987	44.07	MH-985	42.75	0.004	332	Circle	PVC	15 inch	2,377	711	29.9	2014
P-990	MH-989	44.67	MH-987	44.07	0.004	153	Circle	PVC	15 inch	2,360	706	29.9	2014
P-992	MH-991	64.02	MH-989	49.06	0.08	187	Circle	Concrete	8 inch	1,534	64	4.2	
P-994	MH-993	86.96	MH-991	64.02	0.075	305	Circle	Concrete	8 inch	1,487	10	0.6	
P-996	MH-995	104.94	MH-993	86.96	0.057	313	Circle	Concrete	8 inch	1,300	7	0.6	
P-998	MH-997	106.03	MH-995	104.94	0.004	275	Circle	Concrete	8 inch	341	5	1.4	
P-1000	MH-999	107.12	MH-997	106.03	0.004	267	Circle	Concrete	8 inch	347	2	0.7	
P-1003	MH-1001	147	MH-1002	145.1	0.013	149	Circle	PVC	6 inch	284	2	0.8	

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P-1005	MH-1002	145	MH-1004	141.1	0.02	199	Circle	PVC	6 inch	353	5	1.4	
P-1007	MH-1004	141	MH-1006	137.1	0.012	335	Circle	PVC	6 inch	272	7	2.7	
P-1009	MH-1006	137	MH-1008	119.1	0.105	170	Circle	PVC	6 inch	817	10	1.2	
P-1011	MH-1008	119	MH-1010	101.1	0.077	232	Circle	Concrete	8 inch	1,506	12	0.8	
P-1013	MH-1010	101	MH-1012	95.1	0.016	360	Circle	Concrete	8 inch	694	14	2.1	
P-1014	MH-1012	95	MH-991	64.12	0.129	240	Circle	Concrete	8 inch	1,945	52	2.7	
P-1017	MH-1015	140.2	MH-1016	125.2	0.041	366	Circle	PVC	8 inch	1,098	5	0.4	
P-1019	MH-1016	125.1	MH-1018	114.1	0.06	182	Circle	PVC	8 inch	1,333	10	0.7	
P-1020	MH-1018	114	MH-967	90.11	0.152	157	Circle	PVC	8 inch	2,116	19	0.9	
P-1022	MH-1021	116	MH-1018	114.1	0.014	139	Circle	PVC	8 inch	634	5	0.8	
P-1024	MH-1023	74.08	MH-975	68.21	0.049	120	Circle	Concrete	8 inch	1,200	5	0.4	
P-1027	MH-1025	60.8	MH-1026	47.9	0.06	215	Circle	Concrete	8 inch	1,328	5	0.4	
P-1028	MH-1026	47.8	MH-979	44.86	0.026	115	Circle	Concrete	8 inch	867	10	1.1	
P-1038	MH-1037	-2.39	MH-1035	-2.51	0.001	100	Circle	Concrete	8 inch	188	2	1.1	
P-1041	MH-1040	46.14	MH-989	44.67	0.004	378	Circle	PVC	15 inch	2,350	640	27.2	2014
P-1043	MH-1042	47.6	MH-1040	46.14	0.004	412	Circle	PVC	15 inch	2,244	638	28.4	2014
P-1045	MH-1044	47.9	MH-1042	47.77	0.005	24	Circle	Concrete	8 inch	399	100	25	
P-1047	MH-1046	62.95	MH-1044	47.9	0.08	188	Circle	Concrete	8 inch	1,534	97	6.4	
P-1049	MH-1048	90	MH-1046	62.95	0.075	361	Circle	Concrete	8 inch	1,485	95	6.4	
P-1051	MH-1050	97.4	MH-1048	90.1	0.08	91	Circle	PVC	8 inch	1,536	93	6	
P-1053	MH-1052	101.85	MH-1050	97.5	0.014	309	Circle	PVC	8 inch	643	90	14	
P-1055	MH-1054	103.3	MH-1052	101.95	0.005	293	Circle	PVC	8 inch	368	88	23.9	
P-1057	MH-1056	104.69	MH-1054	103.41	0.005	262	Circle	PVC	8 inch	379	85	22.5	
P-1059	MH-1058	105.68	MH-1056	104.79	0.005	182	Circle	PVC	8 inch	379	59	15.5	
P-1061	MH-1060	107.95	MH-1058	105.78	0.011	200	Circle	PVC	8 inch	565	57	10	
P-1063	MH-1062	109.62	MH-1060	108.05	0.015	108	Circle	PVC	8 inch	654	54	8.3	
P-1065	MH-1064	111.09	MH-1062	109.72	0.012	119	Circle	PVC	8 inch	582	49	8.5	
P-1067	MH-1066	121.38	MH-1064	117.66	0.023	161	Circle	PVC	8 inch	824	47	5.7	
P-1069	MH-1068	126.77	MH-1066	121.45	0.048	111	Circle	PVC	8 inch	1,187	24	2	
P-1071	MH-1070	130.46	MH-1068	126.87	0.035	104	Circle	PVC	8 inch	1,008	22	2.1	
P-1073	MH-1072	147.43	MH-1070	130.56	0.059	284	Circle	PVC	8 inch	1,322	17	1.3	
P-1075	MH-1074	152.23	MH-1072	147.53	0.039	119	Circle	PVC	8 inch	1,078	12	1.1	
P-1077	MH-1076	154.76	MH-1074	152.33	0.026	95	Circle	PVC	8 inch	867	10	1.1	
P-1079	MH-1078	163.77	MH-1076	154.86	0.041	217	Circle	PVC	8 inch	1,099	7	0.7	
P-1081	MH-1080	168.28	MH-1078	163.87	0.05	89	Circle	PVC	8 inch	1,207	5	0.4	
P-1083	MH-1082	171.73	MH-1080	168.38	0.019	180	Circle	PVC	8 inch	740	2	0.3	

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P-1085	MH-1084	148.87	MH-1072	147.53	0.005	270	Circle	PVC	8 inch	382	2	0.6	
P-1087	MH-1086	131.21	MH-1070	130.56	0.005	138	Circle	PVC	8 inch	372	2	0.6	
P-1089	MH-1088	123.26	MH-1066	121.48	0.005	357	Circle	PVC	8 inch	383	20	5.3	
P-1091	MH-1090	111.09	MH-1062	109.72	0.009	149	Circle	PVC	8 inch	520	2	0.5	
P-1094	MH-1092	163.51	MH-1093	160	0.022	156	Circle	PVC	8 inch	814	12	1.5	
P-1096	MH-1093	159.9	MH-1095	130.9	0.091	319	Circle	PVC	8 inch	1,635	14	0.9	
P-1098	MH-1095	130.9	MH-1097	129.22	0.016	105	Circle	PVC	8 inch	686	17	2.5	
P-1100	MH-1097	129.12	MH-1099	125.24	0.035	112	Circle	PVC	8 inch	1,009	19	1.9	
P-1102	MH-1099	125.14	MH-1101	112.58	0.031	399	Circle	PVC	8 inch	962	22	2.2	
P-1103	MH-1101	112.48	MH-1056	104.79	0.021	358	Circle	PVC	8 inch	795	24	3	
P-1106	MH-1104	100.83	MH-1105	100.03	0.003	251	Circle	PVC	8 inch	306	2	0.5	
P-1108	MH-1105	99.93	MH-1107	98.45	0.006	264	Circle	PVC	8 inch	406	6	1.6	
P-1110	MH-1107	98.35	MH-1109	97.31	0.006	182	Circle	PVC	8 inch	410	8	2	
P-1112	MH-1109	97.21	MH-1111	92.31	0.021	237	Circle	PVC	8 inch	780	10	1.2	
P-1114	MH-1111	92.21	MH-1113	75.59	0.053	313	Circle	PVC	8 inch	1,250	11	0.9	
P-1116	MH-1113	75.58	MH-1115	38.31	0.129	289	Circle	PVC	8 inch	1,948	13	0.7	
P-1118	MH-1115	38.21	MH-1117	27.27	0.219	50	Circle	PVC	8 inch	2,537	14	0.6	
P-1120	MH-1119	30.96	MH-1117	27.27	0.009	410	Circle	PVC	8 inch	515	11	2.2	
P-1122	MH-1121	35.79	MH-1119	31.06	0.012	397	Circle	PVC	8 inch	592	10	1.6	
P-1124	MH-1123	52.08	MH-1121	35.89	0.083	194	Circle	PVC	8 inch	1,567	8	0.5	
P-1126	MH-1125	76.4	MH-1123	52.18	0.12	202	Circle	PVC	8 inch	1,878	6	0.3	
P-1128	MH-1127	95.6	MH-1125	76.5	0.071	268	Circle	PVC	8 inch	1,448	3	0.2	
P-1130	MH-1129	99.66	MH-1127	95.7	0.017	228	Circle	PVC	8 inch	715	2	0.2	
P-1132	MH-1131	80.16	MH-1125	76.5	0.026	143	Circle	PVC	8 inch	868	2	0.2	
P-1135	MH-1133	26.93	MH-1134	26.21	0.003	212	Circle	PVC	8 inch	316	19	6.1	
P-1137	MH-1134	26.11	MH-1136	26	0.003	34	Circle	PVC	8 inch	308	48	15.6	
P-1138	MH-1117	27.17	MH-1134	26.21	0.008	126	Circle	PVC	8 inch	473	27	5.8	
P-1140	MH-1139	-4.25	MH-87	-6.14	0.012	152	Circle	PVC	8 inch	605	4	0.6	
P-1142	MH-1141	-4	MH-87	-6.14	0.013	164	Circle	PVC	8 inch	620	4	0.6	
P-1145	MH-1143	-2.18	MH-1144	-4.18	0.01	201	Circle	PVC	8 inch	541	4	0.7	
P-1148	MH-1146	-8.5	MH-91	-9.48	0.004	268	Circle	Concrete	8 inch	328	36	11	
P-1151	MH-1149	-0.52	MH-1150	-1.92	0.01	145	Circle	PVC	8 inch	533	4	0.7	
P-1157	MH-1155	5	MH-1156	2.88	0.039	54	Circle	PVC	6 inch	499	4	0.7	
P-1158	MH-1156	2.88	MH-1150	-1.92	0.041	118	Circle	PVC	6 inch	508	11	2.1	
P-1160	MH-1159	2.7	MH-1156	2.3	0.007	61	Circle	PVC	6 inch	204	4	1.8	
P-1163	MH-1161	1	MH-1162	-2.1	0.016	197	Circle	PVC	8 inch	884	4	0.4	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1165	MH-1162	-2	MH-1164	-6.1	0.017	246	Circle	PVC	8 inch	910	7	0.8	2014
P-1167	MH-1166	-4	MH-1164	-6.1	0.009	234	Circle	PVC	8 inch	668	7	1.1	2014
P-1169	MH-1168	-2	MH-1166	-4.1	0.025	83	Circle	PVC	8 inch	1,121	4	0.3	2014
P-1170	MH-1164	-6	MH-95	-10.76	0.013	367	Circle	PVC	8 inch	803	18	2.2	2014
P-1173	MH-1171	0.3	MH-1172	-0.49	0.004	176	Circle	PVC	8 inch	472	4	0.8	2014
P-1175	MH-1172	-0.59	MH-1174	-1.82	0.005	272	Circle	PVC	8 inch	474	7	1.5	2014
P-1177	MH-1174	-1.92	MH-1176	-2.85	0.005	205	Circle	PVC	8 inch	475	11	2.3	2014
P-1179	MH-1176	-2.95	MH-1178	-4.46	0.004	358	Circle	PVC	8 inch	458	14	3.2	2014
P-1181	MH-1178	-4.41	MH-1180	-5.76	0.006	229	Circle	PVC	8 inch	541	18	3.3	2014
P-1182	MH-1180	-5.61	MH-101	-7.95	0.009	267	Circle	PVC	12 inch	1,946	22	1.1	2014
P-1185	MH-1183	0.65	MH-1184	-1.1	0.006	300	Circle	PVC	8 inch	538	2	0.4	2014
P-1187	MH-1184	-1.1	MH-1186	-1.21	0	234	Circle	PVC	8 inch	153	4	2.6	2014
P-1189	MH-1186	-1.21	MH-1188	-2.08	0.003	287	Circle	PVC	8 inch	388	10	2.6	2014
P-1191	MH-1188	-2.08	MH-1190	-2.96	0.003	288	Circle	PVC	8 inch	390	115	29.4	2014
P-1193	MH-1190	-2.96	MH-1192	-3.84	0.003	307	Circle	PVC	8 inch	377	125	33	2014
P-1195	MH-1192	-4.44	MH-1194	-5.77	0.004	305	Circle	PVC	12 inch	1,373	129	9.4	2014
P-1197	MH-1194	-5.77	MH-1196	-6.16	0.005	83	Circle	PVC	12 inch	1,425	133	9.3	2014
P-1201	MH-1198	-7.61	MH-1200	-8.16	0.005	115	Circle	PVC	12 inch	1,438	147	10.2	2014
P-1203	MH-1200	-8.16	MH-1202	-8.84	0.004	174	Circle	PVC	12 inch	1,299	159	12.2	2014
P-1205	MH-1202	-8.84	MH-1204	-9.26	0.004	107	Circle	PVC	12 inch	1,302	161	12.3	2014
P-1207	MH-1204	-9.26	MH-1206	-10.15	0.004	229	Circle	PVC	12 inch	1,296	173	13.3	2014
P-1209	MH-1206	-10.28	MH-1208	-11.02	0.002	388	Circle	PVC	15 inch	1,646	447	27.1	2014
P-1211	MH-1208	-11.02	MH-1210	-11.68	0.002	365	Circle	PVC	15 inch	1,603	454	28.3	2014
P-1212	MH-1210	-11.68	MH-99	-12.3	0.002	313	Circle	PVC	15 inch	1,677	457	27.3	2014
P-1215	MH-1213	1.5	MH-1214	-0.07	0.013	125	Circle	PVC	8 inch	790	2	0.3	2014
P-1217	MH-1214	-0.17	MH-1216	-0.95	0.004	196	Circle	PVC	8 inch	445	6	1.4	2014
P-1219	MH-1216	-1.05	MH-1218	-2.39	0.005	283	Circle	PVC	8 inch	485	8	1.7	2014
P-1220	MH-1218	-2.49	MH-1204	-2.76	0.005	56	Circle	PVC	8 inch	490	10	2	2014
P-1222	MH-1221	3.82	MH-1214	-0.07	0.108	36	Circle	PVC	8 inch	2,318	2	0.1	2014
P-1224	MH-1223	-2.56	MH-1208	-4.66	0.006	324	Circle	PVC	8 inch	568	4	0.6	2014
P-1227	MH-1225	0.26	MH-1226	-0.5	0.004	206	Circle	PVC	8 inch	428	2	0.5	2014
P-1228	MH-1226	-0.58	MH-1186	-1.21	0.003	200	Circle	PVC	8 inch	396	4	1	2014
P-1231	MH-1229	-0.42	MH-1230	-1.24	0.004	193	Circle	PVC	8 inch	460	2	0.4	2014
P-1232	MH-1230	-1.24	MH-1188	-2.08	0.004	210	Circle	PVC	8 inch	446	4	0.9	2014
P-1235	MH-1233	1	MH-1234	-0.9	0.008	240	Circle	PVC	8 inch	627	2	0.3	2014
P-1236	MH-1234	-1	MH-1190	-2.96	0.012	164	Circle	PVC	8 inch	771	8	1	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-1239	MH-1237	4	MH-1238	1.1	0.012	238	Circle	PVC	8 inch	778	2	0.3	2014
P-1240	MH-1238	1	MH-1234	-0.9	0.012	158	Circle	PVC	8 inch	773	4	0.5	2014
P-1242	MH-1241	0.28	MH-1192	-3.84	0.037	112	Circle	PVC	8 inch	1,352	2	0.1	2014
P-1244	MH-1243	0.09	MH-1194	-1.89	0.018	109	Circle	PVC	8 inch	950	2	0.2	2014
P-1247	MH-1245	-1.63	MH-1246	-2.16	0.004	121	Circle	PVC	8 inch	467	2	0.4	2014
P-1249	MH-1246	-2.36	MH-1248	-2.8	0.004	112	Circle	PVC	8 inch	442	4	0.9	2014
P-1251	MH-1248	-2.8	MH-1250	-4.05	0.004	313	Circle	PVC	8 inch	446	6	1.3	2014
P-1253	MH-1250	-4.05	MH-1252	-5.29	0.004	318	Circle	PVC	8 inch	440	8	1.8	2014
P-1254	MH-1252	-5.39	MH-1200	-7.16	0.012	152	Circle	PVC	8 inch	761	10	1.3	2014
P-1257	MH-1255	0.79	MH-1256	-0.38	0.003	376	Circle	PVC	8 inch	393	5	1.2	2014
P-1259	MH-1256	-1.38	MH-1258	-2.53	0.004	290	Circle	PVC	8 inch	444	14	3.3	2014
P-1261	MH-1258	-2.53	MH-1260	-3.4	0.003	284	Circle	PVC	8 inch	390	29	7.4	2014
P-1263	MH-1260	-3.4	MH-1262	-3.89	0.003	170	Circle	PVC	8 inch	379	53	14	2014
P-1265	MH-1262	-3.89	MH-1264	-4.25	0.003	122	Circle	PVC	8 inch	383	72	18.8	2014
P-1267	MH-1264	-4.25	MH-1266	-4.41	0.004	38	Circle	PVC	8 inch	457	77	16.8	2014
P-1269	MH-1266	-4.41	MH-1268	-4.74	0.003	110	Circle	PVC	8 inch	386	82	21.2	2014
P-1271	MH-1268	-4.74	MH-1270	-5.54	0.003	262	Circle	PVC	8 inch	390	96	24.7	2014
P-1273	MH-1270	-5.54	MH-1272	-5.95	0.003	119	Circle	PVC	8 inch	414	135	32.6	2014
P-1275	MH-1272	-5.95	MH-1274	-6.47	0.004	143	Circle	PVC	12 inch	1,254	144	11.5	2014
P-1277	MH-1274	-6.47	MH-1276	-6.99	0.003	199	Circle	PVC	12 inch	1,063	219	20.6	2014
P-1279	MH-1276	-6.99	MH-1278	-7.89	0.003	302	Circle	PVC	12 inch	1,135	246	21.7	2014
P-1281	MH-1278	-7.89	MH-1280	-8.25	0.003	128	Circle	PVC	12 inch	1,102	261	23.6	2014
P-1283	MH-1280	-8.25	MH-1282	-9.45	0.003	393	Circle	PVC	12 inch	1,149	265	23.1	2014
P-1284	MH-1282	-9.45	MH-1206	-9.62	0.004	38	Circle	PVC	12 inch	1,390	270	19.4	2014
P-1287	MH-1285	-1.93	MH-1286	-3.35	0.006	242	Circle	PVC	8 inch	540	5	0.9	2014
P-1288	MH-1286	-3.35	MH-1278	-4.64	0.004	291	Circle	PVC	8 inch	469	10	2	2014
P-1291	MH-1289	0	MH-1290	-0.89	0.006	140	Circle	PVC	8 inch	562	18	3.2	2014
P-1292	MH-1290	-0.99	MH-1276	-6.99	0.018	330	Circle	PVC	8 inch	951	23	2.4	2014
P-1294	MH-1293	0.28	MH-1256	-1.38	0.005	339	Circle	PVC	8 inch	493	5	1	2014
P-1296	MH-1295	-1.54	MH-1258	-2.53	0.003	341	Circle	PVC	8 inch	380	5	1.3	2014
P-1298	MH-1297	-0.58	MH-1258	-2.53	0.005	383	Circle	PVC	8 inch	503	5	1	2014
P-1301	MH-1299	-0.93	MH-1300	-1.93	0.004	237	Circle	PVC	8 inch	458	5	1.1	2014
P-1303	MH-1300	-1.93	MH-1302	-2.33	0.003	139	Circle	PVC	8 inch	378	10	2.5	2014
P-1304	MH-1302	-2.4	MH-1260	-3.4	0.003	341	Circle	PVC	8 inch	382	14	3.8	2014
P-1306	MH-1305	-1.76	MH-1260	-3.4	0.005	316	Circle	PVC	8 inch	508	5	0.9	2014
P-1309	MH-1307	-0.48	MH-1308	-2.64	0.006	341	Circle	PVC	8 inch	561	5	0.9	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-1310	MH-1308	-2.64	MH-1262	-5.89	0.112	29	Circle	PVC	8 inch	2,360	10	0.4	2014
P-1312	MH-1311	-1.75	MH-1262	-5.89	0.021	197	Circle	PVC	8 inch	1,022	5	0.5	2014
P-1314	MH-1313	0.21	MH-1268	-4.74	0.014	357	Circle	PVC	8 inch	830	5	0.6	2014
P-1316	MH-1315	0.12	MH-1268	-0.92	0.004	263	Circle	PVC	8 inch	443	5	1.1	2014
P-1319	MH-1317	-0.02	MH-1318	-0.88	0.004	209	Circle	PVC	8 inch	452	5	1.1	2014
P-1321	MH-1318	-0.88	MH-1320	-1.48	0.003	202	Circle	PVC	8 inch	384	10	2.5	2014
P-1323	MH-1320	-1.48	MH-1322	-1.92	0.003	126	Circle	PVC	8 inch	417	14	3.5	2014
P-1325	MH-1322	-1.92	MH-1324	-3.01	0.003	317	Circle	PVC	8 inch	413	19	4.7	2014
P-1327	MH-1324	-3.01	MH-1326	-4.06	0.004	272	Circle	PVC	8 inch	438	24	5.5	2014
P-1328	MH-1326	-4.06	MH-1270	-5.5	0.004	374	Circle	PVC	8 inch	437	34	7.7	2014
P-1330	MH-1329	-3.13	MH-1326	-4.06	0.004	230	Circle	PVC	8 inch	448	5	1.1	2014
P-1332	MH-1331	-4.3	MH-1272	-5.95	0.004	390	Circle	PVC	8 inch	459	5	1	2014
P-1334	MH-1333	-7.38	MH-1146	-8.13	0.008	98	Circle	PVC	8 inch	474	32	6.8	
P-1335	MH-1144	-4.28	MH-1333	-7.28	0.01	300	Circle	PVC	8 inch	542	7	1.3	
P-1337	MH-1336	-4.28	MH-1333	-7.28	0.01	301	Circle	PVC	8 inch	541	22	4	
P-1338	MH-1150	-2.02	MH-1336	-4.18	0.01	209	Circle	PVC	8 inch	551	18	3.3	
P-1342	MH-1341	105.7	MH-215	105.58	0.011	11	Circle	Steel	8 inch	566	2	0.3	
P-1347	MH-93	-10.48	MH-95	-10.76	0.002	167	Circle	PVC	15 inch	1,543	106	6.9	2014
P-1348	MH-772	92.89	MH-766	92.22	0.007	103	Circle	PVC	8 inch	437	3	0.7	
P-1349	MH-241	120	MH-207	119.06	0.049	19	Circle	PVC	18 inch	10,486	19	0.2	
P-1351	MH-766	92.22	MH-768	91.58	0.003	188	Circle	PVC	8 inch	316	8	2.5	
P-1356	MH-1355	122.87	MH-284	121.91	0.004	218	Circle	Concrete	8 inch	360	2	0.5	
P-1361	MH-1360	224	MH-181	214.41	0.064	150	Circle	PVC	8 inch	1,371	3	0.2	
P-1377	MH-1363	-8.01	MH-1362	-8.2	0.001	241	Circle	PVC	36 inch	10,927	2,481	22.7	2014
P-1378	MH-1364	-7.98	MH-1363	-7.91	0	268	Circle	PVC	36 inch	6,289	2,478	39.4	2014
P-1380	MH-1366	-6.85	MH-1365	-7.55	0.001	598	Circle	PVC	36 inch	13,314	2,471	18.6	2014
P-1381	MH-1367	-6.31	MH-1366	-6.75	0.001	305	Circle	PVC	27 inch	6,863	2,467	35.9	
P-1382	MH-1368	-5.89	MH-1367	-6.21	0.001	374	Circle	PVC	27 inch	5,286	2,463	46.6	
P-1383	MH-1369	-5.46	MH-1368	-5.89	0.001	292	Circle	PVC	27 inch	6,934	2,460	35.5	
P-1384	MH-1370	-5.08	MH-1369	-5.46	0.001	338	Circle	PVC	27 inch	6,059	2,456	40.5	
P-1385	MH-1371	-4.76	MH-1370	-5.08	0.002	158	Circle	PVC	27 inch	8,132	2,453	30.2	
P-1386	MH-1372	-4.51	MH-1371	-4.66	0	386	Circle	PVC	42 inch	11,572	2,449	21.2	2014
P-1387	MH-1373	-4.49	MH-1372	-4.51	0	160	Circle	PVC	42 inch	6,563	2,447	37.3	2014
P-1388	MH-1374	-2.16	MH-1373	-4.29	0.012	179	Circle	PVC	24 inch	11,075	2,445	22.1	
P-1389	MH-1375	4.94	MH-1374	-2.26	0.015	479	Circle	PVC	18 inch	5,780	2,443	42.3	

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

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P-1390	MH-981	34.6	MH-1375	5.04	0.1	297	Circle	Corrugated HDPE (Smooth Interior)	18 inch	16,113	822	5.1	
P-1392	MH-1391	10.4	MH-1375	5.15	0.059	89	Circle	Corrugated HDPE (Smooth Interior)	12 inch	4,207	1,619	38.5	
P-1410	MH-1409	130.66	MH-391	129.5	0.009	123	Circle	PVC	12 inch	1,553	0	0	
P-1422	MH-223	85.41	MH-1421	72.4	0.098	133	Circle	Concrete	8 inch	1,696	172	10.1	
P-1425	MH-1421	72.06	MH-1417	69.69	0.049	48	Circle	PVC	8 inch	1,205	174	14.4	
P-1429	MH-1428	188.2	MH-675	186.64	0.004	390	Circle	PVC	10 inch	622	3	0.5	
P-1431	MH-821	53.41	MH-1430	52.33	0.004	301	Circle	PVC	15 inch	2,258	834	36.9	2014
P-1434	MH-1430	52.23	MH-823	52.21	0.003	6	Circle	PVC	15 inch	2,176	835	38.4	2014
P-1440	MH-1436	55.3	MH-817	55.25	0.003	16	Circle	PVC	15 inch	2,107	811	38.5	2014
P-1446	MH-1444	56.11	MH-1436	55.4	0.006	114	Circle	PVC	15 inch	2,974	810	27.2	2014
P-1520	MH-1362	-8.2	MH-101	-8.25	0.004	14	Circle	PVC	36 inch	23,256	2,485	10.7	2014
P-1524	MH-686	106.58	MH-1105	103.56	0.011	285	Circle	PVC	8 inch	726	3	0.4	
P-1525	MH-1196	-6.16	MH-1471	-6.6	0.007	60	Circle	PVC	12 inch	1,780	135	7.6	2014
P-1526	MH-693	-6.03	MH-1471	-6.6	0.005	115	Circle	PVC	10 inch	900	8	0.9	
P-1527	MH-1472	-5.03	MH-693	-5.93	0.004	225	Circle	PVC	10 inch	808	6	0.7	
P-1528	MH-696	2.23	MH-695	-3.93	0.024	258	Circle	PVC	8 inch	1,089	2	0.2	
P-1529	MH-413	207.26	MH-1475	194.94	0.052	235	Circle	PVC	8 inch	1,614	6	0.3	
P-1530	MH-1476	203.05	MH-699	202.35	0.011	66	Circle	PVC	8 inch	726	6	0.8	
P-1531	MH-702	195.96	MH-1475	194.94	0.004	256	Circle	PVC	8 inch	445	8	1.9	
P-1532	MH-1477	197.73	MH-703	196.43	0.004	325	Circle	PVC	8 inch	446	3	0.6	
P-1533	MH-705	32.48	MH-837	32	0.007	64	Circle	PVC	15 inch	3,264	872	26.7	
P-1534	MH-1478	38.98	MH-707	45.12	0.016	393	Circle	PVC	15 inch	4,711	869	18.4	
P-1535	MH-831	45.42	MH-707	45.22	0.005	38	Circle	PVC	15 inch	2,734	867	31.7	
P-1536	MH-1479	55.84	MH-1444	55.74	0.005	19	Circle	PVC	15 inch	2,734	808	29.6	
P-1537	MH-1480	64.1	MH-709	61.73	0.01	249	Circle	PVC	15 inch	3,677.02	805.1	21.9	
P-1538	MH-811	65.75	MH-711	65.56	0.005	37	Circle	PVC	15 inch	2,700.83	734.58	27.2	
P-1600	MH-656	140.25	MH-1700	133.8	0.087	74	Circle	PVC	12 inch	6,137.04	51.28	0.8	2014
P-1601	MH-658	134.5	MH-1700	133.8	0.009	74	Circle	PVC	12 inch	2,021.75	346.11	17.1	2014
P-1603	MH-1701	132.4	MH-326	131.6	0.012	66	Circle	PVC	12 inch	2,288.59	397.39	17.4	2014
P-1604	MH-1700	133.7	MH-1701	132.5	0.009	128	Circle	PVC	12 inch	2,012.71	397.39	19.7	2014
P-1605	MH-459	135.4	MH-658	134.6	0.006	140	Circle	PVC	12 inch	1,571.36	343.3	21.8	2014
P-1606	MH-322	104.46	MH-1703	103.55	0.005	180	Circle	PVC	12 inch	1,478.02	459.53	31.1	2014
P-1607	MH-1703	103.45	MH-1704	102.7	0.006	135	Circle	PVC	12 inch	1,549.38	459.53	29.7	2014
P-1608	MH-1704	102.6	MH-1705	101.45	0.005	211	Circle	PVC	12 inch	1,534.63	459.53	29.9	2014

2021 (6-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1609	MH-1705	101.35	MH-1706	100.05	0.005	240	Circle	PVC	12 inch	1,529.89	459.53	30	2014
P-1610	MH-1706	99.95	MH-1707	98.2	0.006	275	Circle	PVC	12 inch	1,658.24	459.53	27.7	2014
P-1611	MH-1707	98.1	MH-1708	96.2	0.007	270	Circle	PVC	12 inch	1,743.77	459.53	26.4	2014
P-1612	MH-1708	96.1	MH-1709	94.4	0.007	231	Circle	PVC	12 inch	1,783.25	503.38	28.2	2014
P-1613	MH-1709	94.3	MH-1710	92.35	0.007	296	Circle	PVC	12 inch	1,687.20	503.38	29.8	2014
P-1614	MH-1710	92.25	MH-1711	90.7	0.007	238	Circle	PVC	12 inch	1,677.54	503.38	30	2014
P-1615	MH-1711	90.6	MH-1712	88.65	0.007	281	Circle	PVC	12 inch	1,731.64	503.38	29.1	2014
P-1616	MH-1712	88.55	MH-792	86.56	0.007	282	Circle	PVC	12 inch	1,746.21	503.38	28.8	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-21	MH-19	234.62	MH-20	228.59	0.046	131	Circle	PVC	8 inch	1,164	2	0.2	
P-23	MH-20	228.49	MH-22	215.96	0.06	209	Circle	PVC	8 inch	1,328	3	0.2	
P-26	MH-22	215.86	MH-25	188.81	0.117	232	Circle	PVC	8 inch	1,852	4	0.2	
P-28	MH-25	179.83	MH-27	164.06	0.145	109	Circle	PVC	8 inch	2,063	7	0.3	
P-30	MH-27	164.06	MH-29	151.94	0.098	124	Circle	PVC	8 inch	1,696	8	0.5	
P-32	MH-29	151.84	MH-31	139.99	0.119	100	Circle	PVC	8 inch	1,867	9	0.5	
P-34	MH-31	139.99	MH-33	139.89	0.001	113	Circle	PVC	8 inch	161	10	6.2	
P-36	MH-33	139.89	MH-35	133.12	0.041	166	Circle	PVC	8 inch	1,095	12	1.1	
P-38	MH-35	133.02	MH-37	127.2	0.03	195	Circle	PVC	8 inch	937	14	1.5	
P-40	MH-37	126	MH-39	121.64	0.023	186	Circle	PVC	8 inch	830	15	1.8	
P-42	MH-39	121.54	MH-41	120.21	0.005	271	Circle	PVC	8 inch	380	19	5.1	
P-44	MH-41	120.11	MH-43	118.75	0.005	267	Circle	PVC	8 inch	387	24	6.2	
P-46	MH-43	118.65	MH-45	118.22	0.005	84	Circle	PVC	8 inch	388	27	7	
P-48	MH-45	118.12	MH-47	117.06	0.005	211	Circle	PVC	8 inch	384	28	7.3	
P-50	MH-47	116.96	MH-49	116.8	0.009	18	Circle	PVC	8 inch	511	29	5.7	
P-52	MH-49	117.07	MH-51	114.49	0.018	147	Circle	PVC	12 inch	2,754	571	20.7	2035
P-54	MH-51	114.49	MH-53	110.02	0.016	277	Circle	PVC	12 inch	2,641	572	21.7	2035
P-56	MH-53	110.02	MH-55	106.76	0.065	50	Circle	Concrete	8 inch	1,385	576	41.6	
P-58	MH-55	106.76	MH-57	95.81	0.07	157	Circle	Concrete	8 inch	1,432	577	40.3	
P-60	MH-57	95.81	MH-59	85.38	0.083	125	Circle	Concrete	8 inch	1,567	578	36.9	
P-62	MH-59	85.38	MH-61	72.78	0.093	136	Circle	Concrete	8 inch	1,651	579	35.1	
P-64	MH-61	72.78	MH-63	66.2	0.076	87	Circle	Concrete	8 inch	1,492	583	39.1	
P-68	MH-65	43	MH-67	41.96	0.004	249	Circle	Concrete	8 inch	351	4	1.1	
P-70	MH-67	41.86	MH-69	26.74	0.075	202	Circle	Concrete	8 inch	1,484	879	59.3	
P-72	MH-69	26.74	MH-71	19.77	0.071	98	Circle	Concrete	8 inch	1,446	883	61.1	
P-78	MH-75	-4.53	MH-77	-5.51	0.004	253	Circle	Asbestos Cement	14 inch	1,774	10	0.6	
P-80	MH-77	-5.51	MH-79	-6.29	0.002	363	Circle	Cast iron	14 inch	1,211	12	1	
P-82	MH-79	-6.29	MH-81	-6.72	0.001	409	Circle	Asbestos Cement	14 inch	924	14	1.5	
P-84	MH-81	-6.72	MH-83	-7.12	0.003	132	Circle	Asbestos Cement	14 inch	1,569	21	1.4	
P-86	MH-83	-7.12	MH-85	-7.95	0.003	297	Circle	Asbestos Cement	14 inch	1,507	46	3	
P-88	MH-85	-7.95	MH-87	-8.58	0.002	323	Circle	Asbestos Cement	14 inch	1,259	49	3.9	
P-90	MH-87	-8.27	MH-89	-9.07	0.002	343	Circle	Asbestos Cement	14 inch	1,377	60	4.4	
P-92	MH-89	-9.07	MH-91	-10.11	0.003	342	Circle	Asbestos Cement	14 inch	1,572	64	4	
P-94	MH-91	-10.11	MH-93	-10.32	0.001	284	Circle	PVC	15 inch	1,025	103	10.1	2014
P-100	MH-97	-11.33	MH-99	-12.08	0.003	291	Circle	PVC	15 inch	1,913	132	6.9	2014
P-102	MH-99	-13.2	MH-101	-13.29	0	245	Circle	PVC	24 inch	2,530	660	26.1	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-104	MH-103	190.8	MH-25	188.81	0.017	119	Circle	PVC	8 inch	701	1	0.2	
P-124	MH-122	240.58	MH-123	237.2	0.01	343	Circle	PVC	8 inch	538	24	4.5	
P-126	MH-123	237.2	MH-125	225.96	0.037	305	Circle	PVC	8 inch	1,041	372	35.8	
P-128	MH-125	225.8	MH-127	206.99	0.047	400	Circle	PVC	8 inch	1,176	374	31.8	
P-130	MH-127	206.87	MH-129	196.08	0.027	400	Circle	PVC	8 inch	891	377	42.3	
P-132	MH-129	196.08	MH-131	184.48	0.032	362	Circle	PVC	8 inch	971	379	39	
P-134	MH-131	184.38	MH-133	183.38	0.024	42	Circle	PVC	8 inch	837	437	52.2	
P-136	MH-133	182.62	MH-135	174.75	0.025	314	Circle	PVC	15 inch	4,590	438	9.5	
P-138	MH-135	174.68	MH-137	173.14	0.005	327	Circle	PVC	15 inch	1,990	440	22.1	
P-140	MH-137	173.06	MH-139	171.81	0.005	252	Circle	PVC	15 inch	2,042	442	21.7	
P-142	MH-139	171.74	MH-141	169.66	0.005	401	Circle	PVC	15 inch	2,088	511	24.5	
P-144	MH-141	169.58	MH-143	168.74	0.004	205	Circle	PVC	15 inch	1,856	512	27.6	
P-146	MH-143	168.72	MH-145	167.22	0.005	291	Circle	PVC	15 inch	2,082	526	25.3	
P-148	MH-145	167.18	MH-147	139.79	0.069	397	Circle	PVC	15 inch	7,615	530	7	
P-150	MH-147	139.66	MH-149	136.31	0.01	336	Circle	PVC	15 inch	2,895	532	18.4	
P-152	MH-149	136.22	MH-151	135.04	0.012	100	Circle	PVC	15 inch	3,149	534	16.9	
P-154	MH-151	134.87	MH-153	131.93	0.022	134	Circle	PVC	15 inch	4,294	535	12.4	
P-156	MH-153	131.83	MH-155	131.09	0.007	100	Circle	PVC	15 inch	3,242	538	16.6	
P-158	MH-155	130.99	MH-157	122.09	0.036	249	Circle	PVC	15 inch	7,126	539	7.6	
P-159	MH-157	122.09	MH-49	117.19	0.016	310	Circle	PVC	15 inch	4,738	541	11.4	
P-162	MH-160	132.95	MH-161	132.4	0.002	242	Circle	PVC	12 inch	762	1	0.2	
P-163	MH-161	132.4	MH-153	132.25	0.002	72	Circle	PVC	12 inch	730	3	0.3	
P-166	MH-164	123.49	MH-165	122.73	0.004	191	Circle	PVC	8 inch	342	1	0.3	
P-168	MH-165	122.63	MH-167	122.15	0.004	124	Circle	PVC	8 inch	337	2	0.7	
P-169	MH-167	122.05	MH-39	120.77	0.004	328	Circle	PVC	8 inch	339	3	1	
P-172	MH-170	122.82	MH-171	121.62	0.004	301	Circle	PVC	8 inch	342	1	0.3	
P-174	MH-171	121.52	MH-173	120.85	0.004	167	Circle	PVC	8 inch	344	2	0.7	
P-175	MH-173	120.85	MH-41	120.21	0.002	286	Circle	PVC	8 inch	257	3	1.3	
P-178	MH-176	224.22	MH-177	222.68	0.005	305	Circle	PVC	8 inch	385	22	5.7	
P-180	MH-177	222.68	MH-179	218.82	0.013	308	Circle	PVC	8 inch	607	25	4	
P-182	MH-179	218.82	MH-181	214.41	0.018	239	Circle	PVC	8 inch	737	27	3.7	
P-184	MH-181	214.41	MH-183	202.48	0.056	212	Circle	PVC	8 inch	1,287	33	2.6	
P-186	MH-183	202.48	MH-185	194.44	0.039	206	Circle	PVC	8 inch	1,071	36	3.4	
P-188	MH-185	194.44	MH-187	161.6	0.699	47	Circle	PVC	8 inch	4,533	39	0.9	
P-190	MH-187	191.6	MH-189	190.78	0.005	162	Circle	PVC	8 inch	386	41	10.7	
P-192	MH-189	190.78	MH-191	184.15	0.042	157	Circle	PVC	8 inch	1,115	46	4.2	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-194	MH-191	184.15	MH-193	161.51	0.081	279	Circle	PVC	8 inch	1,545	49	3.2	
P-196	MH-193	161.51	MH-195	154.32	0.171	42	Circle	PVC	8 inch	2,244	52	2.3	
P-198	MH-195	154.32	MH-197	143.68	0.083	128	Circle	PVC	8 inch	2,033	54	2.7	2014
P-200	MH-197	143.58	MH-199	141	0.031	84	Circle	PVC	8 inch	1,236	57	4.6	2014
P-202	MH-199	139.9	MH-201	131.1	0.027	324	Circle	PVC	8 inch	1,162	60	5.1	2014
P-204	MH-201	131	MH-203	124.76	0.013	476	Circle	PVC	8 inch	807	62	7.7	2014
P-206	MH-203	124.66	MH-205	119.6	0.018	276	Circle	PVC	8 inch	955	70	7.3	2014
P-208	MH-205	119.5	MH-207	119.06	0.019	23	Circle	PVC	8 inch	975	72	7.4	2014
P-210	MH-207	118.96	MH-209	117.37	0.006	263	Circle	PVC	12 inch	1,616	227	14	2014
P-212	MH-209	117.27	MH-211	115.62	0.006	275	Circle	PVC	12 inch	1,610	229	14.2	2014
P-214	MH-211	115.52	MH-213	113.3	0.006	366	Circle	PVC	12 inch	1,619	242	15	2014
P-216	MH-213	113.2	MH-215	105.58	0.027	278	Circle	PVC	12 inch	2,647	257	9.7	
P-218	MH-215	105.48	MH-217	101.95	0.01	353	Circle	PVC	12 inch	1,599	271	16.9	
P-220	MH-217	101.7	MH-219	101.6	0.007	15	Circle	PVC	12 inch	1,306	273	20.9	
P-222	MH-219	101.5	MH-221	94.51	0.097	72	Circle	Concrete	8 inch	1,690	275	16.3	
P-230	MH-228	126.83	MH-229	125.31	0.005	308	Circle	Concrete	8 inch	381	2	0.6	
P-232	MH-229	123.21	MH-231	123.14	0	409	Circle	Concrete	8 inch	71	4	6.1	
P-234	MH-231	123.04	MH-233	119.5	0.017	205	Circle	PVC	8 inch	713	6	0.9	
P-236	MH-233	119.4	MH-235	116.1	0.015	218	Circle	PVC	8 inch	667	10	1.4	
P-237	MH-235	116	MH-211	115.62	0.013	30	Circle	PVC	8 inch	610	11	1.9	
P-240	MH-238	132	MH-239	130.1	0.015	126	Circle	PVC	8 inch	666	15	2.3	
P-242	MH-239	130	MH-241	120.1	0.029	337	Circle	PVC	8 inch	930	17	1.8	
P-247	MH-245	244.65	MH-246	240.69	0.011	365	Circle	PVC	8 inch	565	2	0.3	
P-249	MH-246	240.59	MH-248	230.55	0.102	98	Circle	PVC	8 inch	1,736	4	0.2	
P-251	MH-248	230.45	MH-250	219.1	0.028	400	Circle	PVC	8 inch	914	6	0.6	
P-253	MH-250	210.6	MH-252	208.76	0.006	288	Circle	PVC	8 inch	434	14	3.3	
P-255	MH-252	208.66	MH-254	194.58	0.054	263	Circle	PVC	8 inch	1,255	16	1.3	
P-257	MH-254	194.48	MH-256	182.94	0.05	230	Circle	PVC	8 inch	1,215	18	1.5	
P-259	MH-256	182.84	MH-258	181.42	0.004	360	Circle	PVC	8 inch	341	27	8.1	
P-261	MH-258	181.32	MH-260	161.9	0.071	272	Circle	PVC	10 inch	2,627	38	1.4	
P-263	MH-260	161.8	MH-262	147.91	0.131	106	Circle	PVC	10 inch	3,560	39	1.1	
P-265	MH-262	147.66	MH-264	134.16	0.042	320	Circle	PVC	10 inch	2,020	50	2.5	
P-267	MH-264	134.06	MH-266	125.91	0.025	324	Circle	PVC	10 inch	1,560	59	3.8	
P-269	MH-266	125.71	MH-268	124.75	0.004	271	Circle	Steel	12 inch	952	84	8.9	
P-271	MH-268	124.5	MH-270	123.36	0.004	307	Circle	Steel	12 inch	974	86	8.9	
P-273	MH-270	123.26	MH-272	121.9	0.003	401	Circle	Steel	12 inch	931	130	14	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-275	MH-272	121.8	MH-274	120.44	0.003	401	Circle	Steel	12 inch	931	132	14.2	
P-276	MH-274	120.34	MH-207	119.06	0.003	375	Circle	Steel	12 inch	934	134	14.3	
P-279	MH-277	124	MH-278	116	0.017	464	Circle	PVC	6 inch	331	2	0.6	
P-288	MH-286	127.72	MH-287	126.43	0.004	300	Circle	PVC	8 inch	356	3	0.7	
P-289	MH-287	126.43	MH-203	124.76	0.006	300	Circle	PVC	8 inch	405	5	1.3	
P-292	MH-290	160.16	MH-291	160.04	0.005	23	Circle	PVC	8 inch	392	3	0.8	
P-294	MH-291	159.94	MH-293	153.99	0.048	125	Circle	PVC	8 inch	1,183	5	0.4	
P-295	MH-293	153.43	MH-262	145.67	0.031	253	Circle	PVC	8 inch	950	9	0.9	
P-297	MH-296	154.4	MH-293	153.53	0.031	28	Circle	PVC	8 inch	956	2	0.2	
P-300	MH-298	223.33	MH-299	213.27	0.04	253	Circle	PVC	8 inch	1,081	2	0.2	
P-302	MH-299	213.17	MH-301	212.79	0.004	93	Circle	PVC	8 inch	347	4	1.1	
P-303	MH-301	212.69	MH-250	210.7	0.013	159	Circle	PVC	8 inch	607	6	0.9	
P-306	MH-304	126.25	MH-43	118.75	0.025	304	Circle	PVC	8 inch	852	2	0.2	
P-309	MH-307	143.9	MH-308	141.24	0.03	90	Circle	PVC	8 inch	932	2	0.2	
P-311	MH-308	141.2	MH-310	125.96	0.049	312	Circle	PVC	8 inch	1,199	4	0.3	
P-313	MH-310	125.74	MH-312	116.72	0.032	282	Circle	PVC	12 inch	3,718	539	14.5	2021
P-315	MH-312	116.62	MH-314	116.19	0.007	58	Circle	PVC	12 inch	1,790	541	30.2	2021
P-317	MH-314	116.14	MH-316	113.49	0.014	189	Circle	PVC	12 inch	2,461	543	22.1	2021
P-319	MH-316	113.26	MH-318	109.89	0.015	227	Circle	PVC	12 inch	2,533	555	21.9	2021
P-321	MH-318	109.82	MH-320	109.48	0.006	54	Circle	PVC	12 inch	1,649	565	34.3	2021
P-323	MH-320	109.45	MH-322	108.34	0.005	220	Circle	PVC	12 inch	1,477	567	38.4	2021
P-328	MH-326	135.65	MH-327	129.51	0.038	162	Circle	PVC	12 inch	4,047	529	13.1	2021
P-330	MH-327	129.35	MH-329	127.37	0.025	78	Circle	PVC	12 inch	3,312	531	16	2021
P-331	MH-329	127.3	MH-310	125.92	0.011	124	Circle	PVC	12 inch	2,193	533	24.3	2021
P-334	MH-332	155.87	MH-333	148.67	0.05	145	Circle	PVC	8 inch	1,209	2	0.2	
P-336	MH-333	148.6	MH-335	134.6	0.063	223	Circle	PVC	8 inch	1,359	4	0.3	
P-338	MH-335	134.54	MH-337	129.68	0.032	150	Circle	PVC	8 inch	976	6	0.6	
P-340	MH-337	129.66	MH-339	118.75	0.053	206	Circle	PVC	8 inch	1,248	8	0.6	
P-341	MH-339	118.72	MH-316	113.43	0.056	94	Circle	PVC	8 inch	1,287	10	0.8	
P-344	MH-342	151.34	MH-343	149.82	0.022	69	Circle	PVC	8 inch	805	2	0.2	
P-346	MH-343	149.65	MH-345	134.49	0.057	264	Circle	PVC	8 inch	1,300	4	0.3	
P-348	MH-345	134.49	MH-347	127.94	0.043	151	Circle	PVC	8 inch	1,130	6	0.5	
P-349	MH-347	127.84	MH-318	109.89	0.079	227	Circle	PVC	8 inch	1,525	8	0.5	
P-352	MH-350	144	MH-351	141.69	0.025	92	Circle	PVC	8 inch	859	2	0.2	
P-354	MH-351	141.61	MH-353	133.61	0.04	201	Circle	PVC	8 inch	1,082	4	0.4	
P-356	MH-353	133.6	MH-355	126.19	0.028	269	Circle	PVC	8 inch	900	6	0.7	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-358	MH-355	126.15	MH-357	120.57	0.03	187	Circle	PVC	8 inch	937	8	0.9	
P-360	MH-357	120.26	MH-359	116.05	0.03	142	Circle	PVC	8 inch	934	12	1.3	
P-361	MH-359	115.93	MH-322	108.45	0.057	132	Circle	PVC	8 inch	1,291	14	1.1	
P-363	MH-362	124.05	MH-357	120.22	0.023	170	Circle	PVC	8 inch	814	2	0.2	
P-366	MH-364	142.26	MH-365	134.78	0.034	221	Circle	PVC	8 inch	998	2	0.2	
P-368	MH-365	134.73	MH-367	128.57	0.027	231	Circle	PVC	8 inch	886	4	0.5	
P-369	MH-367	128.57	MH-322	108.47	0.097	207	Circle	PVC	8 inch	1,690	6	0.4	
P-372	MH-370	230.75	MH-371	224.6	0.079	78	Circle	PVC	8 inch	1,523	1	0.1	
P-374	MH-371	224.43	MH-373	201.79	0.081	278	Circle	PVC	8 inch	1,548	2	0.1	
P-376	MH-373	201.7	MH-375	196.85	0.016	301	Circle	PVC	8 inch	688	3	0.4	
P-378	MH-375	196.72	MH-377	179.76	0.068	249	Circle	PVC	8 inch	1,415	10	0.7	
P-380	MH-377	179.56	MH-379	155.67	0.089	267	Circle	PVC	8 inch	1,622	11	0.7	
P-382	MH-379	155.55	MH-381	139.74	0.108	147	Circle	PVC	8 inch	1,779	12	0.7	
P-384	MH-381	139.43	MH-383	131.82	0.035	219	Circle	PVC	12 inch	2,981	20	0.7	
P-386	MH-383	131.66	MH-385	131.33	0.016	20	Circle	PVC	12 inch	2,054	36	1.7	
P-388	MH-385	131.26	MH-387	125.21	0.098	62	Circle	PVC	12 inch	4,995	36	0.7	
P-390	MH-389	125.59	MH-387	125.21	0.007	58	Circle	PVC	12 inch	1,294	36	2.8	
P-392	MH-391	131.26	MH-385	130.79	0.011	42	Circle	PVC	12 inch	1,692	0	0	
P-394	MH-393	197.93	MH-375	196.75	0.009	128	Circle	PVC	8 inch	521	7	1.3	
P-397	MH-395	226.27	MH-396	221.56	0.044	106	Circle	PVC	8 inch	1,143	1	0.1	
P-399	MH-396	221.36	MH-398	216.32	0.048	106	Circle	PVC	8 inch	1,183	2	0.1	
P-401	MH-398	216.08	MH-400	212.33	0.046	81	Circle	PVC	8 inch	1,167	3	0.3	
P-403	MH-400	212.21	MH-402	194.02	0.046	399	Circle	PVC	8 inch	1,158	4	0.3	
P-405	MH-402	193.84	MH-404	179.16	0.045	327	Circle	PVC	8 inch	1,149	5	0.5	
P-407	MH-404	179.02	MH-406	161.08	0.053	338	Circle	PVC	8 inch	1,249	6	0.5	
P-408	MH-406	161	MH-381	139.74	0.055	387	Circle	PVC	8 inch	1,271	8	0.6	
P-410	MH-409	165.94	MH-406	161.08	0.014	350	Circle	PVC	8 inch	639	1	0.1	
P-412	MH-411	198.2	MH-402	193.94	0.029	145	Circle	PVC	8 inch	930	1	0.1	
P-467	MH-465	179.62	MH-466	178.85	0.007	112	Circle	PVC	8 inch	450	1	0.2	
P-469	MH-466	178.85	MH-468	171.09	0.032	239	Circle	PVC	8 inch	977	2	0.2	
P-471	MH-468	170.92	MH-470	160.08	0.037	293	Circle	PVC	8 inch	1,043	2	0.2	
P-473	MH-470	159.94	MH-472	159.08	0.005	159	Circle	PVC	8 inch	399	3	0.8	
P-475	MH-472	159.03	MH-474	158.19	0.006	146	Circle	PVC	8 inch	411	4	1	
P-477	MH-474	157.88	MH-476	156.37	0.004	359	Circle	PVC	8 inch	352	9	2.5	
P-479	MH-476	156.21	MH-478	155.85	0.005	71	Circle	PVC	8 inch	386	10	2.5	
P-481	MH-478	155.85	MH-480	155.15	0.004	180	Circle	PVC	8 inch	338	10	3.1	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-483	MH-480	155.02	MH-482	154.72	0.005	64	Circle	PVC	8 inch	371	11	3	
P-485	MH-482	154.72	MH-484	152.33	0.035	69	Circle	PVC	8 inch	1,009	12	1.2	
P-487	MH-484	152.33	MH-486	146.91	0.022	244	Circle	PVC	8 inch	808	13	1.6	
P-489	MH-486	146.6	MH-488	138.64	0.031	256	Circle	PVC	12 inch	2,820	14	0.5	
P-490	MH-488	138.5	MH-383	131.82	0.035	193	Circle	PVC	12 inch	2,975	14	0.5	
P-493	MH-491	191.11	MH-492	182.09	0.032	282	Circle	PVC	8 inch	970	1	0.1	
P-495	MH-492	181.98	MH-494	180.01	0.007	282	Circle	PVC	8 inch	453	2	0.4	
P-497	MH-494	179.94	MH-496	179	0.006	150	Circle	PVC	8 inch	429	2	0.6	
P-499	MH-496	178.93	MH-498	174.07	0.021	230	Circle	PVC	8 inch	788	3	0.4	
P-500	MH-498	173.93	MH-474	158.13	0.061	260	Circle	PVC	8 inch	1,337	4	0.3	
P-513	MH-511	186.12	MH-512	183.48	0.01	276	Circle	PVC	8 inch	530	3	0.5	
P-515	MH-512	183.18	MH-514	181.06	0.006	382	Circle	PVC	8 inch	404	6	1.4	
P-517	MH-514	180.95	MH-516	179.74	0.007	166	Circle	PVC	8 inch	463	11	2.4	
P-519	MH-516	185.06	MH-518	183.46	0.004	401	Circle	PVC	10 inch	621	20	3.2	
P-520	MH-518	183.36	MH-431	181.58	0.004	399	Circle	PVC	10 inch	657	22	3.4	
P-523	MH-521	193	MH-522	190.1	0.011	268	Circle	PVC	8 inch	564	3	0.5	
P-525	MH-522	190	MH-524	189.1	0.014	65	Circle	PVC	8 inch	638	6	0.9	
P-527	MH-524	189	MH-526	187.1	0.008	250	Circle	PVC	8 inch	473	11	2.4	
P-528	MH-526	187	MH-427	185	0.008	249	Circle	PVC	8 inch	486	14	2.9	
P-530	MH-529	190.75	MH-524	189.1	0.016	101	Circle	PVC	8 inch	693	3	0.4	
P-532	MH-531	192.81	MH-514	189.44	0.01	343	Circle	PVC	8 inch	538	3	0.5	
P-534	MH-533	189	MH-425	187.6	0.008	173	Circle	PVC	8 inch	488	3	0.6	
P-536	MH-535	186.97	MH-429	182.6	0.013	348	Circle	PVC	8 inch	608	3	0.5	
P-539	MH-537	181.15	MH-538	179.99	0.005	211	Circle	PVC	8 inch	402	3	0.7	
P-541	MH-538	179.89	MH-540	177.66	0.01	218	Circle	PVC	8 inch	549	6	1	
P-543	MH-540	177.56	MH-542	177.25	0.005	58	Circle	PVC	8 inch	397	8	2.1	
P-545	MH-542	177.15	MH-544	175.1	0.015	141	Circle	PVC	8 inch	654	11	1.7	
P-547	MH-544	175	MH-546	172.2	0.009	324	Circle	PVC	8 inch	504	14	2.8	
P-548	MH-546	171.98	MH-437	169.85	0.006	345	Circle	PVC	8 inch	426	28	6.6	
P-551	MH-549	180.72	MH-550	178.72	0.021	97	Circle	PVC	8 inch	779	3	0.4	
P-553	MH-550	178.62	MH-552	177.73	0.006	148	Circle	PVC	8 inch	421	6	1.3	
P-555	MH-552	177.63	MH-554	176.62	0.006	169	Circle	PVC	8 inch	419	8	2	
P-556	MH-554	176.52	MH-546	172.2	0.016	278	Circle	PVC	8 inch	676	11	1.7	
P-559	MH-557	202.17	MH-558	201.77	0.005	76	Circle	PVC	8 inch	393	3	0.7	
P-561	MH-558	201.77	MH-560	199.93	0.005	400	Circle	PVC	8 inch	368	6	1.5	
P-563	MH-560	199.83	MH-562	195.7	0.012	346	Circle	PVC	8 inch	593	32	5.4	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-565	MH-562	196.23	MH-564	195.93	0.004	77	Circle	PVC	8 inch	339	35	10.3	
P-567	MH-564	195.83	MH-566	194.35	0.004	375	Circle	PVC	8 inch	341	38	11.1	
P-569	MH-566	194.23	MH-568	193.79	0.005	86	Circle	PVC	8 inch	388	40	10.4	
P-571	MH-568	193.79	MH-570	192.42	0.005	288	Circle	PVC	8 inch	374	43	11.6	
P-573	MH-570	199.35	MH-572	176.21	0.062	373	Circle	PVC	8 inch	1,351	74	5.5	
P-575	MH-572	176.11	MH-574	173.45	0.009	281	Circle	PVC	8 inch	528	77	14.5	
P-576	MH-574	173.35	MH-441	171.25	0.005	400	Circle	PVC	8 inch	393	79	20.2	
P-579	MH-577	252.92	MH-578	241.07	0.049	240	Circle	PVC	8 inch	1,205	16	1.4	
P-581	MH-578	240.97	MH-580	227.6	0.088	152	Circle	PVC	8 inch	1,608	19	1.2	
P-583	MH-580	227.5	MH-582	202.51	0.062	400	Circle	PVC	8 inch	1,356	25	1.8	
P-584	MH-582	202.41	MH-570	199.45	0.052	57	Circle	PVC	8 inch	1,236	28	2.2	
P-586	MH-585	233.68	MH-580	227.6	0.035	174	Circle	PVC	8 inch	1,014	3	0.3	
P-589	MH-587	234.47	MH-588	214.64	0.118	168	Circle	PVC	8 inch	1,863	3	0.2	
P-591	MH-588	214.54	MH-590	213.28	0.027	47	Circle	PVC	8 inch	888	6	0.6	
P-593	MH-590	213.18	MH-592	209.06	0.02	210	Circle	PVC	8 inch	760	8	1.1	
P-595	MH-592	208.96	MH-594	208.37	0.005	109	Circle	PVC	8 inch	399	11	2.8	
P-596	MH-594	208.27	MH-560	203.62	0.058	80	Circle	PVC	8 inch	1,308	14	1.1	
P-598	MH-597	226.56	MH-560	203.62	0.08	287	Circle	PVC	8 inch	1,533	9	0.6	
P-601	MH-599	158.18	MH-600	156.69	0.004	393	Circle	PVC	8 inch	334	94	28.2	
P-603	MH-600	156.59	MH-602	154.76	0.012	158	Circle	PVC	8 inch	584	97	16.7	
P-605	MH-602	154.66	MH-604	154.21	0.015	31	Circle	PVC	8 inch	653	100	15.3	
P-607	MH-604	154.11	MH-606	152.05	0.074	28	Circle	PVC	8 inch	1,471	103	7	
P-609	MH-606	152.05	MH-608	149.86	0.012	188	Circle	PVC	8 inch	585	106	18.1	
P-610	MH-608	149.86	MH-445	149.66	0.005	41	Circle	PVC	8 inch	379	109	28.7	
P-613	MH-611	163.36	MH-612	161.87	0.106	14	Circle	PVC	6 inch	822	3	0.3	
P-615	MH-612	161.77	MH-614	154.19	0.032	239	Circle	PVC	8 inch	966	8	0.9	
P-617	MH-614	154.09	MH-616	153.13	0.004	243	Circle	PVC	8 inch	341	11	3.3	
P-619	MH-616	153.03	MH-618	152.46	0.005	125	Circle	PVC	8 inch	366	17	4.6	
P-620	MH-618	152.36	MH-447	149.04	0.026	128	Circle	PVC	8 inch	873	20	2.2	
P-623	MH-621	154.04	MH-622	140.78	0.044	304	Circle	PVC	8 inch	1,133	3	0.2	
P-624	MH-622	140.62	MH-453	137.71	0.037	78	Circle	PVC	8 inch	1,048	6	0.5	
P-627	MH-625	143.5	MH-626	139.83	0.009	400	Circle	PVC	8 inch	519	3	0.5	
P-629	MH-626	139.75	MH-628	136.93	0.033	86	Circle	PVC	8 inch	982	14	1.4	
P-631	MH-628	136.87	MH-630	136.04	0.008	107	Circle	PVC	8 inch	478	17	3.5	
P-632	MH-630	135.99	MH-457	135.25	0.007	104	Circle	PVC	8 inch	457	20	4.3	
P-635	MH-633	157.79	MH-634	156.13	0.011	153	Circle	PVC	8 inch	565	3	0.5	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-637	MH-634	156.04	MH-636	146.32	0.028	348	Circle	PVC	8 inch	906	6	0.6	
P-638	MH-636	146.26	MH-626	139.92	0.034	187	Circle	PVC	8 inch	999	8	0.8	
P-640	MH-639	164.36	MH-612	161.87	0.035	72	Circle	PVC	6 inch	468	3	0.6	
P-642	MH-641	159.22	MH-616	153.13	0.055	110	Circle	PVC	8 inch	1,276	3	0.2	
P-645	MH-643	169.21	MH-644	167.81	0.007	196	Circle	PVC	8 inch	458	38	8.2	
P-647	MH-644	167.26	MH-646	165.55	0.007	252	Circle	PVC	8 inch	447	40	9.1	
P-649	MH-646	166.72	MH-648	164.43	0.013	172	Circle	PVC	8 inch	626	43	6.9	
P-651	MH-648	164.33	MH-650	162.57	0.007	244	Circle	PVC	8 inch	461	57	12.4	
P-653	MH-650	162.47	MH-652	158.81	0.015	240	Circle	PVC	8 inch	670	60	9	
P-655	MH-652	158.71	MH-654	143.06	0.043	360	Circle	PVC	8 inch	1,131	68	6	
P-657	MH-654	142.96	MH-656	140.35	0.029	90	Circle	PVC	8 inch	924	71	7.6	
P-663	MH-661	156.46	MH-662	154.06	0.02	118	Circle	PVC	8 inch	773	3	0.4	
P-665	MH-662	153.96	MH-664	144.93	0.024	374	Circle	PVC	8 inch	843	6	0.7	
P-666	MH-664	144.84	MH-451	144.31	0.013	42	Circle	PVC	8 inch	609	8	1.4	
P-669	MH-667	199.97	MH-668	196.79	0.028	113	Circle	PVC	8 inch	910	3	0.3	
P-671	MH-668	196.69	MH-670	180.94	0.059	267	Circle	PVC	8 inch	1,317	6	0.4	
P-673	MH-670	180.84	MH-672	172.51	0.067	124	Circle	PVC	8 inch	1,406	8	0.6	
P-674	MH-672	172.41	MH-648	164.43	0.06	134	Circle	PVC	8 inch	1,324	11	0.8	
P-676	MH-675	186.46	MH-516	185.16	0.008	164	Circle	PVC	10 inch	875	6	0.6	
P-679	MH-677	125.79	MH-678	121.09	0.017	269	Circle	Concrete	8 inch	717	1	0.2	
P-680	MH-678	121.09	MH-53	110.25	0.037	293	Circle	Concrete	8 inch	1,043	2	0.2	
P-681	MH-101	-8.25	WW-MAIN	-10.67	0.033	74	Circle	PVC	36 inch	70,374	3,841	5.5	2014
P-682	MH-1136	26	WW-PIONEER	22	0.045	88	Circle	PVC	30 inch	39,248	154	0.4	
P-683	MH-681	109	MH-682	83.64	0.078	324	Circle	Concrete	8 inch	1,517	1	0.1	
P-684	MH-682	83.28	MH-61	72.78	0.048	219	Circle	Concrete	8 inch	1,188	3	0.2	
P-685	MH-387	125.12	WW-COPPER	122.5	0.114	23	Circle	PVC	30 inch	62,131	72	0.1	
P-688	MH-687	93.91	MH-223	85.51	0.06	141	Circle	Concrete	8 inch	1,324	2	0.1	
P-690	MH-689	95.43	MH-221	94.51	0.004	217	Circle	Concrete	8 inch	353	2	0.6	
P-693	MH-691	99.5	MH-692	80.2	0.102	190	Circle	Concrete	8 inch	1,729	3	0.2	
P-694	MH-419	189	MH-421	188.5	0.003	192	Circle	PVC	8 inch	277	31	11.1	
P-695	MH-95	-10.76	MH-97	-11.33	0.004	152	Circle	PVC	15 inch	2,308	129	5.6	2014
P-696	MH-694	82.5	MH-1473	71.2	0.05	224	Circle	Concrete	8 inch	1,218	2	0.2	
P-697	MH-278	115.9	MH-213	113.3	0.163	16	Circle	Concrete	8 inch	2,186	13	0.6	
P-698	MH-417	194	MH-419	189	0.056	90	Circle	PVC	8 inch	1,278	28	2.2	
P-699	MH-697	113	MH-698	105.3	0.022	351	Circle	PVC	8 inch	803	2	0.2	
P-700	MH-421	188.5	MH-423	187.5	0.004	285	Circle	PVC	8 inch	321	34	10.5	

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P-701	MH-698	105.2	MH-700	103.2	0.005	426	Circle	Concrete	8 inch	372	4	1	
P-702	MH-700	103.1	MH-692	80.1	0.052	442	Circle	Concrete	8 inch	1,237	30	2.4	
P-703	MH-692	80	MH-1473	71.3	0.053	164	Circle	Concrete	8 inch	1,249	35	2.8	
P-704	MH-1365	-7.65	MH-1364	-7.98	0.006	60	Circle	PVC	36 inch	28,860	3,145	10.9	2014
P-705	MH-1473	71.1	MH-704	27.8	0.115	378	Circle	Concrete	8 inch	1,836	39	2.1	
P-706	MH-423	187.5	MH-425	186	0.004	400	Circle	PVC	8 inch	332	36	11	
P-707	MH-704	27.6	MH-706	25.43	0.005	413	Circle	PVC	15 inch	2,732	1,260	46.1	2014
P-708	MH-425	186	MH-427	185	0.004	269	Circle	PVC	8 inch	331	42	12.7	
P-709	MH-706	25.33	MH-708	24.28	0.005	229	Circle	PVC	15 inch	2,552	1,262	49.5	2014
P-710	MH-427	185	MH-429	182.6	0.008	308	Circle	PVC	8 inch	479	59	12.3	
P-711	MH-708	24.18	MH-710	24.03	0.005	31	Circle	PVC	15 inch	2,622	1,264	48.2	2014
P-712	MH-429	182.5	MH-431	181.58	0.005	170	Circle	PVC	8 inch	399	65	16.2	
P-713	MH-710	23.93	MH-712	21.93	0.005	400	Circle	PVC	15 inch	2,665	1,266	47.5	2014
P-714	MH-712	21.83	MH-71	20.38	0.005	289	Circle	PVC	15 inch	2,670	1,301	48.7	2014
P-715	MH-431	181.48	MH-433	180.06	0.004	372	Circle	PVC	8 inch	335	90	26.8	
P-716	MH-715	28.38	MH-69	26.84	0.004	383	Circle	Concrete	8 inch	344	2	0.6	
P-717	MH-433	172.5	MH-435	170.19	0.006	392	Circle	PVC	8 inch	416	94	22.6	
P-718	MH-435	170.09	MH-437	169.7	0.004	91	Circle	PVC	8 inch	355	97	27.3	
P-720	MH-437	169.7	MH-439	169.13	0.005	112	Circle	PVC	8 inch	387	128	33.1	
P-722	MH-439	169.13	MH-441	167.9	0.007	175	Circle	PVC	8 inch	455	131	28.7	
P-724	MH-441	167.9	MH-443	164.82	0.013	244	Circle	PVC	8 inch	609	213	35	
P-726	MH-443	164.72	MH-445	157.16	0.027	280	Circle	PVC	8 inch	891	216	24.3	
P-728	MH-445	149.66	MH-447	149.1	0.012	47	Circle	PVC	8 inch	592	329	55.6	
P-729	MH-447	149	MH-449	145.9	0.014	217	Circle	PVC	8 inch	648	352	54.2	
P-730	MH-449	145.8	MH-451	144.66	0.004	258	Circle	PVC	12 inch	1,382	354	25.6	2021
P-732	MH-451	144.56	MH-453	137.93	0.022	308	Circle	PVC	12 inch	3,050	366	12	2021
P-733	MH-453	137.93	MH-455	136.8	0.004	265	Circle	PVC	12 inch	1,357	374	27.6	2021
P-736	MH-455	136.7	MH-457	136.1	0.003	175	Circle	PVC	12 inch	1,217	377	31	2021
P-737	MH-457	136.1	MH-459	135.92	0.004	51	Circle	PVC	12 inch	1,235	399	32.3	2021
P-738	MH-736	87.23	MH-737	86.66	0.005	107	Circle	PVC	12 inch	1,517	2	0.1	2014
P-739	MH-1035	-2.61	MH-1393	-2.72	0.002	50	Circle	PVC	10 inch	600	4	0.7	
P-740	MH-737	86.34	MH-739	86.01	0.005	60	Circle	PVC	12 inch	1,542	3	0.2	2014
P-741	MH-284	121.91	MH-282	120.84	0.004	274	Circle	Concrete	8 inch	339	4	1.1	
P-742	MH-739	86.01	MH-741	84.65	0.004	305	Circle	PVC	12 inch	1,388	5	0.4	2014
P-743	MH-282	120.84	MH-280	116.32	0.02	224	Circle	PVC	8 inch	770	6	0.7	
P-744	MH-741	84.1	MH-743	83.26	0.004	237	Circle	PVC	15 inch	2,244	839	37.4	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-745	MH-280	116.32	MH-278	115.58	0.005	154	Circle	PVC	8 inch	376	9	2.3	
P-746	MH-743	83.18	MH-745	82.48	0.003	252	Circle	PVC	15 inch	1,986	840	42.3	2014
P-747	MH-1393	-2.82	MH-75	-4.53	0.009	187	Circle	Concrete	8 inch	519	6	1.2	
P-748	MH-745	82.4	MH-747	81.84	0.002	243	Circle	PVC	15 inch	1,809	903	49.9	2014
P-749	MH-71	19.67	MH-1391	10.5	0.064	144	Circle	Concrete	12 inch	4,035	2,186	54.2	
P-750	MH-749	82.17	MH-747	82.01	0.005	35	Circle	PVC	8 inch	367	13	3.4	
P-751	MH-676	-1	MH-75	-4.43	0.017	206	Circle	PVC	12 inch	2,682	2	0.1	
P-752	MH-751	83.7	MH-749	82.27	0.019	74	Circle	PVC	8 inch	754	11	1.5	
P-753	MH-63	66.1	MH-1417	64.57	0.005	313	Circle	PVC	15 inch	2,635	585	22.2	
P-754	MH-753	89	MH-751	83.8	0.016	331	Circle	PVC	8 inch	680	8	1.2	
P-755	MH-1417	64.47	MH-225	57.05	0.047	157	Circle	PVC	15 inch	8,194	872	10.6	
P-756	MH-755	91.9	MH-753	89.1	0.018	160	Circle	PVC	8 inch	717	5	0.7	
P-757	MH-225	56.95	MH-67	42	0.126	119	Circle	PVC	8 inch	1,922	874	45.4	
P-758	MH-757	95	MH-755	92	0.024	123	Circle	PVC	8 inch	847	3	0.4	
P-759	MH-221	94.41	MH-223	85.51	0.031	291	Circle	PVC	8 inch	948	279	29.4	
P-760	MH-759	98	MH-757	95.1	0.027	108	Circle	PVC	8 inch	889	2	0.2	
P-762	MH-761	91	MH-753	89.1	0.015	127	Circle	PVC	8 inch	663	2	0.2	
P-765	MH-763	107.25	MH-764	95.23	0.049	245	Circle	PVC	8 inch	1,201	2	0.1	
P-767	MH-764	95.13	MH-766	92.22	0.015	190	Circle	PVC	8 inch	671	3	0.5	
P-770	MH-768	84.93	MH-741	84.65	0.007	40	Circle	PVC	8 inch	454	27	5.9	
P-771	MH-1648	114	MH-686	106.68	0.042	174	Circle	PVC	8 inch	1,446	9	0.6	
P-772	MH-688	167.17	MH-1092	163.64	0.034	105	Circle	PVC	8 inch	1,293	10	0.8	
P-773	MH-771	93.33	MH-772	92.99	0.004	76	Circle	PVC	8 inch	363	2	0.4	
P-774	MH-1469	171.83	MH-688	167.32	0.028	164	Circle	PVC	8 inch	1,169	8	0.7	
P-775	MH-690	177.29	MH-1469	171.88	0.029	187	Circle	PVC	8 inch	1,199	5	0.4	
P-776	MH-1470	178.04	MH-690	177.39	0.002	347	Circle	PVC	8 inch	305	2	0.8	
P-777	MH-775	99.74	MH-776	98.69	0.005	233	Circle	PVC	8 inch	364	2	0.4	
P-778	MH-1471	-6.7	MH-1198	-7.61	0.003	344	Circle	PVC	12 inch	1,069	174	16.3	2014
P-779	MH-776	98.69	MH-778	98.22	0.004	131	Circle	PVC	8 inch	325	3	1	
P-781	MH-778	98.22	MH-780	97.09	0.004	298	Circle	PVC	8 inch	334	5	1.4	
P-782	MH-695	-4.03	MH-1472	-4.93	0.004	222	Circle	PVC	10 inch	814	4	0.5	
P-783	MH-780	96.99	MH-782	90.47	0.023	278	Circle	PVC	8 inch	831	6	0.8	
P-784	MH-1474	65.06	MH-65	43.1	0.097	227	Circle	Concrete	8 inch	1,687	2	0.1	
P-785	MH-782	90.47	MH-784	89.85	0.007	85	Circle	PVC	8 inch	463	8	1.7	
P-786	MH-699	202.25	MH-1475	194.94	0.049	148	Circle	PVC	8 inch	1,567	8	0.5	
P-787	MH-784	89.75	MH-786	88.85	0.005	199	Circle	PVC	8 inch	365	10	2.7	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-788	MH-701	205.13	MH-1476	203.15	0.011	183	Circle	PVC	8 inch	733	3	0.4	
P-789	MH-786	88.8	MH-788	88	0.003	298	Circle	PVC	8 inch	281	12	4.1	
P-790	MH-703	196.33	MH-702	196.06	0.004	67	Circle	PVC	8 inch	448	6	1.3	
P-791	MH-788	87.9	MH-790	87.03	0.007	121	Circle	PVC	8 inch	460	13	2.8	
P-792	MH-1475	194.84	MH-417	194.1	0.004	186	Circle	PVC	8 inch	445	25	5.7	
P-793	MH-790	86.93	MH-792	86.55	0.004	85	Circle	PVC	8 inch	363	15	4.1	
P-794	MH-1478	38.88	MH-705	32.71	0.015	412	Circle	PVC	15 inch	4,612	1,192	25.9	
P-795	MH-792	86.28	MH-794	85.19	0.004	309	Circle	PVC	15 inch	2,238	733	32.8	2021
P-796	MH-794	85.11	MH-741	84.31	0.003	297	Circle	PVC	15 inch	1,956	805	41.2	2021
P-798	MH-797	86.83	MH-794	85.65	0.006	201	Circle	PVC	8 inch	416	70	16.9	
P-799	MH-709	61.63	MH-1479	55.94	0.014	398	Circle	PVC	15 inch	4,506	1,129	25	
P-800	MH-747	81.74	MH-799	81.25	0.003	173	Circle	PVC	15 inch	2,006	917	45.7	2014
P-801	MH-711	65.46	MH-1480	64.21	0.005	252	Circle	PVC	15 inch	2,654	1,057	39.8	
P-802	MH-799	81.28	MH-801	80.99	0.006	46	Circle	PVC	15 inch	2,993	922	30.8	2014
P-803	MH-1481	210.13	MH-413	207.36	0.012	238	Circle	PVC	8 inch	761	3	0.4	
P-804	MH-801	80.65	MH-803	79.19	0.005	300	Circle	PVC	15 inch	2,629	924	35.1	2014
P-806	MH-803	80.55	MH-805	79.16	0.005	279	Circle	PVC	15 inch	2,660	996	37.5	2014
P-808	MH-805	79.06	MH-807	77.63	0.005	285	Circle	PVC	15 inch	2,670	998	37.4	2014
P-810	MH-807	77.53	MH-809	68.78	0.029	300	Circle	PVC	15 inch	6,437	1,003	15.6	2014
P-812	MH-809	68.1	MH-811	66.85	0.008	155	Circle	PVC	15 inch	3,385	1,053	31.1	2014
P-820	MH-817	55.15	MH-819	54.68	0.003	175	Circle	PVC	15 inch	1,953	1,135	58.1	2014
P-822	MH-819	54.58	MH-821	53.51	0.004	302	Circle	PVC	15 inch	2,243	1,154	51.5	2014
P-826	MH-823	51.85	MH-825	50.43	0.005	296	Circle	PVC	15 inch	2,610	1,159	44.4	2014
P-828	MH-825	50.37	MH-827	48.23	0.009	246	Circle	PVC	15 inch	3,515	1,161	33	2014
P-830	MH-827	48.23	MH-829	47.76	0.011	42	Circle	PVC	15 inch	3,987	1,167	29.3	2014
P-832	MH-829	47.71	MH-831	45.52	0.007	300	Circle	PVC	15 inch	3,220	1,168	36.3	2014
P-840	MH-837	31.9	MH-839	28.41	0.015	239	Circle	PVC	15 inch	4,554	1,215	26.7	2014
P-842	MH-839	28.32	MH-841	27.63	0.006	116	Circle	PVC	15 inch	2,907	1,217	41.9	2014
P-843	MH-841	27.53	MH-704	27.3	0.005	46	Circle	PVC	15 inch	2,665	1,219	45.7	2014
P-845	MH-844	68.3	MH-811	66.85	0.005	276	Circle	PVC	8 inch	393	2	0.4	
P-848	MH-846	82.12	MH-847	81.71	0.008	53	Circle	PVC	8 inch	477	2	0.3	
P-850	MH-847	81.71	MH-849	71.09	0.078	136	Circle	PVC	8 inch	1,516	3	0.2	
P-852	MH-849	80.95	MH-851	80.69	0.004	65	Circle	PVC	8 inch	343	5	1.4	
P-853	MH-851	80.59	MH-803	79.29	0.004	324	Circle	PVC	8 inch	344	6	1.9	
P-856	MH-854	81.7	MH-855	81.15	0.004	149	Circle	PVC	8 inch	330	2	0.5	
P-858	MH-855	81.15	MH-857	80.36	0.005	150	Circle	PVC	8 inch	394	62	15.6	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-860	MH-857	80.36	MH-859	79.83	0.008	66	Circle	PVC	8 inch	486	63	13	
P-861	MH-859	79.58	MH-803	79.29	0.004	68	Circle	PVC	8 inch	354	65	18.3	
P-863	MH-862	81.5	MH-855	81.15	0.003	100	Circle	PVC	8 inch	321	58	18.2	
P-866	MH-864	83.22	MH-865	82.97	0.002	128	Circle	PVC	8 inch	240	2	0.7	
P-867	MH-865	82.87	MH-799	81.42	0.006	253	Circle	PVC	8 inch	411	3	0.8	
P-870	MH-868	82.98	MH-869	81.93	0.008	138	Circle	PVC	8 inch	473	2	0.3	
P-871	MH-869	81.83	MH-807	76.84	0.018	281	Circle	PVC	8 inch	723	3	0.4	
P-874	MH-872	114	MH-873	106.35	0.048	160	Circle	PVC	8 inch	1,186	2	0.1	
P-876	MH-873	106.25	MH-875	94.71	0.037	310	Circle	PVC	8 inch	1,046	5	0.4	
P-878	MH-875	94.61	MH-877	86.76	0.042	186	Circle	PVC	8 inch	1,114	9	0.8	
P-880	MH-877	86.66	MH-879	58.71	0.11	255	Circle	PVC	8 inch	1,796	11	0.6	
P-882	MH-879	58.61	MH-881	56.75	0.017	112	Circle	PVC	8 inch	699	14	2	
P-883	MH-881	56.65	MH-819	55.01	0.012	140	Circle	PVC	8 inch	587	18	3.1	
P-886	MH-884	60.5	MH-885	58.23	0.008	300	Circle	PVC	8 inch	472	2	0.3	
P-887	MH-885	58.13	MH-881	56.75	0.005	273	Circle	PVC	8 inch	386	3	0.8	
P-889	MH-888	60.28	MH-879	58.71	0.01	160	Circle	PVC	8 inch	537	2	0.3	
P-891	MH-890	109.05	MH-873	106.35	0.009	313	Circle	PVC	8 inch	504	2	0.3	
P-894	MH-892	102	MH-893	96.51	0.038	144	Circle	PVC	8 inch	1,059	2	0.1	
P-895	MH-893	96.41	MH-875	94.71	0.005	330	Circle	PVC	8 inch	389	3	0.8	
P-898	MH-896	65.5	MH-897	63.1	0.015	165	Circle	PVC	8 inch	654	2	0.2	
P-900	MH-897	63	MH-899	59	0.018	217	Circle	PVC	8 inch	736	3	0.4	
P-901	MH-899	58.9	MH-827	48.33	0.081	131	Circle	PVC	8 inch	1,541	5	0.3	
P-904	MH-902	105	MH-903	104	0.01	103	Circle	PVC	8 inch	534	2	0.3	
P-906	MH-903	103.9	MH-905	102.67	0.01	122	Circle	PVC	8 inch	545	3	0.6	
P-908	MH-907	110	MH-905	102.67	0.035	208	Circle	PVC	8 inch	1,018	2	0.1	
P-911	MH-909	113	MH-910	109	0.044	91	Circle	PVC	8 inch	1,137	2	0.1	
P-912	MH-910	108.9	MH-905	102.65	0.013	474	Circle	PVC	8 inch	623	3	0.5	
P-914	MH-905	102.55	MH-913	101.85	0.005	135	Circle	PVC	8 inch	391	9	2.3	
P-916	MH-913	101.75	MH-915	85.11	0.049	338	Circle	PVC	8 inch	1,203	11	0.9	
P-918	MH-915	85.01	MH-917	71.6	0.082	163	Circle	PVC	8 inch	1,556	17	1.1	
P-920	MH-917	71.5	MH-919	66.18	0.066	81	Circle	PVC	8 inch	1,390	18	1.3	
P-921	MH-919	66.08	MH-831	45.52	0.108	190	Circle	PVC	8 inch	1,784	20	1.1	
P-924	MH-922	104.5	MH-923	98.1	0.043	148	Circle	PVC	8 inch	1,128	2	0.1	
P-926	MH-923	98	MH-925	92.1	0.055	107	Circle	PVC	8 inch	1,274	3	0.2	
P-927	MH-925	92	MH-915	85.11	0.033	212	Circle	PVC	8 inch	978	5	0.5	
P-930	MH-928	115.97	MH-929	103.16	0.042	303	Circle	PVC	8 inch	1,115	9	0.8	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-932	MH-929	102.98	MH-931	85.22	0.059	301	Circle	PVC	8 inch	1,317	15	1.1	
P-934	MH-931	85.05	MH-933	59.9	0.085	297	Circle	PVC	8 inch	1,578	16	1	
P-935	MH-933	59.25	MH-837	32	0.09	302	Circle	PVC	8 inch	1,629	20	1.2	
P-938	MH-936	0	MH-937	-1.9	0.026	73	Circle	PVC	6 inch	406	2	0.5	
P-940	MH-937	-1.9	MH-939	-3.27	0.009	153	Circle	PVC	8 inch	513	4	0.8	
P-942	MH-939	-3.27	MH-941	-4.78	0.004	372	Circle	Concrete	8 inch	346	11	3.2	
P-944	MH-941	-4.78	MH-943	-5.91	0.004	284	Circle	Concrete	8 inch	342	13	3.8	
P-945	MH-943	-5.91	MH-83	-6.43	0.003	157	Circle	PVC	8 inch	406	21	5.1	
P-947	MH-946	-4.52	MH-81	-6.37	0.01	186	Circle	Concrete	8 inch	541	4	0.7	
P-950	MH-948	-0.39	MH-949	-1.85	0.004	364	Circle	Concrete	8 inch	343	2	0.6	
P-951	MH-949	-1.85	MH-943	-2.41	0.004	140	Circle	Concrete	8 inch	343	4	1.2	
P-954	MH-952	-2.68	MH-953	-3.09	0.004	102	Circle	Concrete	8 inch	344	3	0.9	
P-955	MH-953	-3.09	MH-939	-3.27	0.003	52	Circle	Concrete	8 inch	319	5	1.6	
P-958	MH-956	146	MH-957	141	0.014	363	Circle	PVC	8 inch	637	5	0.8	
P-960	MH-957	140.9	MH-959	134.4	0.025	265	Circle	PVC	8 inch	849	10	1.1	
P-962	MH-959	134.3	MH-961	116.3	0.097	185	Circle	PVC	8 inch	1,692	14	0.9	
P-964	MH-961	116.2	MH-963	99.2	0.139	122	Circle	PVC	8 inch	2,025	19	0.9	
P-966	MH-963	99.1	MH-965	90.1	0.049	185	Circle	PVC	8 inch	1,196	24	2	
P-968	MH-965	90	MH-967	87.11	0.02	144	Circle	PVC	8 inch	768	29	3.8	
P-970	MH-967	87.01	MH-969	80.01	0.073	96	Circle	PVC	8 inch	1,465	53	3.6	
P-972	MH-969	79.91	MH-971	72.91	0.084	83	Circle	PVC	8 inch	1,575	58	3.7	
P-974	MH-971	72.81	MH-973	68.81	0.058	69	Circle	PVC	8 inch	1,306	63	4.8	
P-976	MH-973	68.71	MH-975	68.31	0.004	106	Circle	Concrete	8 inch	333	68	20.3	
P-978	MH-975	68.11	MH-977	50.88	0.059	291	Circle	Concrete	8 inch	1,320	78	5.9	
P-980	MH-977	50.78	MH-979	44.86	0.035	170	Circle	Concrete	8 inch	1,012	83	8.2	
P-982	MH-979	44.76	MH-981	34.76	0.065	154	Circle	Concrete	8 inch	1,382	97	7	
P-984	MH-983	41.7	MH-981	34.86	0.025	274	Circle	PVC	15 inch	5,955	822	13.8	2014
P-986	MH-985	42.75	MH-983	41.7	0.004	259	Circle	PVC	15 inch	2,400	817	34	2014
P-988	MH-987	44.07	MH-985	42.75	0.004	332	Circle	PVC	15 inch	2,377	812	34.2	2014
P-990	MH-989	44.67	MH-987	44.07	0.004	153	Circle	PVC	15 inch	2,360	807	34.2	2014
P-992	MH-991	64.02	MH-989	49.06	0.08	187	Circle	Concrete	8 inch	1,534	117	7.6	
P-994	MH-993	86.96	MH-991	64.02	0.075	305	Circle	Concrete	8 inch	1,487	10	0.7	
P-996	MH-995	104.94	MH-993	86.96	0.057	313	Circle	Concrete	8 inch	1,300	8	0.6	
P-998	MH-997	106.03	MH-995	104.94	0.004	275	Circle	Concrete	8 inch	341	5	1.4	
P-1000	MH-999	107.12	MH-997	106.03	0.004	267	Circle	Concrete	8 inch	347	2	0.7	
P-1003	MH-1001	147	MH-1002	145.1	0.013	149	Circle	PVC	6 inch	284	2	0.8	

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P-1005	MH-1002	145	MH-1004	141.1	0.02	199	Circle	PVC	6 inch	353	5	1.4	
P-1007	MH-1004	141	MH-1006	137.1	0.012	335	Circle	PVC	6 inch	272	8	2.8	
P-1009	MH-1006	137	MH-1008	119.1	0.105	170	Circle	PVC	6 inch	817	10	1.2	
P-1011	MH-1008	119	MH-1010	101.1	0.077	232	Circle	Concrete	8 inch	1,506	12	0.8	
P-1013	MH-1010	101	MH-1012	95.1	0.016	360	Circle	Concrete	8 inch	694	15	2.1	
P-1014	MH-1012	95	MH-991	64.12	0.129	240	Circle	Concrete	8 inch	1,945	102	5.3	
P-1017	MH-1015	140.2	MH-1016	125.2	0.041	366	Circle	PVC	8 inch	1,098	5	0.4	
P-1019	MH-1016	125.1	MH-1018	114.1	0.06	182	Circle	PVC	8 inch	1,333	10	0.7	
P-1020	MH-1018	114	MH-967	90.11	0.152	157	Circle	PVC	8 inch	2,116	20	0.9	
P-1022	MH-1021	116	MH-1018	114.1	0.014	139	Circle	PVC	8 inch	634	5	0.8	
P-1024	MH-1023	74.08	MH-975	68.21	0.049	120	Circle	Concrete	8 inch	1,200	5	0.4	
P-1027	MH-1025	60.8	MH-1026	47.9	0.06	215	Circle	Concrete	8 inch	1,328	5	0.4	
P-1028	MH-1026	47.8	MH-979	44.86	0.026	115	Circle	Concrete	8 inch	867	10	1.1	
P-1038	MH-1037	-2.39	MH-1035	-2.51	0.001	100	Circle	Concrete	8 inch	188	2	1.1	
P-1041	MH-1040	46.14	MH-989	44.67	0.004	378	Circle	PVC	15 inch	2,350	687	29.2	2014
P-1043	MH-1042	47.6	MH-1040	46.14	0.004	412	Circle	PVC	15 inch	2,244	685	30.5	2014
P-1045	MH-1044	47.9	MH-1042	47.77	0.005	24	Circle	Concrete	8 inch	399	147	36.8	
P-1047	MH-1046	62.95	MH-1044	47.9	0.08	188	Circle	Concrete	8 inch	1,534	145	9.4	
P-1049	MH-1048	90	MH-1046	62.95	0.075	361	Circle	Concrete	8 inch	1,485	142	9.6	
P-1051	MH-1050	97.4	MH-1048	90.1	0.08	91	Circle	PVC	8 inch	1,536	139	9.1	
P-1053	MH-1052	101.85	MH-1050	97.5	0.014	309	Circle	PVC	8 inch	643	137	21.3	
P-1055	MH-1054	103.3	MH-1052	101.95	0.005	293	Circle	PVC	8 inch	368	135	36.6	
P-1057	MH-1056	104.69	MH-1054	103.41	0.005	262	Circle	PVC	8 inch	379	132	34.9	
P-1059	MH-1058	105.68	MH-1056	104.79	0.005	182	Circle	PVC	8 inch	379	105	27.7	
P-1061	MH-1060	107.95	MH-1058	105.78	0.011	200	Circle	PVC	8 inch	565	103	18.2	
P-1063	MH-1062	109.62	MH-1060	108.05	0.015	108	Circle	PVC	8 inch	654	100	15.4	
P-1065	MH-1064	111.09	MH-1062	109.72	0.012	119	Circle	PVC	8 inch	582	96	16.4	
P-1067	MH-1066	121.38	MH-1064	117.66	0.023	161	Circle	PVC	8 inch	824	93	11.3	
P-1069	MH-1068	126.77	MH-1066	121.45	0.048	111	Circle	PVC	8 inch	1,187	37	3.1	
P-1071	MH-1070	130.46	MH-1068	126.87	0.035	104	Circle	PVC	8 inch	1,008	35	3.5	
P-1073	MH-1072	147.43	MH-1070	130.56	0.059	284	Circle	PVC	8 inch	1,322	17	1.3	
P-1075	MH-1074	152.23	MH-1072	147.53	0.039	119	Circle	PVC	8 inch	1,078	12	1.1	
P-1077	MH-1076	154.76	MH-1074	152.33	0.026	95	Circle	PVC	8 inch	867	10	1.1	
P-1079	MH-1078	163.77	MH-1076	154.86	0.041	217	Circle	PVC	8 inch	1,099	7	0.7	
P-1081	MH-1080	168.28	MH-1078	163.87	0.05	89	Circle	PVC	8 inch	1,207	5	0.4	
P-1083	MH-1082	171.73	MH-1080	168.38	0.019	180	Circle	PVC	8 inch	740	2	0.3	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1085	MH-1084	148.87	MH-1072	147.53	0.005	270	Circle	PVC	8 inch	382	2	0.6	
P-1087	MH-1086	131.21	MH-1070	130.56	0.005	138	Circle	PVC	8 inch	372	16	4.2	
P-1089	MH-1088	123.26	MH-1066	121.48	0.005	357	Circle	PVC	8 inch	383	53	14	
P-1091	MH-1090	111.09	MH-1062	109.72	0.009	149	Circle	PVC	8 inch	520	2	0.5	
P-1094	MH-1092	163.51	MH-1093	160	0.022	156	Circle	PVC	8 inch	814	13	1.5	
P-1096	MH-1093	159.9	MH-1095	130.9	0.091	319	Circle	PVC	8 inch	1,635	15	0.9	
P-1098	MH-1095	130.9	MH-1097	129.22	0.016	105	Circle	PVC	8 inch	686	17	2.5	
P-1100	MH-1097	129.12	MH-1099	125.24	0.035	112	Circle	PVC	8 inch	1,009	20	2	
P-1102	MH-1099	125.14	MH-1101	112.58	0.031	399	Circle	PVC	8 inch	962	22	2.3	
P-1103	MH-1101	112.48	MH-1056	104.79	0.021	358	Circle	PVC	8 inch	795	25	3.1	
P-1106	MH-1104	100.83	MH-1105	100.03	0.003	251	Circle	PVC	8 inch	306	2	0.6	
P-1108	MH-1105	99.93	MH-1107	98.45	0.006	264	Circle	PVC	8 inch	406	14	3.5	
P-1110	MH-1107	98.35	MH-1109	97.31	0.006	182	Circle	PVC	8 inch	410	16	3.9	
P-1112	MH-1109	97.21	MH-1111	92.31	0.021	237	Circle	PVC	8 inch	780	18	2.3	
P-1114	MH-1111	92.21	MH-1113	75.59	0.053	313	Circle	PVC	8 inch	1,250	19	1.5	
P-1116	MH-1113	75.58	MH-1115	38.31	0.129	289	Circle	PVC	8 inch	1,948	21	1.1	
P-1118	MH-1115	38.21	MH-1117	27.27	0.219	50	Circle	PVC	8 inch	2,537	22	0.9	
P-1120	MH-1119	30.96	MH-1117	27.27	0.009	410	Circle	PVC	8 inch	515	12	2.4	
P-1122	MH-1121	35.79	MH-1119	31.06	0.012	397	Circle	PVC	8 inch	592	11	1.8	
P-1124	MH-1123	52.08	MH-1121	35.89	0.083	194	Circle	PVC	8 inch	1,567	8	0.5	
P-1126	MH-1125	76.4	MH-1123	52.18	0.12	202	Circle	PVC	8 inch	1,878	7	0.4	
P-1128	MH-1127	95.6	MH-1125	76.5	0.071	268	Circle	PVC	8 inch	1,448	3	0.2	
P-1130	MH-1129	99.66	MH-1127	95.7	0.017	228	Circle	PVC	8 inch	715	2	0.2	
P-1132	MH-1131	80.16	MH-1125	76.5	0.026	143	Circle	PVC	8 inch	868	2	0.2	
P-1135	MH-1133	26.93	MH-1134	26.21	0.003	212	Circle	PVC	8 inch	316	114	36.2	
P-1137	MH-1134	26.11	MH-1136	26	0.003	34	Circle	PVC	8 inch	308	152	49.4	
P-1138	MH-1117	27.17	MH-1134	26.21	0.008	126	Circle	PVC	8 inch	473	36	7.7	
P-1140	MH-1139	-4.25	MH-87	-6.14	0.012	152	Circle	PVC	8 inch	605	4	0.6	
P-1142	MH-1141	-4	MH-87	-6.14	0.013	164	Circle	PVC	8 inch	620	4	0.6	
P-1145	MH-1143	-2.18	MH-1144	-4.18	0.01	201	Circle	PVC	8 inch	541	4	0.7	
P-1148	MH-1146	-8.5	MH-91	-9.48	0.004	268	Circle	Concrete	8 inch	328	36	11	
P-1151	MH-1149	-0.52	MH-1150	-1.92	0.01	145	Circle	PVC	8 inch	533	4	0.7	
P-1157	MH-1155	5	MH-1156	2.88	0.039	54	Circle	PVC	6 inch	499	4	0.7	
P-1158	MH-1156	2.88	MH-1150	-1.92	0.041	118	Circle	PVC	6 inch	508	11	2.1	
P-1160	MH-1159	2.7	MH-1156	2.3	0.007	61	Circle	PVC	6 inch	204	4	1.8	
P-1163	MH-1161	1	MH-1162	-2.1	0.016	197	Circle	PVC	8 inch	884	4	0.4	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-1165	MH-1162	-2	MH-1164	-6.1	0.017	246	Circle	PVC	8 inch	910	7	0.8	2014
P-1167	MH-1166	-4	MH-1164	-6.1	0.009	234	Circle	PVC	8 inch	668	7	1.1	2014
P-1169	MH-1168	-2	MH-1166	-4.1	0.025	83	Circle	PVC	8 inch	1,121	4	0.3	2014
P-1170	MH-1164	-6	MH-95	-10.76	0.013	367	Circle	PVC	8 inch	803	18	2.2	2014
P-1173	MH-1171	0.3	MH-1172	-0.49	0.004	176	Circle	PVC	8 inch	472	4	0.8	2014
P-1175	MH-1172	-0.59	MH-1174	-1.82	0.005	272	Circle	PVC	8 inch	474	7	1.5	2014
P-1177	MH-1174	-1.92	MH-1176	-2.85	0.005	205	Circle	PVC	8 inch	475	11	2.3	2014
P-1179	MH-1176	-2.95	MH-1178	-4.46	0.004	358	Circle	PVC	8 inch	458	14	3.1	2014
P-1181	MH-1178	-4.41	MH-1180	-5.76	0.006	229	Circle	PVC	8 inch	541	18	3.3	2014
P-1182	MH-1180	-5.61	MH-101	-7.95	0.009	267	Circle	PVC	12 inch	1,946	22	1.1	2014
P-1185	MH-1183	0.65	MH-1184	-1.1	0.006	300	Circle	PVC	8 inch	538	31	5.7	2014
P-1187	MH-1184	-1.1	MH-1186	-1.21	0	234	Circle	PVC	8 inch	153	33	21.3	2014
P-1189	MH-1186	-1.21	MH-1188	-2.08	0.003	287	Circle	PVC	8 inch	388	39	10.1	2014
P-1191	MH-1188	-2.08	MH-1190	-2.96	0.003	288	Circle	PVC	8 inch	390	144	37	2014
P-1193	MH-1190	-2.96	MH-1192	-3.84	0.003	307	Circle	PVC	8 inch	377	154	40.9	2014
P-1195	MH-1192	-4.44	MH-1194	-5.77	0.004	305	Circle	PVC	12 inch	1,373	158	11.5	2014
P-1197	MH-1194	-5.77	MH-1196	-6.16	0.005	83	Circle	PVC	12 inch	1,425	162	11.4	2014
P-1201	MH-1198	-7.61	MH-1200	-8.16	0.005	115	Circle	PVC	12 inch	1,438	176	12.3	2014
P-1203	MH-1200	-8.16	MH-1202	-8.84	0.004	174	Circle	PVC	12 inch	1,299	188	14.5	2014
P-1205	MH-1202	-8.84	MH-1204	-9.26	0.004	107	Circle	PVC	12 inch	1,302	190	14.6	2014
P-1207	MH-1204	-9.26	MH-1206	-10.15	0.004	229	Circle	PVC	12 inch	1,296	202	15.6	2014
P-1209	MH-1206	-10.28	MH-1208	-11.02	0.002	388	Circle	PVC	15 inch	1,646	480	29.2	2014
P-1211	MH-1208	-11.02	MH-1210	-11.68	0.002	365	Circle	PVC	15 inch	1,603	520	32.5	2014
P-1212	MH-1210	-11.68	MH-99	-12.3	0.002	313	Circle	PVC	15 inch	1,677	524	31.2	2014
P-1215	MH-1213	1.5	MH-1214	-0.07	0.013	125	Circle	PVC	8 inch	790	2	0.3	2014
P-1217	MH-1214	-0.17	MH-1216	-0.95	0.004	196	Circle	PVC	8 inch	445	6	1.4	2014
P-1219	MH-1216	-1.05	MH-1218	-2.39	0.005	283	Circle	PVC	8 inch	485	8	1.7	2014
P-1220	MH-1218	-2.49	MH-1204	-2.76	0.005	56	Circle	PVC	8 inch	490	10	2	2014
P-1222	MH-1221	3.82	MH-1214	-0.07	0.108	36	Circle	PVC	8 inch	2,318	2	0.1	2014
P-1224	MH-1223	-2.56	MH-1208	-4.66	0.006	324	Circle	PVC	8 inch	568	37	6.5	2014
P-1227	MH-1225	0.26	MH-1226	-0.5	0.004	206	Circle	PVC	8 inch	428	2	0.5	2014
P-1228	MH-1226	-0.58	MH-1186	-1.21	0.003	200	Circle	PVC	8 inch	396	5	1.2	2014
P-1231	MH-1229	-0.42	MH-1230	-1.24	0.004	193	Circle	PVC	8 inch	460	2	0.5	2014
P-1232	MH-1230	-1.24	MH-1188	-2.08	0.004	210	Circle	PVC	8 inch	446	5	1	2014
P-1235	MH-1233	1	MH-1234	-0.9	0.008	240	Circle	PVC	8 inch	627	2	0.3	2014
P-1236	MH-1234	-1	MH-1190	-2.96	0.012	164	Circle	PVC	8 inch	771	8	1	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-1239	MH-1237	4	MH-1238	1.1	0.012	238	Circle	PVC	8 inch	778	2	0.3	2014
P-1240	MH-1238	1	MH-1234	-0.9	0.012	158	Circle	PVC	8 inch	773	4	0.5	2014
P-1242	MH-1241	0.28	MH-1192	-3.84	0.037	112	Circle	PVC	8 inch	1,352	2	0.1	2014
P-1244	MH-1243	0.09	MH-1194	-1.89	0.018	109	Circle	PVC	8 inch	950	2	0.2	2014
P-1247	MH-1245	-1.63	MH-1246	-2.16	0.004	121	Circle	PVC	8 inch	467	2	0.4	2014
P-1249	MH-1246	-2.36	MH-1248	-2.8	0.004	112	Circle	PVC	8 inch	442	4	0.9	2014
P-1251	MH-1248	-2.8	MH-1250	-4.05	0.004	313	Circle	PVC	8 inch	446	6	1.3	2014
P-1253	MH-1250	-4.05	MH-1252	-5.29	0.004	318	Circle	PVC	8 inch	440	8	1.8	2014
P-1254	MH-1252	-5.39	MH-1200	-7.16	0.012	152	Circle	PVC	8 inch	761	10	1.3	2014
P-1257	MH-1255	0.79	MH-1256	-0.38	0.003	376	Circle	PVC	8 inch	393	5	1.2	2014
P-1259	MH-1256	-1.38	MH-1258	-2.53	0.004	290	Circle	PVC	8 inch	444	15	3.3	2014
P-1261	MH-1258	-2.53	MH-1260	-3.4	0.003	284	Circle	PVC	8 inch	390	30	7.6	2014
P-1263	MH-1260	-3.4	MH-1262	-3.89	0.003	170	Circle	PVC	8 inch	379	54	14.3	2014
P-1265	MH-1262	-3.89	MH-1264	-4.25	0.003	122	Circle	PVC	8 inch	383	73	19.1	2014
P-1267	MH-1264	-4.25	MH-1266	-4.41	0.004	38	Circle	PVC	8 inch	457	78	17.1	2014
P-1269	MH-1266	-4.41	MH-1268	-4.74	0.003	110	Circle	PVC	8 inch	386	83	21.5	2014
P-1271	MH-1268	-4.74	MH-1270	-5.54	0.003	262	Circle	PVC	8 inch	390	97	25	2014
P-1273	MH-1270	-5.54	MH-1272	-5.95	0.003	119	Circle	PVC	8 inch	414	139	33.5	2014
P-1275	MH-1272	-5.95	MH-1274	-6.47	0.004	143	Circle	PVC	12 inch	1,254	148	11.8	2014
P-1277	MH-1274	-6.47	MH-1276	-6.99	0.003	199	Circle	PVC	12 inch	1,063	222	20.9	2014
P-1279	MH-1276	-6.99	MH-1278	-7.89	0.003	302	Circle	PVC	12 inch	1,135	250	22	2014
P-1281	MH-1278	-7.89	MH-1280	-8.25	0.003	128	Circle	PVC	12 inch	1,102	264	24	2014
P-1283	MH-1280	-8.25	MH-1282	-9.45	0.003	393	Circle	PVC	12 inch	1,149	269	23.4	2014
P-1284	MH-1282	-9.45	MH-1206	-9.62	0.004	38	Circle	PVC	12 inch	1,390	274	19.7	2014
P-1287	MH-1285	-1.93	MH-1286	-3.35	0.006	242	Circle	PVC	8 inch	540	5	0.9	2014
P-1288	MH-1286	-3.35	MH-1278	-4.64	0.004	291	Circle	PVC	8 inch	469	10	2	2014
P-1291	MH-1289	0	MH-1290	-0.89	0.006	140	Circle	PVC	8 inch	562	18	3.2	2014
P-1292	MH-1290	-0.99	MH-1276	-6.99	0.018	330	Circle	PVC	8 inch	951	23	2.4	2014
P-1294	MH-1293	0.28	MH-1256	-1.38	0.005	339	Circle	PVC	8 inch	493	5	1	2014
P-1296	MH-1295	-1.54	MH-1258	-2.53	0.003	341	Circle	PVC	8 inch	380	5	1.3	2014
P-1298	MH-1297	-0.58	MH-1258	-2.53	0.005	383	Circle	PVC	8 inch	503	5	1	2014
P-1301	MH-1299	-0.93	MH-1300	-1.93	0.004	237	Circle	PVC	8 inch	458	5	1	2014
P-1303	MH-1300	-1.93	MH-1302	-2.33	0.003	139	Circle	PVC	8 inch	378	10	2.5	2014
P-1304	MH-1302	-2.4	MH-1260	-3.4	0.003	341	Circle	PVC	8 inch	382	15	3.9	2014
P-1306	MH-1305	-1.76	MH-1260	-3.4	0.005	316	Circle	PVC	8 inch	508	5	0.9	2014
P-1309	MH-1307	-0.48	MH-1308	-2.64	0.006	341	Circle	PVC	8 inch	561	5	0.9	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

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P-1310	MH-1308	-2.64	MH-1262	-5.89	0.112	29	Circle	PVC	8 inch	2,360	10	0.4	2014
P-1312	MH-1311	-1.75	MH-1262	-5.89	0.021	197	Circle	PVC	8 inch	1,022	5	0.5	2014
P-1314	MH-1313	0.21	MH-1268	-4.74	0.014	357	Circle	PVC	8 inch	830	5	0.6	2014
P-1316	MH-1315	0.12	MH-1268	-0.92	0.004	263	Circle	PVC	8 inch	443	5	1.1	2014
P-1319	MH-1317	-0.02	MH-1318	-0.88	0.004	209	Circle	PVC	8 inch	452	7	1.6	2014
P-1321	MH-1318	-0.88	MH-1320	-1.48	0.003	202	Circle	PVC	8 inch	384	12	3.2	2014
P-1323	MH-1320	-1.48	MH-1322	-1.92	0.003	126	Circle	PVC	8 inch	417	17	4.1	2014
P-1325	MH-1322	-1.92	MH-1324	-3.01	0.003	317	Circle	PVC	8 inch	413	22	5.3	2014
P-1327	MH-1324	-3.01	MH-1326	-4.06	0.004	272	Circle	PVC	8 inch	438	27	6.1	2014
P-1328	MH-1326	-4.06	MH-1270	-5.5	0.004	374	Circle	PVC	8 inch	437	36	8.3	2014
P-1330	MH-1329	-3.13	MH-1326	-4.06	0.004	230	Circle	PVC	8 inch	448	5	1.1	2014
P-1332	MH-1331	-4.3	MH-1272	-5.95	0.004	390	Circle	PVC	8 inch	459	5	1	2014
P-1334	MH-1333	-7.38	MH-1146	-8.13	0.008	98	Circle	PVC	8 inch	474	32	6.8	
P-1335	MH-1144	-4.28	MH-1333	-7.28	0.01	300	Circle	PVC	8 inch	542	7	1.3	
P-1337	MH-1336	-4.28	MH-1333	-7.28	0.01	301	Circle	PVC	8 inch	541	22	4	
P-1338	MH-1150	-2.02	MH-1336	-4.18	0.01	209	Circle	PVC	8 inch	551	18	3.3	
P-1342	MH-1341	105.7	MH-215	105.58	0.011	11	Circle	Steel	8 inch	566	2	0.3	
P-1347	MH-93	-10.48	MH-95	-10.76	0.002	167	Circle	PVC	15 inch	1,543	107	6.9	2014
P-1348	MH-772	92.89	MH-766	92.22	0.007	103	Circle	PVC	8 inch	437	3	0.7	
P-1349	MH-241	120	MH-207	119.06	0.049	19	Circle	PVC	18 inch	10,486	19	0.2	
P-1351	MH-766	92.22	MH-768	91.58	0.003	188	Circle	PVC	8 inch	316	8	2.5	
P-1356	MH-1355	122.87	MH-284	121.91	0.004	218	Circle	Concrete	8 inch	360	2	0.5	
P-1361	MH-1360	224	MH-181	214.41	0.064	150	Circle	PVC	8 inch	1,371	4	0.3	
P-1377	MH-1363	-8.01	MH-1362	-8.2	0.001	241	Circle	PVC	36 inch	10,927	3,152	28.8	2014
P-1378	MH-1364	-7.98	MH-1363	-7.91	0	268	Circle	PVC	36 inch	6,289	3,148	50.1	2014
P-1380	MH-1366	-6.85	MH-1365	-7.55	0.001	598	Circle	PVC	36 inch	13,314	3,141	23.6	2014
P-1381	MH-1367	-6.31	MH-1366	-6.75	0.001	305	Circle	PVC	27 inch	6,863	3,138	45.7	
P-1382	MH-1368	-5.89	MH-1367	-6.21	0.001	374	Circle	PVC	27 inch	5,286	3,134	59.3	
P-1383	MH-1369	-5.46	MH-1368	-5.89	0.001	292	Circle	PVC	27 inch	6,934	3,130	45.1	
P-1384	MH-1370	-5.08	MH-1369	-5.46	0.001	338	Circle	PVC	27 inch	6,059	3,127	51.6	
P-1385	MH-1371	-4.76	MH-1370	-5.08	0.002	158	Circle	PVC	27 inch	8,132	3,123	38.4	
P-1386	MH-1372	-4.51	MH-1371	-4.66	0	386	Circle	PVC	42 inch	11,572	3,120	27	2014
P-1387	MH-1373	-4.49	MH-1372	-4.51	0	160	Circle	PVC	42 inch	6,563	3,118	47.5	2014
P-1388	MH-1374	-2.16	MH-1373	-4.29	0.012	179	Circle	PVC	24 inch	11,075	3,116	28.1	
P-1389	MH-1375	4.94	MH-1374	-2.26	0.015	479	Circle	PVC	18 inch	5,780	3,114	53.9	

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1390	MH-981	34.6	MH-1375	5.04	0.1	297	Circle	Corrugated HDPE (Smooth Interior)	18 inch	16,113	924	5.7	
P-1392	MH-1391	10.4	MH-1375	5.15	0.059	89	Circle	Corrugated HDPE (Smooth Interior)	12 inch	4,207	2,188	52	
P-1410	MH-1409	130.66	MH-391	129.5	0.009	123	Circle	PVC	12 inch	1,553	0	0	
P-1422	MH-223	85.41	MH-1421	72.4	0.098	133	Circle	Concrete	8 inch	1,696	283	16.7	
P-1425	MH-1421	72.06	MH-1417	69.69	0.049	48	Circle	PVC	8 inch	1,205	285	23.6	
P-1429	MH-1428	188.2	MH-675	186.64	0.004	390	Circle	PVC	10 inch	622	3	0.5	
P-1431	MH-821	53.41	MH-1430	52.33	0.004	301	Circle	PVC	15 inch	2,258	1,156	51.2	2014
P-1434	MH-1430	52.23	MH-823	52.21	0.003	6	Circle	PVC	15 inch	2,176	1,157	53.2	2014
P-1440	MH-1436	55.3	MH-817	55.25	0.003	16	Circle	PVC	15 inch	2,107	1,133	53.8	2014
P-1446	MH-1444	56.11	MH-1436	55.4	0.006	114	Circle	PVC	15 inch	2,974	1,132	38	2014
P-1520	MH-1362	-8.2	MH-101	-8.25	0.004	14	Circle	PVC	36 inch	23,256	3,156	13.6	2014
P-1524	MH-686	106.58	MH-1105	103.56	0.011	285	Circle	PVC	8 inch	726	11	1.5	
P-1525	MH-1196	-6.16	MH-1471	-6.6	0.007	60	Circle	PVC	12 inch	1,780	164	9.2	2014
P-1526	MH-693	-6.03	MH-1471	-6.6	0.005	115	Circle	PVC	10 inch	900	8	0.9	
P-1527	MH-1472	-5.03	MH-693	-5.93	0.004	225	Circle	PVC	10 inch	808	6	0.7	
P-1528	MH-696	2.23	MH-695	-3.93	0.024	258	Circle	PVC	8 inch	1,089	2	0.2	
P-1529	MH-413	207.26	MH-1475	194.94	0.052	235	Circle	PVC	8 inch	1,614	6	0.3	
P-1530	MH-1476	203.05	MH-699	202.35	0.011	66	Circle	PVC	8 inch	726	6	0.8	
P-1531	MH-702	195.96	MH-1475	194.94	0.004	256	Circle	PVC	8 inch	445	8	1.9	
P-1532	MH-1477	197.73	MH-703	196.43	0.004	325	Circle	PVC	8 inch	446	3	0.6	
P-1533	MH-705	32.48	MH-837	32	0.007	64	Circle	PVC	15 inch	3,264	1,194	36.6	
P-1534	MH-1478	38.98	MH-707	45.12	0.016	393	Circle	PVC	15 inch	4,711	1,191	25.3	
P-1535	MH-831	45.42	MH-707	45.22	0.005	38	Circle	PVC	15 inch	2,734	1,189	43.5	
P-1536	MH-1479	55.84	MH-1444	55.74	0.005	19	Circle	PVC	15 inch	2,734	1,130	41.3	
P-1537	MH-1480	64.1	MH-709	61.73	0.01	249	Circle	PVC	15 inch	3,677.02	1,127.17	30.7	
P-1538	MH-811	65.75	MH-711	65.56	0.005	37	Circle	PVC	15 inch	2,700.83	1,055.74	39.1	
P-1600	MH-656	140.25	MH-1700	133.8	0.087	74	Circle	PVC	12 inch	6,137.04	73.35	1.2	2014
P-1601	MH-658	134.5	MH-1700	133.8	0.009	74	Circle	PVC	12 inch	2,021.75	453.9	22.5	2014
P-1603	MH-1701	132.4	MH-326	131.6	0.012	66	Circle	PVC	12 inch	2,288.59	527.25	23	2014
P-1604	MH-1700	133.7	MH-1701	132.5	0.009	128	Circle	PVC	12 inch	2,012.71	527.25	26.2	2014
P-1605	MH-459	135.4	MH-658	134.6	0.006	140	Circle	PVC	12 inch	1,571.36	451.1	28.7	2014
P-1606	MH-322	104.46	MH-1703	103.55	0.005	180	Circle	PVC	12 inch	1,478.02	589.35	39.9	2014
P-1607	MH-1703	103.45	MH-1704	102.7	0.006	135	Circle	PVC	12 inch	1,549.38	589.35	38	2014
P-1608	MH-1704	102.6	MH-1705	101.45	0.005	211	Circle	PVC	12 inch	1,534.63	589.35	38.4	2014

2035 (20-year) - Peak Hour Flow - Pipe Capacity Table

Label	Upstream Node	Upstream Invert Elevation (ft)	Downstream Node	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Length (ft)	Section Shape	Material	Section Size	Design Capacity (gpm)	Flow (gpm)	Percent Full (%)	Installation Year
P-1609	MH-1705	101.35	MH-1706	100.05	0.005	240	Circle	PVC	12 inch	1,529.89	589.35	38.5	2014
P-1610	MH-1706	99.95	MH-1707	98.2	0.006	275	Circle	PVC	12 inch	1,658.24	589.35	35.5	2014
P-1611	MH-1707	98.1	MH-1708	96.2	0.007	270	Circle	PVC	12 inch	1,743.77	589.35	33.8	2014
P-1612	MH-1708	96.1	MH-1709	94.4	0.007	231	Circle	PVC	12 inch	1,783.25	716.85	40.2	2014
P-1613	MH-1709	94.3	MH-1710	92.35	0.007	296	Circle	PVC	12 inch	1,687.20	716.85	42.5	2014
P-1614	MH-1710	92.25	MH-1711	90.7	0.007	238	Circle	PVC	12 inch	1,677.54	716.85	42.7	2014
P-1615	MH-1711	90.6	MH-1712	88.65	0.007	281	Circle	PVC	12 inch	1,731.64	716.85	41.4	2014
P-1616	MH-1712	88.55	MH-792	86.56	0.007	282	Circle	PVC	12 inch	1,746.21	716.85	41.1	2014

APPENDIX K

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 <u>grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.</u>

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/	Ammonia as Nitrogen[1]	6	50.00	300.00
	In House	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

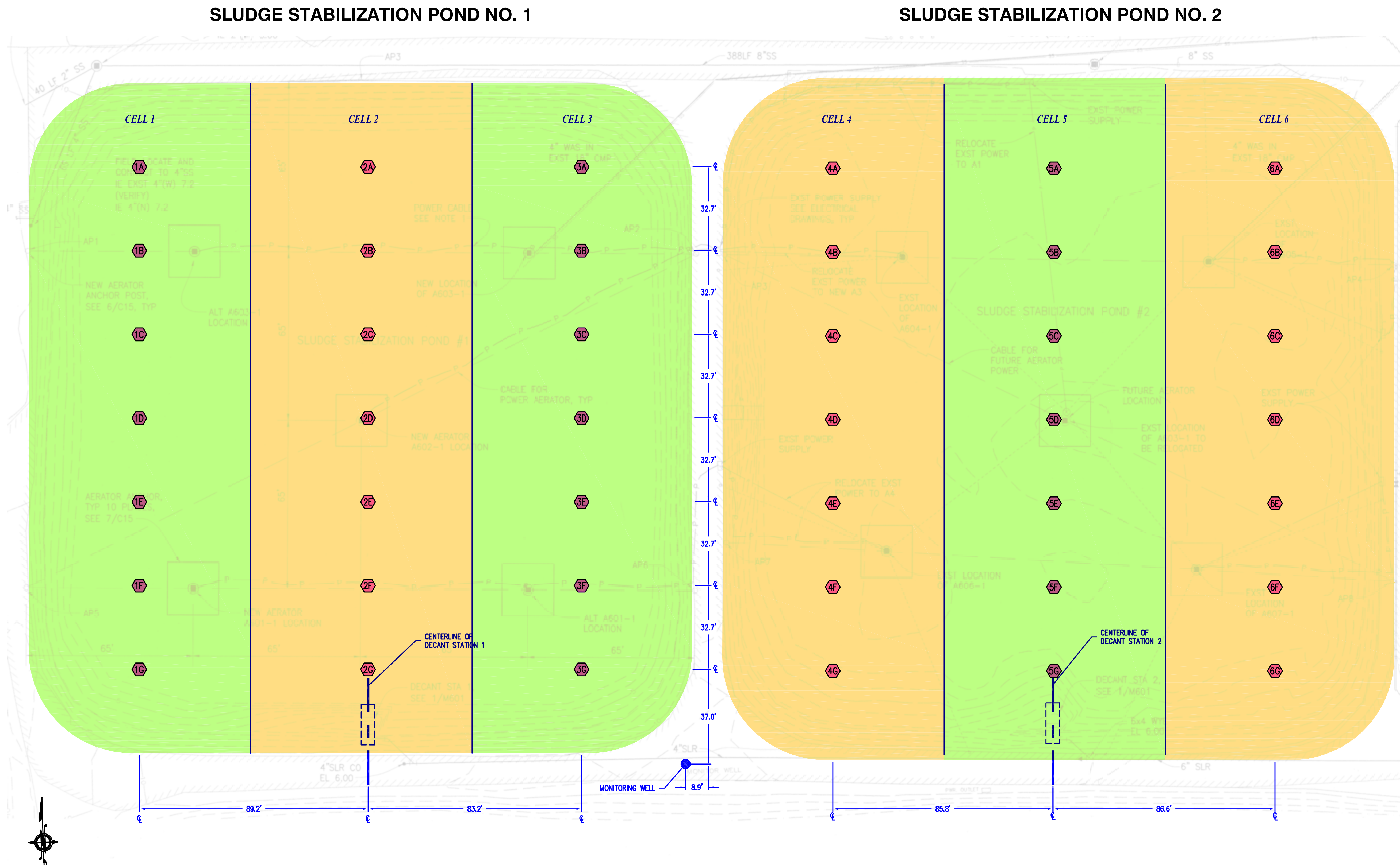
		Pond No. 2	
Description	Cost	High DWS = 455	Low DWS = 295
Bid Document Preparation		$25,000	$25,000
Dredging and Dewatering (per ton)	$525.00	$238,875.00	$154,875.00
Transportation and Tipping (per wet ton)	$46.00	$104,696.00	$104,696.00
Subtotal		$369,000.00	$285,000.00
Contingency		$74,000.00	$57,000.00
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.



SAMPLING LOCATION MAP

1" = 20'

FIGURE 1

SAMPLING LOCATION MAP

PRELIMINARY

EXPIRES 8/2/08

EXPIRES 1/30/2009

CITY OF STANWOOD

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
CLIENT: STA	1
JOB NO.: 108-044	
FILENAME: SAMPLING PLAN	

APPENDIX L

FINANCIAL CHAPTER DOCUMENTATION

City of Stanwood
Sewer Utility Rate Study
Assumptions

Economic & Financial Factors		2014	2015	2016	2017	2018	2019	2020	2021
1 General Cost Inflation		2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%
2 Construction Cost Inflation		3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%
3 Labor Cost Inflation		2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%
4 Benefit Cost Inflation		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
5 Customer Growth		0.17%	0.00%	1.33%	1.31%	1.30%	1.28%	1.26%	4.30%
6 General Inflation plus Growth		2.40%	2.23%	3.59%	3.57%	3.56%	3.54%	3.52%	6.63%
7 No Escalation		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fund Earnings		0.25%	0.50%	0.75%	1.00%	1.00%	1.00%	1.00%	1.00%
Local / State Excise Tax		3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%
State B&O Tax		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Allocation of Revenues to Excise Tax Base	per 2010	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%

Accounting Assumptions		2014	2015	2016	2017	2018	2019	2020	2021
FISCAL POLICY RESTRICTIONS									
Min. Op. Fund Balance (days of O&M expense)		60	60	60	60	60	60	60	60
Max. Op. Fund Balance (days of O&M expense)		60	60	60	60	60	60	60	60
Revenue Stabilization Reserve (25% of total rate revenues)		25%	25%	25%	25%	25%	25%	25%	25%
Phase-in (four years to replenish - % of policy target)		50%	50%	50%	50%	50%	50%	50%	60%
Minimum Capital Fund Balance Target									
Select Minimum Capital Fund Balance Target	1	**Defined as % of Plant**							
1 - Defined as % of Plant									
Plant-in-Service in 2013	$ 3,270,401								
Minimum Capital Fund Balance - % of plant assets		1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
2 - Amount at Right ==>									
RATE FUNDED SYSTEM REINVESTMENT									
Select Reinvestment Funding Strategy	2	**Equal to Annual Depreciation Expense less Annual Debt Principal Payments**							
Amount of Annual Cash Funding from Rates									
1 - Equal to Annual Depreciation Expense		$ 568,106	$ 585,231	$ 624,351	$ 662,586	$ 693,367	$ 745,747	$ 774,863	$ 800,617
2 - Equal to Depreciation less Annual Debt Principal Payments		-	13,281	52,401	54,280	41,518	11,732	-	-
	Phase-In Strategy	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
3 - Equal to Amount at Right ==>									
4 - Do Not Fund Depreciation									

City of Stanwood
Sewer Utility Rate Study
Assumptions

Economic & Financial Factors		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1 General Cost Inflation		2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%
2 Construction Cost Inflation		3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%	3.62%
3 Labor Cost Inflation		2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%	2.23%
4 Benefit Cost Inflation		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
5 Customer Growth		4.13%	3.96%	3.81%	3.67%	3.54%	3.42%	3.31%	3.20%	3.10%	3.01%	2.92%	2.84%	2.76%	2.69%
6 General Inflation plus Growth		6.45%	6.28%	6.13%	5.98%	5.85%	5.73%	5.61%	5.50%	5.40%	5.31%	5.22%	5.13%	5.05%	4.98%
7 No Escalation		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Fund Earnings		1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
Local / State Excise Tax		3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%	3.85%
State B&O Tax		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Allocation of Revenues to Excise Tax Base	per 2010	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%	20.00%

Accounting Assumptions		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
FISCAL POLICY RESTRICTIONS															
Min. Op. Fund Balance (days of O&M expense)		60	60	60	60	60	60	60	60	60	60	60	60	60	60
Max. Op. Fund Balance (days of O&M expense)		60	60	60	60	60	60	60	60	60	60	60	60	60	60
Revenue Stabilization Reserve (25% of total rate revenues)		25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%	25%
Phase-in (four years to replenish - % of policy target)		100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Minimum Capital Fund Balance Target															
Select Minimum Capital Fund Balance Target	1														
1 - Defined as % of Plant															
Plant-in-Service in 2013	$ 3,270,401														
Minimum Capital Fund Balance - % of plant assets		1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
2 - Amount at Right ==>															
RATE FUNDED SYSTEM REINVESTMENT															
Select Reinvestment Funding Strategy	2														
Amount of Annual Cash Funding from Rates															
1 - Equal to Annual Depreciation Expense		$ 835,401	$ 871,445	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793	$ 908,793
2 - Equal to Depreciation less Annual Debt Principal Payments		-	-	-	377,954	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485
	Phase-In Strategy	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
3 - Equal to Amount at Right ==>															
4 - Do Not Fund Depreciation															

Capital Financing Assumptions		2014	2015	2016	2017	2018	2019	2020	2021
Connection Charges									
Select Plant Investment Fee Alternative	1	**CPI Escalator on PIF (excludes Hook-up fee)**							
1a - Plant Investment Fee (Existing) (per ERU)	$ 6,476	$ 6,476	$ 6,620	$ 6,860	$ 7,108	$ 7,365	$ 7,632	$ 7,908	$ 8,194
Utility Hook-Up Connection Fee	500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500
2 - Calculated Charge	8,687	$ 8,687	$ 8,881	$ 9,079	$ 9,282	$ 9,489	$ 9,700	$ 9,917	$ 10,138
			90	*91*	*90*	*91*	*90*	*91*	*90*
Annual Sewer ERUs - Future Development Flow Projections		2,252	2,342	2,433	2,523	2,614	2,704	2,795	2,885
Modified Near-Term for Financial Projections		2,252	2,252	2,282	2,312	2,342	2,372	2,402	2,505
ERU Growth Projection (City near-term forecast)	64	4	0	30	30	30	30	30	103
Plant Investment Fee Revenue	$ 414,399	$ 23,954	**$ -**	**$ 205,800**	**$ 213,248**	**$ 220,965**	**$ 228,961**	**$ 237,247**	**$ 847,301**
Connection Charge Revenue	$ 32,215	$ 1,500	$ -	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000	$ 51,700
REVENUE BONDS									
Term (years)		20	20	20	20	20	20	20	20
Interest Cost		4.50%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Issuance Cost		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Revenue Bond Coverage Requirement	1.25								
Use Reserves to Pay for Last Payment	No								
PWTF LOANS									
Term (years; no more than 20 years)		20	20	20	20	20	20	20	20
Interest Cost		1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
OTHER LOANS									
Term (years)		20	20	20	20	20	20	20	20
Interest Cost		0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Issuance Cost		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

Capital Financing Assumptions

Capital Financing Assumptions		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Connection Charges															
Select Plant Investment Fee Alternative	1														
1a - Plant Investment Fee (Existing) (per ERU)	$ 6,476	$ 8,491	$ 8,798	$ 9,117	$ 9,447	$ 9,788	$ 10,143	$ 10,510	$ 10,890	$ 11,284	$ 11,692	$ 12,115	$ 12,554	$ 13,008	$ 13,479
Utility Hook-Up Connection Fee	500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500
2 - Calculated Charge	8,687	$ 10,364	$ 10,595	$ 10,831	$ 11,073	$ 11,320	$ 11,572	$ 11,831	$ 12,094	$ 12,364	$ 12,640	$ 12,922	$ 13,210	$ 13,505	$ 13,806
		77	77	76	76	77	77	76	76	77	76	77	76	77	73
Annual Sewer ERUs - Future Development Flow Projections		2,962	3,039	3,115	3,191	3,268	3,345	3,421	3,497	3,574	3,650	3,727	3,803	3,880	3,953
Modified Near-Term for Financial Projections		2,609	2,712	2,816	2,919	3,022	3,126	3,229	3,333	3,436	3,539	3,643	3,746	3,850	3,953
ERU Growth Projection (City near-term forecast)	64	103	103	103	103	103	103	103	103	103	103	103	103	103	103
Plant Investment Fee Revenue	$ 414,399	**$ 877,963**	**$ 909,735**	**$ 942,656**	**$ 976,769**	**$1,012,116**	**$1,048,742**	**$1,086,694**	**$1,126,019**	**$1,166,767**	**$1,208,990**	**$1,252,740**	**$1,298,074**	**$1,345,049**	**$1,393,723**
Connection Charge Revenue	$ 32,215	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700	$ 51,700
REVENUE BONDS															
Term (years)		20	20	20	20	20	20	20	20	20	20	20	20	20	20
Interest Cost		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Issuance Cost		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Revenue Bond Coverage Requirement	**1.25**														
Use Reserves to Pay for Last Payment	**No**														
PWTF LOANS															
Term (years; no more than 20 years)		20	20	20	20	20	20	20	20	20	20	20	20	20	20
Interest Cost		1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
OTHER LOANS															
Term (years)		20	20	20	20	20	20	20	20	20	20	20	20	20	20
Interest Cost		0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Issuance Cost		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

City of Stanwood
Sewer Utility Rate Study
Operating Revenue and Expenditure Forecast

			Actual	Budget	with growth Test	Projection	Projection	Projection	Projection	Projection	Projection	Projection
Revenues		**FORECAST BASIS**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Rate revenues				per Y-E Actual								
Sewer Service Charge	5	Customer Growth	$ 1,570,026	$ 1,625,018	$ 1,625,018	$ 1,646,665	$ 1,668,313	$ 1,689,961	$ 1,711,608	$ 1,733,256	$ 1,807,868	$ 1,882,481
Sewer-Other Fees	5	Customer Growth	1,160	600	$ 600	$ 608	$ 616	$ 624	$ 632	$ 640	$ 668	$ 695
Total Rate Revenue			**$ 1,571,186**	**$ 1,625,618**	**$ 1,625,618**	**$ 1,647,273**	**$ 1,668,929**	**$ 1,690,585**	**$ 1,712,240**	**$ 1,733,896**	**$ 1,808,536**	**$ 1,883,176**
Non-rate revenues				per Y-E Actual								
Miscellaneous	7	No Escalation	803	-	-	-	-	-	-	-	-	-
Total Non-rate revenues			**$ 803**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL REVENUES			**$ 1,571,989**	**$ 1,625,618**	**$ 1,625,618**	**$ 1,647,273**	**$ 1,668,929**	**$ 1,690,585**	**$ 1,712,240**	**$ 1,733,896**	**$ 1,808,536**	**$ 1,883,176**

Expenses		**FORECAST BASIS**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Excise Taxes		*Calculated*	$ 32,083	$ 30,000	$ 32,017	$ 35,756	$ 36,294	$ 36,837	$ 37,383	$ 37,934	$ 49,105	$ 51,035
Sewer												
Salaries & Wages	1	General Cost Inflation	$ 162,681	$ 313,567	$ 264,683	$ 270,586	$ 276,621	$ 282,791	$ 289,098	$ 295,546	$ 302,138	$ 308,876
Overtime	1	General Cost Inflation	2,047	1,748	3,130	3,200	3,271	3,344	3,419	3,495	3,573	3,653
Social Security	1	General Cost Inflation	12,315	24,122	20,488	20,945	21,412	21,890	22,378	22,877	23,387	23,909
Retirement	1	General Cost Inflation	13,222	31,532	27,177	27,783	28,403	29,036	29,684	30,346	31,023	31,715
Medical Benefits	1	General Cost Inflation	41,750	67,257	77,521	79,250	81,018	82,824	84,672	86,560	88,491	90,464
L & I	1	General Cost Inflation	2,674	5,907	5,147	5,262	5,379	5,499	5,622	5,747	5,875	6,006
Unemployment Insurance	1	General Cost Inflation	4,942	9,459	8,034	8,213	8,396	8,584	8,775	8,971	9,171	9,375
Supplies	1	General Cost Inflation	22,920	25,000	35,000	35,781	36,579	37,394	38,228	39,081	39,953	40,844
Uniforms	1	General Cost Inflation	1,548	4,000	5,500	5,623	5,748	5,876	6,007	6,141	6,278	6,418
Fuel	1	General Cost Inflation	4,428	7,500	9,000	9,201	9,406	9,616	9,830	10,049	10,274	10,503
Small Equipment	1	General Cost Inflation	18,296	2,500	2,500	2,556	2,613	2,671	2,731	2,792	2,854	2,917
Professional Services	1	General Cost Inflation	53,920	70,000	70,000	71,561	73,157	74,789	76,457	78,162	79,906	81,688
Communications	1	General Cost Inflation	14,967	15,000	8,000	8,178	8,361	8,547	8,738	8,933	9,132	9,336
Advertising	1	General Cost Inflation	436	500	500	511	523	534	546	558	571	583
Rentals	1	General Cost Inflation	-	500	500	511	523	534	546	558	571	583
Insurance	1	General Cost Inflation	28,518	30,600	30,600	31,282	31,980	32,693	33,423	34,168	34,930	35,709
Utilities	1	General Cost Inflation	110,262	95,000	100,000	102,230	104,510	106,841	109,224	111,660	114,151	116,697
Repair/maintenance	1	General Cost Inflation	16,544	20,000	30,000	30,669	31,353	32,052	32,767	33,498	34,245	35,009
Miscellaneous	1	General Cost Inflation	12,155	-	-	-	-	-	-	-	-	-
Meeting, Training & travel	1	General Cost Inflation	2,476	3,000	5,000	5,112	5,226	5,342	5,461	5,583	5,708	5,835
credit card bank fees	1	General Cost Inflation	-	-	-	-	-	-	-	-	-	-
dues	1	General Cost Inflation	165	500	500	511	523	534	546	558	571	583
Interfund Payment for service	1	General Cost Inflation	167,187	154,395	154,395	157,839	161,359	164,958	168,637	172,398	176,243	180,174
Permits	1	General Cost Inflation	7,880	9,000	9,000	9,201	9,406	9,616	9,830	10,049	10,274	10,503
Expensed Capital Outlay [from CIP]												
Infiltration and Inflow Study	1	General Cost Inflation		-	-	53,684	-	-	-	-	64,127	
Rate Study	1	General Cost Inflation		-	-	-	55,627	-	-	-	-	-
Interfund Transfers												
Transfer To Equip Replaceme	7	No Escalation	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Add'l O&M from CIP		*From CIP*	-	-	-	-	-	-	-	-	-	-
Total Cash O&M Expenditures			**$ 773,416**	**$ 961,087**	**$ 938,692**	**$ 1,015,445**	**$ 1,037,687**	**$ 1,002,804**	**$ 1,024,002**	**$ 1,045,666**	**$ 1,142,548**	**$ 1,102,416**

City of Stanwood
Sewer Utility Rate Study
Operating Revenue and Expend

Revenues		FORECAST BASIS	Projection 2023	Projection 2024	Projection 2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Rate revenues															
Sewer Service Charge	5	Customer Growth	$ 1,957,093	$ 2,031,705	$ 2,106,317	$ 2,180,930	$ 2,255,542	$ 2,330,154	$ 2,404,767	$ 2,479,379	$ 2,553,991	$ 2,628,603	$ 2,703,216	$ 2,777,828	$ 2,852,440
Sewer-Other Fees	5	Customer Growth	$ 723	$ 750	$ 778	$ 805	$ 833	$ 860	$ 888	$ 915	$ 943	$ 971	$ 998	$ 1,026	$ 1,053
Total Rate Revenue			**$ 1,957,816**	**$ 2,032,455**	**$ 2,107,095**	**$2,181,735**	**$2,256,375**	**$2,331,015**	**$2,405,654**	**$2,480,294**	**$2,554,934**	**$2,629,574**	**$2,704,214**	**$2,778,854**	**$ 2,853,493**
Non-rate revenues															
Miscellaneous	7	No Escalation	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Non-rate revenues			**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
TOTAL REVENUES			**$ 1,957,816**	**$ 2,032,455**	**$ 2,107,095**	**$2,181,735**	**$2,256,375**	**$2,331,015**	**$2,405,654**	**$2,480,294**	**$2,554,934**	**$2,629,574**	**$2,704,214**	**$2,778,854**	**$ 2,853,493**
Expenses		**FORECAST BASIS**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Excise Taxes		*Calculated*	$ 52,982	$ 54,946	$ 56,927	$ 58,928	$ 60,947	$ 62,987	$ 65,047	$ 67,128	$ 69,231	$ 71,358	$ 73,508	$ 75,682	$ 77,883
Sewer															
Salaries & Wages	1	General Cost Inflation	$ 315,765	$ 322,808	$ 330,008	$ 337,368	$ 344,892	$ 352,585	$ 360,448	$ 368,488	$ 376,706	$ 385,108	$ 393,697	$ 402,478	$ 411,455
Overtime	1	General Cost Inflation	3,734	3,817	3,902	3,990	4,079	4,169	4,262	4,358	4,455	4,554	4,656	4,759	4,866
Social Security	1	General Cost Inflation	24,442	24,987	25,545	26,114	26,697	27,292	27,901	28,523	29,159	29,810	30,474	31,154	31,849
Retirement	1	General Cost Inflation	32,422	33,145	33,884	34,640	35,413	36,203	37,010	37,835	38,679	39,542	40,424	41,325	42,247
Medical Benefits	1	General Cost Inflation	92,482	94,545	96,653	98,809	101,013	103,266	105,569	107,924	110,331	112,791	115,307	117,879	120,508
L & I	1	General Cost Inflation	6,140	6,277	6,417	6,560	6,707	6,856	7,009	7,166	7,325	7,489	7,656	7,827	8,001
Unemployment Insurance	1	General Cost Inflation	9,585	9,798	10,017	10,240	10,469	10,702	10,941	11,185	11,434	11,689	11,950	12,217	12,489
Supplies	1	General Cost Inflation	41,755	42,686	43,638	44,611	45,606	46,624	47,663	48,726	49,813	50,924	52,060	53,221	54,408
Uniforms	1	General Cost Inflation	6,561	6,708	6,857	7,010	7,167	7,327	7,490	7,657	7,828	8,002	8,181	8,363	8,550
Fuel	1	General Cost Inflation	10,737	10,976	11,221	11,472	11,727	11,989	12,256	12,530	12,809	13,095	13,387	13,685	13,991
Small Equipment	1	General Cost Inflation	2,982	3,049	3,117	3,187	3,258	3,330	3,405	3,480	3,558	3,637	3,719	3,802	3,886
Professional Services	1	General Cost Inflation	83,510	85,372	87,276	89,223	91,213	93,247	95,327	97,453	99,626	101,848	104,120	106,442	108,816
Communications	1	General Cost Inflation	9,544	9,757	9,974	10,197	10,424	10,657	10,894	11,137	11,386	11,640	11,899	12,165	12,436
Advertising	1	General Cost Inflation	596	610	623	637	652	666	681	696	712	727	744	760	777
Rentals	1	General Cost Inflation	596	610	623	637	652	666	681	696	712	727	744	760	777
Insurance	1	General Cost Inflation	36,506	37,320	38,152	39,003	39,873	40,762	41,671	42,601	43,551	44,522	45,515	46,530	47,568
Utilities	1	General Cost Inflation	119,299	121,960	124,680	127,461	130,304	133,210	136,181	139,218	142,324	145,498	148,743	152,060	155,452
Repair/maintenance	1	General Cost Inflation	35,790	36,588	37,404	38,238	39,091	39,963	40,854	41,766	42,697	43,649	44,623	45,618	46,636
Miscellaneous	1	General Cost Inflation	-	-	-	-	-	-	-	-	-	-	-	-	-
Meeting, Training & travel	1	General Cost Inflation	5,965	6,098	6,234	6,373	6,515	6,661	6,809	6,961	7,116	7,275	7,437	7,603	7,773
credit card bank fees	1	General Cost Inflation	-	-	-	-	-	-	-	-	-	-	-	-	-
dues	1	General Cost Inflation	596	610	623	637	652	666	681	696	712	727	744	760	777
Interfund Payment for service	1	General Cost Inflation	184,192	188,300	192,500	196,794	201,183	205,670	210,257	214,946	219,740	224,641	229,652	234,774	240,010
Permits	1	General Cost Inflation	10,737	10,976	11,221	11,472	11,727	11,989	12,256	12,530	12,809	13,095	13,387	13,685	13,991
Expensed Capital Outlay [from CIP]															
Infiltration and Inflow Study	1	General Cost Inflation													
Rate Study	1	General Cost Inflation	-	-	-	-	-	-	-	-	-	-	-	-	-
Interfund Transfers															
Transfer To Equip Replaceme	7	No Escalation	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000	40,000
Add'l O&M from CIP		*From CIP*	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Cash O&M Expenditures			**$ 1,126,920**	**$ 1,151,944**	**$ 1,177,501**	**$1,203,601**	**$1,230,259**	**$1,257,486**	**$1,285,295**	**$1,313,700**	**$1,342,714**	**$1,372,351**	**$1,402,625**	**$1,433,552**	**$ 1,465,145**

City of Stanwood
Sewer Utility Rate Study
Existing Debt

Existing Debt Service - Revenue Bonds	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
2011 Water and Sewer Revenue Bonds	**ALL TO WATER**																					
Annual Interest Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Use of Debt reserve for Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL REVENUE BONDS																						
Annual Interest Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Use of Debt reserve for Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annual Debt Reserve Target on Existing Rev	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Existing State Loan Debt	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
SRF Loan WWTP																						
Annual Interest Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	465,029	465,029	465,029	465,029	465,029	465,029	465,029	465,029	465,029	465,029	465,029	23,221	11,610	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ 465,029	$465,029	$465,029	$465,029	$465,029	$465,029	$465,029	$465,029	$465,029	$465,029	$465,029	$ 23,221	$ 11,610	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PWTF- 271st Trunkline																						
Annual Interest Payment	$ 6,950	$ 6,415	$ 5,881	$ 5,346	$ 4,811	$ 4,277	$ 3,742	$ 3,208	$ 2,673	$ 2,138	$ 1,604	$ 1,069	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	106,921	106,921	106,921	106,921	106,921	106,921	106,921	106,921	106,921	106,921	106,921	106,921	106,921	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ 113,871	$113,336	$112,802	$112,267	$111,732	$111,198	$110,663	$110,129	$109,594	$109,059	$108,525	$107,990	$107,456		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Interest Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL PWTF LOANS																						
Annual Interest Payment	$ 6,950	$ 6,415	$ 5,881	$ 5,346	$ 4,811	$ 4,277	$ 3,742	$ 3,208	$ 2,673	$ 2,138	$ 1,604	$ 1,069	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	130,142	118,531	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ 578,900	$578,365	$577,831	$577,296	$576,761	$576,227	$575,692	$575,158	$574,623	$574,088	$573,554	$131,211	$119,066	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Total Existing Debt Service	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
TOTAL EXISTING LOANS																						
Annual Interest Payment	$ 6,950	$ 6,415	$ 5,881	$ 5,346	$ 4,811	$ 4,277	$ 3,742	$ 3,208	$ 2,673	$ 2,138	$ 1,604	$ 1,069	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payment	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	130,142	118,531	-	-	-	-	-	-	-	-	-
Total Annual Payment	$ 578,900	$578,365	$577,831	$577,296	$576,761	$576,227	$575,692	$575,158	$574,623	$574,088	$573,554	$131,211	$119,066	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

City of Stanwood
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year:	2014

	No	Description	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
EX1	1	Sewer Drainage Basin 1 Pipe Replacement Program	$ -	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429
EX2	2	Collector/Interceptor System Flow Monitoring and Video	-	40,000	-	40,000	-	40,000	-	40,000	27,571	27,571	27,571
EX3	3	270th Street NW Pipe Construction	-	100,000	-	-	-	-	-	-	-		
EX4	4	272nd Street NW and 76th Drive NW Gravity Main Replacement	-	-	-	-	96,450	546,550	-	-	-		
EX5A	5	Church Creek Collection System Construction	-	-	-	-	-	-	-	-	146,429	146,429	146,429
EX5B	6	Cedarhome Collection System Construction	-	-	-	-	-	-	-	-	-		
EX13	7	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	-	-	-	-	47,200	188,800	-	-	-		
EX14	8	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	-	169,000	760,500	760,500	-	-	-	-	-		
EX15	9	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	-	-	-	-	-	-	40,650	230,350	-		
EX16	10	Upper Pioneer Highway Interceptor Existing Deficiencies	-	-	-	-	85,800	486,200	-	-	-		
EX17	11	Pioneer Highway Interceptor Existing Deficiencies	-	-	-	-	-	-	-	-	79,857	79,857	79,857
EX18	12	Lower Pioneer Highway Interceptor Existing Deficiencies	-	-	-	-	-	-	-	-	12,193	12,193	12,193
EX19	13	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	-	-	-	-	-	-	-	107,550	87,064	87,064	87,064
EX20	14	265th Street NW Gravity Main Existing Deficiencies									20,714	20,714	20,714
EX6	15	Miscellaneous Improvements	-	35,000	35,000	35,000	35,000	35,000	35,000	35,000	30,000	30,000	30,000
EX7	16	Telemetry System Upgrades	40,000	10,000	50,000	15,000	-	-	-	-	11,429	11,429	11,429
EX8A	17	Long-term Biosolids Utilization Study	-	110,000	-	-	-	-	-	-			
EX8B	18	Long-term Biosolids Utilization Modifications	-	-	288,750	545,417	545,417	545,417	-	-			
EX8C	19	Biosolids Removal and Utilization	-	-	-	-	-	-	500,000	-			
EX9	20	Grit Removal Unit Installation	-	-	-	-	50,750	76,125	76,125	-			
EX10	21	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	-	-	-	48,000	-	-	-	-			
EX11	22	Sheet Pile Installation	-	-	-	-	200,000	-	250,000	250,000	600,000	600,000	600,000
EX12	23	Main Lift Station (Lift Station 4) Force Main Upgrades	-	72,900	413,100	-	-	-	-	-			
M1	24	Inflow and Infiltration Study **[O&M per CIP notes-see O&M page]**											
M2	25	Comprehensive Sewer System Plan Update	101,000	15,000	-	-	-	-	-	-			
M3	26	Sewer Rate Study **[O&M per CIP notes-see O&M page]**											
M4	27	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates1	-	-	-	-	-	-	-	66,667	19,048	19,048	19,048
M5	28	Wastewater Treatment Plant Update and Expansion2,3											
		Total Capital Projects	**$ 141,000**	**$ 826,329**	**$ 1,821,779**	**$ 1,718,345**	**$ 1,335,045**	**$ 2,192,520**	**$ 1,176,204**	**$ 1,003,995**	**$ 1,308,733**	**$ 1,308,733**	**$ 1,308,733**
		Total Upgrade/Expansion Projects	40,000	295,807	764,599	621,166	809,262	689,637	330,270	282,045	771,017	771,017	771,017
		Total R&R Projects	101,000	530,521	1,057,179	1,097,179	525,783	1,502,883	845,933	721,950	537,717	537,717	537,717
		Projects by Grants / Developer Donations											
		Projects by Enterprise Fund											

City of Stanwood
Sewer Utility Rate Study
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Project Costs and O&M Impacts in Year:

No	Description	2025	2026	2027	2028	2029	2030	2031	2032	2033
1	Sewer Drainage Basin 1 Pipe Replacement Program	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429	$ 274,429
2	Collector/Interceptor System Flow Monitoring and Video	27,571	27,571	27,571	27,571	-				
3	270th Street NW Pipe Construction					-				
4	272nd Street NW and 76th Drive NW Gravity Main Replacement					-				
5	Church Creek Collection System Construction	146,429	146,429	146,429	146,429	-				
6	Cedarhome Collection System Construction					25,000	25,000	25,000	25,000	25,000
7	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies					-				
8	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies					-				
9	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies					-				
10	Upper Pioneer Highway Interceptor Existing Deficiencies					-				
11	Pioneer Highway Interceptor Existing Deficiencies	79,857	79,857	79,857	79,857	-				
12	Lower Pioneer Highway Interceptor Existing Deficiencies	12,193	12,193	12,193	12,193	69,093	69,093	69,093	69,093	69,093
13	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	87,064	87,064	87,064	87,064	-				
14	265th Street NW Gravity Main Existing Deficiencies	20,714	20,714	20,714	20,714	-				
15	Miscellaneous Improvements	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
16	Telemetry System Upgrades	11,429	11,429	11,429	11,429	11,429	11,429	11,429	11,429	11,429
17	Long-term Biosolids Utilization Study									
18	Long-term Biosolids Utilization Modifications									
19	Biosolids Removal and Utilization									
20	Grit Removal Unit Installation									
21	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades									
22	Sheet Pile Installation	600,000	600,000	600,000	600,000					
23	Main Lift Station (Lift Station 4) Force Main Upgrades									
24	Inflow and Infiltration Study **[O&M per CIP notes-see O&M page]**									
25	Comprehensive Sewer System Plan Update					16,571	16,571	16,571	16,571	16,571
26	Sewer Rate Study **[O&M per CIP notes-see O&M page]**									
27	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates1	19,048	19,048	19,048	19,048					
28	Wastewater Treatment Plant Update and Expansion2,3					1,642,571	1,642,571	1,642,571	1,642,571	1,642,571
	Total Capital Projects	**$ 1,308,733**	**$ 1,308,733**	**$ 1,308,733**	**$ 1,308,733**	**$ 2,069,093**	**$ 2,069,093**	**$ 2,069,093**	**$ 2,069,093**	**$ 2,069,093**
	Total Upgrade/Expansion Projects	771,017	771,017	771,017	771,017	1,684,317	1,684,317	1,684,317	1,684,317	1,684,317
	Total R&R Projects	537,717	537,717	537,717	537,717	384,776	384,776	384,776	384,776	384,776
	Projects by Grants / Developer Donations									
	Projects by Enterprise Fund									

City of Stanwood
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year:

No	Description	2034	2035	Annual O&M Impact	Useful Life (Years)	Function	For GFC Calculation: % Upgrade / Expansion	For GFC Calculation: % R&R	Specific Funding Source 1-Balances, 2-CIAC		Upgrade / Expansion	R&R
1	Sewer Drainage Basin 1 Pipe Replacement Program	$ 274,429	$ 274,429		50		0%	100%	1	Balances	$ 1,048	$3,017,667
2	Collector/Interceptor System Flow Monitoring and Video				50		0%	100%	1	Balances	-	270,286
3	270th Street NW Pipe Construction				50		100%	0%	1	Balances	100,000	-
4	272nd Street NW and 76th Drive NW Gravity Main Replacement				50		0%	100%	1	Balances	-	643,000
5	Church Creek Collection System Construction				50		100%	0%	1	Balances	585,714	-
6	Cedarhome Collection System Construction	25,000	25,000		50		100%	0%	1	Balances	-	-
7	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies				50		7%	93%	1	Balances	17,000	219,000
8	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies				50		2%	98%	1	Balances	28,120	1,661,880
9	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies				50		10%	90%	1	Balances	27,000	244,000
10	Upper Pioneer Highway Interceptor Existing Deficiencies				50		11%	89%	1	Balances	64,000	508,000
11	Pioneer Highway Interceptor Existing Deficiencies				50		4%	96%	1	Balances	13,714	305,714
12	Lower Pioneer Highway Interceptor Existing Deficiencies	69,093	69,093		50		8%	92%	1	Balances	3,686	45,086
13	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies				50		8%	92%	1	Balances	38,143	417,664
14	265th Street NW Gravity Main Existing Deficiencies				50		7%	93%	1	Balances	5,714	77,143
15	Miscellaneous Improvements	30,000	30,000		50		0%	100%	1	Balances	-	365,000
16	Telemetry System Upgrades	11,429	11,429		50		100%	0%	1	Balances	160,714	-
17	Long-term Biosolids Utilization Study				50		100%	0%	1	Balances	110,000	-
18	Long-term Biosolids Utilization Modifications				50		100%	0%	1	Balances	1,925,000	-
19	Biosolids Removal and Utilization				50		0%	100%	1	Balances	-	500,000
20	Grit Removal Unit Installation				50		100%	0%	1	Balances	203,000	-
21	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades				50		100%	0%	1	Balances	48,000	-
22	Sheet Pile Installation				50		100%	0%	1	Balances	3,100,000	-
23	Main Lift Station (Lift Station 4) Force Main Upgrades				50		100%	0%	1	Balances	486,000	-
24	Inflow and Infiltration Study **[O&M per CIP notes-see O&M page]**				50		0%	100%	1	Balances	-	-
25	Comprehensive Sewer System Plan Update	16,571	16,571		50		0%	100%	1	Balances	-	116,000
26	Sewer Rate Study **[O&M per CIP notes-see O&M page]**				50		0%	100%	1	Balances	-	-
27	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates1				50		0%	100%	1	Balances	-	142,857
28	Wastewater Treatment Plant Update and Expansion2,3	1,642,571	1,642,571		50		100%	0%	1	Balances	-	-
	Total Capital Projects	**$ 2,069,093**	**$ 2,069,093**	**$ -**			**43%**	**57%**			**$ 6,916,853**	**$ 8,533,297**
	Total Upgrade/Expansion Projects	1,684,317	1,684,317				6,145,836	7,995,580				
	Total R&R Projects	384,776	384,776									
	Projects by Grants / Developer Donations			-							-	-
	Projects by Enterprise Fund			-							6,916,853	8,533,297

City of Stanwood
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year:

TOTAL FORECASTED PROJECT COSTS

No	Description	TOTAL ESCALATED COSTS	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	Sewer Drainage Basin 1 Pipe Replacement Program	$ 4,180,475	$ -	$ 284,360	$ 294,650	$ 305,313	$ 316,361	$ 327,810	$ 339,672	$ 351,964	$ 364,701	$ 377,899
2	Collector/Interceptor System Flow Monitoring and Video	381,984	-	41,448	-	44,502	-	47,781	-	51,301	36,641	37,967
3	270th Street NW Pipe Construction	103,619	-	103,619	-	-	-	-	-	-	-	-
4	272nd Street NW and 76th Drive NW Gravity Main Replacement	764,051	-	-	-	-	111,188	652,863	-	-	-	-
5	Church Creek Collection System Construction	1,045,994	-	-	-	-	-	-	-	-	194,596	201,638
6	Cedarhome Collection System Construction	-	-	-	-	-	-	-	-	-	-	-
7	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	279,937	-	-	-	-	54,412	225,525	-	-	-	-
8	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	1,837,739	-	175,116	816,538	846,086	-	-	-	-	-	-
9	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	345,746	-	-	-	-	-	-	50,314	295,432	-	-
10	Upper Pioneer Highway Interceptor Existing Deficiencies	679,684	-	-	-	-	98,910	580,774	-	-	-	-
11	Pioneer Highway Interceptor Existing Deficiencies	570,449	-	-	-	-	-	-	-	-	106,126	109,966
12	Lower Pioneer Highway Interceptor Existing Deficiencies	87,098	-	-	-	-	-	-	-	-	16,204	16,790
13	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	759,869	-	-	-	-	-	-	-	137,937	115,704	119,891
14	265th Street NW Gravity Main Existing Deficiencies	147,970	-	-	-	-	-	-	-	-	27,528	28,524
15	Miscellaneous Improvements	497,451	-	36,267	37,579	38,939	40,348	41,808	43,321	44,889	39,868	41,311
16	Telemetry System Upgrades	202,373	40,000	10,362	53,684	16,688	-	-	-	-	15,188	15,738
17	Long-term Biosolids Utilization Study	113,981	-	113,981	-	-	-	-	-	-	-	-
18	Long-term Biosolids Utilization Modifications	2,197,090	-	-	310,027	606,798	628,756	651,509	-	-	-	-
19	Biosolids Removal and Utilization	618,872	-	-	-	-	-	-	618,872	-	-	-
20	Grit Removal Unit Installation	243,660	-	-	-	-	58,505	90,933	94,223	-	-	-
21	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	53,402	-	-	-	53,402	-	-	-	-	-	-
22	Sheet Pile Installation	5,146,653	-	-	-	-	230,560	-	309,436	320,634	797,368	826,223
23	Main Lift Station (Lift Station 4) Force Main Upgrades	519,077	-	75,538	443,539	-	-	-	-	-	-	-
24	Inflow and Infiltration Study **[O&M per CIP notes-see O&M page]**	-	-	-	-	-	-	-	-	-	-	-
25	Comprehensive Sewer System Plan Update	116,543	101,000	15,543	-	-	-	-	-	-	-	-
26	Sewer Rate Study **[O&M per CIP notes-see O&M page]**	-	-	-	-	-	-	-	-	-	-	-
27	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates1	221,567	-	-	-	-	-	-	-	85,502	25,313	26,229
28	Wastewater Treatment Plant Update and Expansion2,3	-	-	-	-	-	-	-	-	-	-	-
	Total Capital Projects	**$ 21,115,285**	**$ 141,000**	**$ 856,232**	**$ 1,956,017**	**$ 1,911,727**	**$ 1,539,040**	**$ 2,619,003**	**$ 1,455,839**	**$ 1,287,659**	**$ 1,739,237**	**$ 1,802,177**
	Total Upgrade/Expansion Projects	9,893,404	40,000	306,512	820,939	691,071	932,917	823,783	408,790	361,733	1,024,640	1,061,720
	Total R&R Projects	11,221,881	101,000	549,720	1,135,078	1,220,655	606,123	1,795,220	1,047,049	925,926	714,597	740,457
	Projects by Grants / Developer Donations	-	-	-	-	-	-	-	-	-	-	-
	Projects by Enterprise Fund	21,115,285	141,000	856,232	1,956,017	1,911,727	1,539,040	2,619,003	1,455,839	1,287,659	1,739,237	1,802,177

City of Stanwood
Sewer Utility Rate Study
Capital Improvement Program

Project Costs and O&M Impacts in Year:

No	Description	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	Sewer Drainage Basin 1 Pipe Replacement Program	$ 391,574	$ 405,744	$ 420,427	$ 435,642	$ 451,407	$ 467,742	$ 484,668	$ 502,208	$ 520,381	$ 539,213	$ 558,726	$ 578,945
2	Collector/Interceptor System Flow Monitoring and Video	39,341	40,765	42,240	43,768	45,352	-	-	-	-	-	-	-
3	270th Street NW Pipe Construction	-	-	-	-	-	-	-	-	-	-	-	-
4	272nd Street NW and 76th Drive NW Gravity Main Replacement	-	-	-	-	-	-	-	-	-	-	-	-
5	Church Creek Collection System Construction	208,935	216,496	224,330	232,448	240,860	-	-	-	-	-	-	-
6	Cedarhome Collection System Construction	-	-	-	-	-	42,611	44,153	45,750	47,406	49,121	50,899	52,741
7	99th Avenue NW and 272nd Street NW Gravity Main Existing Deficiencies	-	-	-	-	-	-	-	-	-	-	-	-
8	94th Drive NW and 271st Street NW Gravity Main Existing Deficiencies	-	-	-	-	-	-	-	-	-	-	-	-
9	Sewer Drainage Basin 1 Primary Interceptor Existing Deficiencies	-	-	-	-	-	-	-	-	-	-	-	-
10	Upper Pioneer Highway Interceptor Existing Deficiencies	-	-	-	-	-	-	-	-	-	-	-	-
11	Pioneer Highway Interceptor Existing Deficiencies	113,946	118,069	122,342	126,769	131,357	-	-	-	-	-	-	-
12	Lower Pioneer Highway Interceptor Existing Deficiencies	17,398	18,027	18,680	19,356	20,056	117,763	122,025	126,441	131,016	135,758	140,670	145,761
13	72nd Avenue NW and 261st Street NW Interceptor Existing Deficiencies	124,229	128,725	133,383	138,210	143,212	-	-	-	-	-	-	-
14	265th Street NW Gravity Main Existing Deficiencies	29,557	30,626	31,734	32,883	34,073	-	-	-	-	-	-	-
15	Miscellaneous Improvements	42,806	44,355	45,960	47,623	49,347	51,133	52,983	54,900	56,887	58,946	61,079	63,289
16	Telemetry System Upgrades	16,307	16,897	17,509	18,142	18,799	19,479	20,184	20,914	21,671	22,456	23,268	24,110
17	Long-term Biosolids Utilization Study	-	-	-	-	-	-	-	-	-	-	-	-
18	Long-term Biosolids Utilization Modifications	-	-	-	-	-	-	-	-	-	-	-	-
19	Biosolids Removal and Utilization	-	-	-	-	-	-	-	-	-	-	-	-
20	Grit Removal Unit Installation	-	-	-	-	-	-	-	-	-	-	-	-
21	Ultraviolet Disinfection System Energy Efficiency and Recycle Pump Upgrades	-	-	-	-	-	-	-	-	-	-	-	-
22	Sheet Pile Installation	856,122	887,104	919,206	952,470	986,938	-	-	-	-	-	-	-
23	Main Lift Station (Lift Station 4) Force Main Upgrades	-	-	-	-	-	-	-	-	-	-	-	-
24	Inflow and Infiltration Study **[O&M per CIP notes-see O&M page]**	-	-	-	-	-	-	-	-	-	-	-	-
25	Comprehensive Sewer System Plan Update	-	-	-	-	-	28,245	29,267	30,326	31,423	32,560	33,739	34,960
26	Sewer Rate Study **[O&M per CIP notes-see O&M page]**	-	-	-	-	-	-	-	-	-	-	-	-
27	Comprehensive Sewer System Plan and Wastewater Facilities Plan Updates1	27,178	28,162	29,181	30,237	31,331	-	-	-	-	-	-	-
28	Wastewater Treatment Plant Update and Expansion2,3	-	-	-	-	-	2,799,634	2,900,946	3,005,925	3,114,703	3,227,417	3,344,210	3,465,230
	Total Capital Projects	**$ 1,867,393**	**$ 1,934,970**	**$ 2,004,993**	**$2,077,549**	**$2,152,731**	**$3,526,606**	**$3,654,226**	**$3,786,465**	**$3,923,488**	**$4,065,471**	**$4,212,591**	**$4,365,035**
	Total Upgrade/Expansion Projects	1,100,141	1,139,953	1,181,205	1,223,950	1,268,242	2,870,785	2,974,673	3,082,320	3,193,862	3,309,441	3,429,202	3,553,297
	Total R&R Projects	767,252	795,017	823,787	853,598	884,488	655,821	679,553	704,145	729,626	756,030	783,389	811,738
	Projects by Grants / Developer Donations	-	-	-	-	-	-	-	-	-	-	-	-
	Projects by Enterprise Fund	1,867,393	1,934,970	2,004,993	2,077,549	2,152,731	3,526,606	3,654,226	3,786,465	3,923,488	4,065,471	4,212,591	4,365,035

City of Stanwood
Sewer Utility Rate Study
Capital Funding Analysis

Summary of Expenditures	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
CAPITAL PROJECTS										
Improvement Upgrades & Expansions	$ 40,000	$ 306,512	$ 820,939	$ 691,071	$ 932,917	$ 823,783	$ 408,790	$ 361,733	$ 1,024,640	$ 1,061,720
Repairs and Replacements	101,000	549,720	1,135,078	1,220,655	606,123	1,795,220	1,047,049	925,926	714,597	740,457
TOTAL CAPITAL EXPENDITURES	**$ 141,000**	**$ 856,232**	**$ 1,956,017**	**$ 1,911,727**	**$ 1,539,040**	**$ 2,619,003**	**$ 1,455,839**	**$ 1,287,659**	**$ 1,739,237**	**$ 1,802,177**

Capital Financing Plan	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Project- Specific Grants/developer Donations	-	-	-	-	-	-	-	-	-	-
Cost Remaining to be Funded	**$ 141,000**	**$ 856,232**	**$ 1,956,017**	**$ 1,911,727**	**$ 1,539,040**	**$ 2,619,003**	**$ 1,455,839**	**$ 1,287,659**	**$ 1,739,237**	**$ 1,802,177**
OTHER FUNDING SOURCES										
Other Outside Sources	-	-	-	-	-	-	-	-	-	-
PWTF Loans	-	-	-	-	-	-	-	-	-	-
Other Loan Proceeds	-	-	-	-	-	-	-	-	-	-
Capital Fund Balance	141,000	856,232	1,956,017	824,071	290,768	280,390	258,497	420,095	907,106	947,608
Revenue Bond Proceeds	-	-	-	1,087,656	1,248,272	2,338,613	1,197,342	867,564	832,131	854,568
Rate										
Total										
TOTAL CAPITAL RESOURCES	**$ 141,000**	**$ 856,232**	**$ 1,956,017**	**$ 1,911,727**	**$ 1,539,040**	**$ 2,619,003**	**$ 1,455,839**	**$ 1,287,659**	**$ 1,739,237**	**$ 1,802,177**

New Debt Computations	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
REVENUE BONDS										
Amount to Fund	$ -	$ -	$ -	$ 1,087,656	$ 1,248,272	$ 2,338,613	$ 1,197,342	$ 867,564	$ 832,131	$ 854,568
Issuance Costs	-	-	-	18,032	20,695	38,772	19,851	14,383	13,796	14,168
Reserve Required	-	-	-	96,464	110,709	207,411	106,192	76,944	73,801	75,791
Amount of Debt Issue	$ -	$ -	$ -	$ 1,202,152	$ 1,379,675	$ 2,584,795	$ 1,323,385	$ 958,891	$ 919,729	$ 944,528
OTHER LOANS										
Amount to Fund	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Issuance Costs	-	-	-	-	-	-	-	-	-	-
Amount of Debt Issue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PWTF LOANS										
Amount to Fund	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Debt Service Summary	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EXISTING DEBT SERVICE										
Annual Interest Payments	$ 6,950	$ 6,415	$ 5,881	$ 5,346	$ 4,811	$ 4,277	$ 3,742	$ 3,208	$ 2,673	$ 2,138
Annual Principal Payments	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950	571,950
Total Debt Service Payments	$ 578,900	$ 578,365	$ 577,831	$ 577,296	$ 576,761	$ 576,227	$ 575,692	$ 575,158	$ 574,623	$ 574,088
Revenue Bond Payments Only	-	-	-	-	-	-	-	-	-	-
NEW DEBT SERVICE										
Annual Interest Payments	$ -	$ -	$ -	$ 60,108	$ 127,274	$ 252,518	$ 310,584	$ 348,019	$ 381,521	$ 414,247
Annual Principal Payments	-	-	-	36,356	79,899	162,065	210,191	249,699	289,999	333,064
Total Debt Service Payments	$ -	$ -	$ -	$ 96,464	$ 207,172	$ 414,583	$ 520,775	$ 597,719	$ 671,520	$ 747,312
Revenue Bond Payments Only	-	-	-	96,464	207,172	414,583	520,775	597,719	671,520	747,312
TOTAL DEBT SERVICE PAYMENTS	**$ 578,900**	**$ 578,365**	**$ 577,831**	**$ 673,760**	**$ 783,933**	**$ 990,810**	**$ 1,096,467**	**$ 1,172,877**	**$ 1,246,143**	**$ 1,321,400**
Total Interest Payments	6,950	6,415	5,881	65,454	132,085	256,795	314,326	351,227	384,194	416,385
Total Principal Payments	571,950	571,950	571,950	608,306	651,849	734,015	782,141	821,649	861,949	905,014
Total Revenue Bond Payments Only	-	-	-	96,464	207,172	414,583	520,775	597,719	671,520	747,312

City of Stanwood
Sewer Utility Rate Study
Capital Funding Analysis

End Year 2035

Summary of Expenditures	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
CAPITAL PROJECTS												
Improvement Upgrades & Expansions	$ 1,100,141	$ 1,139,953	$ 1,181,205	$ 1,223,950	$ 1,268,242	$ 2,870,785	$ 2,974,673	$ 3,082,320	$ 3,193,862	$ 3,309,441	$ 3,429,202	$ 3,553,297
Repairs and Replacements	767,252	795,017	823,787	853,598	884,488	655,821	679,553	704,145	729,626	756,030	783,389	811,738
TOTAL CAPITAL EXPENDITURES	**$ 1,867,393**	**$ 1,934,970**	**$ 2,004,993**	**$ 2,077,549**	**$ 2,152,731**	**$ 3,526,606**	**$ 3,654,226**	**$ 3,786,465**	**$ 3,923,488**	**$ 4,065,471**	**$ 4,212,591**	**$ 4,365,035**
Capital Financing Plan	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
Project- Specific Grants/developer Donations	-	-	-	-	-	-	-	-	-	-	-	-
Cost Remaining to be Funded	**$ 1,867,393**	**$ 1,934,970**	**$ 2,004,993**	**$ 2,077,549**	**$ 2,152,731**	**$ 3,526,606**	**$ 3,654,226**	**$ 3,786,465**	**$ 3,923,488**	**$ 4,065,471**	**$ 4,212,591**	**$ 4,365,035**
OTHER FUNDING SOURCES												
Other Outside Sources	-	-	-	-	-	-	-	-	-	-	-	-
PWTF Loans	-	-	-	-	-	-	-	-	-	-	-	-
Other Loan Proceeds	-	-	-	-	-	-	-	-	-	-	-	-
Capital Fund Balance	1,199,021	1,287,407	1,798,378	2,009,959	2,099,915	2,189,396	2,279,762	2,372,220	2,465,718	2,560,293	2,655,993	2,752,871
Revenue Bond Proceeds	668,372	647,563	206,614	67,590	52,815	1,337,210	1,374,464	1,414,244	1,457,770	1,505,178	1,556,598	1,612,164
Rate												
Total												
TOTAL CAPITAL RESOURCES	**$ 1,867,393**	**$ 1,934,970**	**$ 2,004,993**	**$ 2,077,549**	**$ 2,152,731**	**$ 3,526,606**	**$ 3,654,226**	**$ 3,786,465**	**$ 3,923,488**	**$ 4,065,471**	**$ 4,212,591**	**$ 4,365,035**
New Debt Computations	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
REVENUE BONDS												
Amount to Fund	$ 668,372	$ 647,563	$ 206,614	$ 67,590	$ 52,815	$ 1,337,210	$ 1,374,464	$ 1,414,244	$ 1,457,770	$ 1,505,178	$ 1,556,598	$ 1,612,164
Issuance Costs	11,081	10,736	3,425	1,121	876	22,170	22,787	23,447	24,168	24,954	25,807	26,728
Reserve Required	59,278	57,432	18,325	5,994	4,684	118,597	121,901	125,429	129,289	133,494	138,054	142,982
Amount of Debt Issue	$ 738,731	$ 715,731	$ 228,364	$ 74,705	$ 58,375	$ 1,477,976	$ 1,519,152	$ 1,563,120	$ 1,611,227	$ 1,663,626	$ 1,720,459	$ 1,781,875
OTHER LOANS												
Amount to Fund	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Issuance Costs	-	-	-	-	-	-	-	-	-	-	-	-
Amount of Debt Issue	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PWTF LOANS												
Amount to Fund	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Debt Service Summary	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
EXISTING DEBT SERVICE												
Annual Interest Payments	$ 1,604	$ 535	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Annual Principal Payments	571,950	118,531	-	-	-	-	-	-	-	-	-	-
Total Debt Service Payments	$ 573,554	$ 119,066	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Revenue Bond Payments Only	-	-	-	-	-	-	-	-	-	-	-	-
NEW DEBT SERVICE												
Annual Interest Payments	$ 434,531	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714	$ 451,714
Annual Principal Payments	372,059	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307
Total Debt Service Payments	$ 806,589	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021
Revenue Bond Payments Only	806,589	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021
TOTAL DEBT SERVICE PAYMENTS	**$ 1,380,143**	**$ 983,087**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**	**$ 864,021**
Total Interest Payments	436,135	452,249	451,714	451,714	451,714	451,714	451,714	451,714	451,714	451,714	451,714	451,714
Total Principal Payments	944,009	530,838	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307	412,307
Total Revenue Bond Payments Only	806,589	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021

City of Stanwood
Sewer Utility Rate Study
Revenue Requirements Analysis

Cash Flow Sufficiency Test	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EXPENSES										
Cash Operating Expenses	$ 961,087	$ 938,692	$ 1,015,445	$ 1,037,687	$ 1,002,804	$ 1,024,002	$ 1,045,666	$ 1,142,548	$ 1,102,416	$ 1,126,920
Existing Debt Service	578,900	578,365	577,831	577,296	576,761	576,227	575,692	575,158	574,623	574,088
New Debt Service	-	-	-	96,464	207,172	414,583	520,775	597,719	671,520	747,312
Rate-Funded CIP	-	-	-	-	-	-	-	-	-	-
Rate Funded System Reinvestment	-	13,281	52,401	54,280	41,518	11,732	-	-	-	-
Additions Required to Meet Minimum Op. Fund Balance	-	-	-	-	-	-	-	-	273,849	61,995
Total Expenses	$ 1,539,987	$ 1,530,338	$ 1,645,677	$ 1,765,726	$ 1,828,255	$ 2,026,544	$ 2,142,133	$ 2,315,425	$ 2,622,408	$ 2,510,315
REVENUES										
Rate Revenue	$ 1,625,618	$ 1,625,618	$ 1,647,273	$ 1,668,929	$ 1,690,585	$ 1,712,240	$ 1,733,896	$ 1,808,536	$ 1,883,176	$ 1,957,816
Other Non Rate Revenue	-	-	-	-	-	-	-	-	-	-
Sewer Fund Intrest Earnings	3,236	4,109	6,188	8,448	10,274	12,505	14,651	14,144	15,759	19,236
Total Revenue	$ 1,628,854	$ 1,629,727	$ 1,653,462	$ 1,677,377	$ 1,700,859	$ 1,724,745	$ 1,748,547	$ 1,822,680	$ 1,898,935	$ 1,977,051
Use of Operating Reserve	-	-	-	-	-	-	-	-	-	-
NET CASH FLOW (DEFICIENCY)	**$ 88,867**	**$ 99,389**	**$ 7,784**	**$ (88,349)**	**$ (127,396)**	**$ (301,799)**	**$ (393,586)**	**$ (492,745)**	**$ (723,474)**	**$ (533,264)**
% of Rate Revenue	-5.47%	-6.11%	-0.47%	5.29%	7.54%	17.63%	22.70%	27.25%	38.42%	27.24%

Coverage Sufficiency Test	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
EXPENSES										
Cash Operating Expenses	$ 921,087	$ 845,008	$ 919,818	$ 997,687	$ 962,804	$ 984,002	$ 941,539	$ 1,102,548	$ 1,062,416	$ 1,086,920
Revenue Bond Debt Service	-	-	-	96,464	207,172	414,583	520,775	597,719	671,520	747,312
Revenue Bond Coverage Requirement at 1.25	-	-	-	24,116	51,793	103,646	130,194	149,430	167,880	186,828
Total Expenses	$ 921,087	$ 845,008	$ 919,818	$ 1,118,267	$ 1,221,769	$ 1,502,231	$ 1,592,508	$ 1,849,696	$ 1,901,817	$ 2,021,060
ALLOWABLE REVENUES										
Rate Revenue	$ 1,625,618	$ 1,625,618	$ 1,647,273	$ 1,668,929	$ 1,690,585	$ 1,712,240	$ 1,733,896	$ 1,808,536	$ 1,883,176	$ 1,957,816
Other Revenue	-	-	-	-	-	-	-	-	-	-
Plant Investment Fee Revenue	25,454	-	220,800	228,248	235,965	243,961	252,247	899,001	929,663	961,435
Interest Earnings - All Funds	9,767	4,109	6,188	8,448	10,274	12,505	14,651	14,144	15,759	19,236
Total Revenue	$ 1,660,839	$ 1,629,727	$ 1,874,262	$ 1,905,625	$ 1,936,823	$ 1,968,706	$ 2,000,794	$ 2,721,682	$ 2,828,598	$ 2,938,486
Coverage Realized	n/a	n/a	n/a	9.41	4.70	2.38	2.03	2.71	2.63	2.48
COVERAGE SURPLUS (DEFICIENCY)	**$ 739,752**	**$ 784,719**	**$ 954,444**	**$ 787,359**	**$ 715,054**	**$ 466,475**	**$ 408,286**	**$ 871,985**	**$ 926,782**	**$ 917,426**

City of Stanwood
Sewer Utility Rate Study
Revenue Requirements Analys

Cash Flow Sufficiency Test	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
EXPENSES												
Cash Operating Expenses	$ 1,151,944	$ 1,177,501	$ 1,203,601	$ 1,230,259	$ 1,257,486	$ 1,285,295	$ 1,313,700	$ 1,342,714	$ 1,372,351	$ 1,402,625	$ 1,433,552	$ 1,465,145
Existing Debt Service	573,554	119,066	-	-	-	-	-	-	-	-	-	-
New Debt Service	806,589	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021
Rate-Funded CIP	-	-	-	-	-	-	-	-	-	-	-	-
Rate Funded System Reinvestment	-	377,954	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485
Additions Required to Meet Minimum Op. Fund Balance	30,321	30,408	30,498	30,589	30,683	30,779	30,876	30,977	31,079	31,184	31,291	31,401
Total Expenses	$ 2,562,408	$ 2,568,951	$ 2,594,606	$ 2,621,355	$ 2,648,675	$ 2,676,580	$ 2,705,083	$ 2,734,197	$ 2,763,937	$ 2,794,316	$ 2,825,349	$ 2,857,052
REVENUES												
Rate Revenue	$ 2,032,455	$ 2,107,095	$ 2,181,735	$ 2,256,375	$ 2,331,015	$ 2,405,654	$ 2,480,294	$ 2,554,934	$ 2,629,574	$ 2,704,214	$ 2,778,854	$ 2,853,493
Other Non Rate Revenue	-	-	-	-	-	-	-	-	-	-	-	-
Sewer Fund Intrest Earnings	20,613	21,509	22,388	22,876	23,242	23,596	25,089	26,617	28,181	29,785	31,432	33,125
Total Revenue	$ 2,053,069	$ 2,128,605	$ 2,204,123	$ 2,279,251	$ 2,354,256	$ 2,429,250	$ 2,505,384	$ 2,581,551	$ 2,657,755	$ 2,733,999	$ 2,810,285	$ 2,886,618
Use of Operating Reserve	-	-	-	-	-	-	-	-	-	-	-	-
NET CASH FLOW (DEFICIENCY)	**$ (509,340)**	**$ (440,346)**	**$ (390,483)**	**$ (342,104)**	**$ (294,419)**	**$ (247,330)**	**$ (199,699)**	**$ (152,646)**	**$ (106,182)**	**$ (60,317)**	**$ (15,064)**	**$ 29,566**
% of Rate Revenue	25.06%	20.90%	17.90%	15.16%	12.63%	10.28%	8.05%	5.97%	4.04%	2.23%	0.54%	-1.04%

Coverage Sufficiency Test	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
EXPENSES												
Cash Operating Expenses	$ 1,111,944	$ 1,137,501	$ 1,163,601	$ 1,190,259	$ 1,217,486	$ 1,245,295	$ 1,273,700	$ 1,302,714	$ 1,332,351	$ 1,362,625	$ 1,393,552	$ 1,465,145
Revenue Bond Debt Service	806,589	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021	864,021
Revenue Bond Coverage Requirement at 1.25	201,647	216,005	216,005	216,005	216,005	216,005	216,005	216,005	216,005	216,005	216,005	216,005
Total Expenses	$ 2,120,181	$ 2,217,527	$ 2,243,628	$ 2,270,286	$ 2,297,512	$ 2,325,322	$ 2,353,726	$ 2,382,740	$ 2,412,378	$ 2,442,652	$ 2,473,578	$ 2,545,171
ALLOWABLE REVENUES												
Rate Revenue	$ 2,032,455	$ 2,107,095	$ 2,181,735	$ 2,256,375	$ 2,331,015	$ 2,405,654	$ 2,480,294	$ 2,554,934	$ 2,629,574	$ 2,704,214	$ 2,778,854	$ 2,853,493
Other Revenue	-	-	-	-	-	-	-	-	-	-	-	-
Plant Investment Fee Revenue	994,356	1,028,469	1,063,816	1,100,442	1,138,394	1,177,719	1,218,467	1,260,690	1,304,440	1,349,774	1,396,749	1,445,423
Interest Earnings - All Funds	20,613	21,509	22,388	22,876	23,242	23,596	25,089	26,617	28,181	29,785	31,432	33,125
Total Revenue	$ 3,047,425	$ 3,157,073	$ 3,267,939	$ 3,379,693	$ 3,492,650	$ 3,606,969	$ 3,723,851	$ 3,842,241	$ 3,962,195	$ 4,083,773	$ 4,207,034	$ 4,332,041
Coverage Realized	2.40	2.34	2.44	2.53	2.63	2.73	2.84	2.94	3.04	3.15	3.26	3.32
COVERAGE SURPLUS (DEFICIENCY)	**$ 927,244**	**$ 939,546**	**$ 1,024,311**	**$ 1,109,408**	**$ 1,195,138**	**$ 1,281,647**	**$ 1,370,124**	**$ 1,459,501**	**$ 1,549,818**	**$ 1,641,121**	**$ 1,733,455**	**$ 1,786,870**

Maximum Revenue Deficiency	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Sufficiency Test Driving the Deficiency	*None*	*None*	*None*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*
Maximum Deficiency From Tests	$ -	$ -	$ -	$ 88,349	$ 127,396	$ 301,799	$ 393,586	$ 492,745	$ 723,474	$ 533,264
less: Net Revenue From Prior Rate Increases	-	-	(55,435)	(114,293)	(176,721)	(242,870)	(312,900)	(419,307)	(605,158)	(761,374)
Revenue Deficiency	$ -	$ -	$ -	$ -	$ -	$ 58,929	$ 80,686	$ 73,438	$ 118,315	$ -
Plus: Adjustment for State Excise Tax	-	-	-	-	-	2,360	3,231	2,941	4,738	-
Total Revenue Deficiency	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 61,289**	**$ 83,917**	**$ 76,379**	**$ 123,053**	**$ -**

Rate Increases	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Rate Revenue with no Increase	$ 1,625,618	$ 1,625,618	$ 1,647,273	$ 1,668,929	$ 1,690,585	$ 1,712,240	$ 1,733,896	$ 1,808,536	$ 1,883,176	$ 1,957,816
Revenues from Prior Rate Increases	-	-	57,655	58,413	120,412	186,151	255,790	339,437	454,094	654,335
Rate Revenue Before Rate Increase (Incl. previous increases)	1,625,618	1,625,618	1,704,928	1,727,342	1,810,997	1,898,392	1,989,686	2,147,973	2,337,270	2,612,151
Required Annual Rate Increase	0.00%	0.00%	0.00%	0.00%	0.00%	3.23%	4.22%	3.56%	5.26%	0.00%
Number of Months New Rates Will Be In Effect	12	12	12	12	12	12	12	12	12	12
Info: Percentage Increase to Generate Required Revenue	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*3.23%*	*4.22%*	*3.56%*	*5.26%*	*0.00%*
Policy Induced Rate Increases	0.00%	3.50%	3.50%	3.50%	3.50%	3.50%	4.50%	7.50%		
ANNUAL RATE INCREASE	**0.00%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**3.50%**	**4.50%**	**7.50%**	**5.26%**	**0.00%**
CUMULATIVE RATE INCREASE	**0.00%**	**3.50%**	**7.12%**	**10.87%**	**14.75%**	**18.77%**	**24.11%**	**33.42%**	**40.45%**	**40.45%**

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Balance less minimum balance	$ -	$ -	$ -	$ 72,191	$ 179,606	$ 172,112	$ -	$ -	$ -	$ -
Coverage After Rate Increase	n/a	n/a	n/a	8.85	4.72	2.53	2.32	2.18	2.34	2.21
Days of O & M	134.53	139.01	135.97	162.98	209.56	207.79	149.14	163.12	259.73	274.16
Monthly Charge	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57	$ 52.18	$ 52.18
Incremental Charge per CCF on Winter Average	$ 5.19	$ 5.37	$ 5.56	$ 5.75	$ 5.96	$ 6.16	$ 6.44	$ 6.92	$ 7.29	$ 7.29
Sample Bill at 5 ccf winter average assumption	$ 37.15	$ 38.45	$ 39.80	$ 41.19	$ 42.63	$ 44.12	$ 46.11	$ 49.57	$ 52.18	$ 52.18

Impacts of Rate Increases	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Rate Revenues After Rate Increase	$ 1,625,618	$ 1,682,514	$ 1,764,600	$ 1,850,372	$ 1,939,985	$ 2,033,604	$ 2,151,994	$ 2,412,979	$ 2,644,847	$ 2,749,676
Full Year Rate Revenues After Rate Increase	*1,625,618*	*1,682,514*	*1,764,600*	*1,850,372*	*1,939,985*	*2,033,604*	*2,151,994*	*2,412,979*	*2,644,847*	*2,749,676*
Additional State Taxes Due to Rate Increases	-	2,191	4,517	6,986	9,602	12,373	16,097	23,271	29,324	30,487
Net Cash Flow After Rate Increase	88,867	154,095	120,594	86,108	112,402	7,192	8,415	88,428	282,722	290,105
Coverage After Rate Increase	n/a	n/a	n/a	11.22	5.86	3.12	2.81	3.68	3.72	3.50

Maximum Revenue Deficiency

Maximum Revenue Deficiency	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Sufficiency Test Driving the Deficiency	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*Cash*	*None*
Maximum Deficiency From Tests	$ 509,340	$ 440,346	$ 390,483	$ 342,104	$ 294,419	$ 247,330	$ 199,699	$ 152,646	$ 106,182	$ 60,317	$ 15,064	$ -
less: Net Revenue From Prior Rate Increases	(790,400)	(819,427)	(822,157)	(824,992)	(827,936)	(830,994)	(834,169)	(837,467)	(840,891)	(844,448)	(848,141)	(851,977)
Revenue Deficiency	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Plus: Adjustment for State Excise Tax	-	-	-	-	-	-	-	-	-	-	-	-
Total Revenue Deficiency	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**

Rate Increases

Rate Increases	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Rate Revenue with no Increase	$ 2,032,455	$ 2,107,095	$ 2,181,735	$ 2,256,375	$ 2,331,015	$ 2,405,654	$ 2,480,294	$ 2,554,934	$ 2,629,574	$ 2,704,214	$ 2,778,854	$ 2,853,493
Revenues from Prior Rate Increases	822,049	852,238	855,078	858,026	861,088	864,268	867,571	871,000	874,562	878,261	882,102	886,091
Rate Revenue Before Rate Increase (Incl. previous increases)	2,854,505	2,959,333	3,036,813	3,114,401	3,192,103	3,269,923	3,347,865	3,425,935	3,504,136	3,582,475	3,660,956	3,739,585
Required Annual Rate Increase	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Number of Months New Rates Will Be In Effect	12	12	12	12	12	12	12	12	12	12	12	12
Info: Percentage Increase to Generate Required Revenue	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Policy Induced Rate Increases												
ANNUAL RATE INCREASE	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**
CUMULATIVE RATE INCREASE	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**	**40.45%**

Balance less minimum balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Coverage After Rate Increase	2.15	2.10	2.16	2.22	2.27	2.33	2.39	2.45	2.51	2.56	2.62	2.63
Days of O & M	278.57	281.21	284.36	287.27	290.75	292.43	294.68	296.73	299.41	300.26	301.75	303.07
Monthly Charge	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18
Incremental Charge per CCF on Winter Average	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29	$ 7.29
Sample Bill at 5 ccf winter average assumption	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18	$ 52.18

Impacts of Rate Increases

Impacts of Rate Increases	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Rate Revenues After Rate Increase	$ 2,854,505	$ 2,959,333	$ 3,036,813	$ 3,114,401	$ 3,192,103	$ 3,269,923	$ 3,347,865	$ 3,425,935	$ 3,504,136	$ 3,582,475	$ 3,660,956	$ 3,739,585
Full Year Rate Revenues After Rate Increase	*2,854,505*	*2,959,333*	*3,064,162*	*3,168,991*	*3,273,820*	*3,378,648*	*3,483,477*	*3,588,306*	*3,693,135*	*3,797,963*	*3,902,792*	*4,007,621*
Additional State Taxes Due to Rate Increases	31,649	32,811	32,920	33,034	33,152	33,274	33,401	33,534	33,671	33,813	33,961	34,115
Net Cash Flow After Rate Increase	311,382	409,489	462,172	513,477	564,200	614,442	665,346	715,798	765,789	815,314	864,368	912,943
Coverage After Rate Increase	3.38	3.29	3.39	3.49	3.59	3.70	3.80	3.91	4.02	4.13	4.24	4.30

City of Stanwood
Sewer Utility Rate Study
Fund Activity

Funds	2014	2015	2016	2017	2018	2019	2020	2021
Sewer Fund - 401 — Perform Transfer?	Yes							
Beginning Balance	$ 826,879	$ 354,240	$ 357,508	$ 377,237	$ 463,345	$ 575,747	$ 582,939	$ 426,091
plus: Net Cash Flow after Rate Increase	88,867	154,095	120,594	86,108	112,402	7,192	8,415	88,428
less: Transfer of Surplus to Capital Fund	(561,506)	(150,827)	(100,865)	-	-	-	(165,264)	(3,904)
Ending Balance	**$ 354,240**	**$ 357,508**	**$ 377,237**	**$ 463,345**	**$ 575,747**	**$ 582,939**	**$ 426,091**	**$ 510,615**
Operating Reserves	*$ 157,987*	*$ 154,306*	*$ 166,922*	*$ 170,579*	*$ 164,844*	*$ 168,329*	*$ 171,890*	*$ 187,816*
Revenue Stabilization Reserve	*196,253*	*203,202*	*210,314*	*220,575*	*231,296*	*242,498*	*254,201*	*322,799*
Minimum Target Balance	*$ 354,240*	*$ 357,508*	*$ 377,237*	*$ 391,154*	*$ 396,141*	*$ 410,827*	*$ 426,091*	*$ 510,615*
Maximum Funds to be Kept as Operating Reserves	*$ 354,240*	*$ 357,508*	*$ 377,237*	*$ 391,154*	*$ 396,141*	*$ 410,827*	*$ 426,091*	*$ 510,615*
Info: No of Days of Cash Operating Expenses	*135*	*139*	*136*	*163*	*210*	*208*	*149*	*163*
Sewer Construction Funds - 403-407								
Beginning Balance	$ 2,612,418	$ 3,064,909	$ 2,388,110	$ 824,071	$ 290,768	$ 280,390	$ 258,497	$ 420,095
plus: Rate-Funded System Reinvestment	-	13,281	52,401	54,280	41,518	11,732	-	-
plus: Transfer from Sewer Fund	561,506	150,827	100,865	-	-	-	165,264	3,904
plus: Grants / Developer Donations / Other Outside Sources	-	-	-	-	-	-	-	-
plus: PIF and Connection Charge Revenue	25,454	-	220,800	228,248	235,965	243,961	252,247	899,001
plus: Net Debt Proceeds Available for Projects	-	-	-	1,087,656	1,248,272	2,338,613	1,197,342	867,564
plus: Direct Rate Funding	-	-	-	-	-	-	-	-
plus: Interest Earnings	6,531	15,325	17,911	8,241	2,908	2,804	2,585	4,201
less: Capital Expenditures	(141,000)	(856,232)	(1,956,017)	(1,911,727)	(1,539,040)	(2,619,003)	(1,455,839)	(1,287,659)
Ending Balance	3,064,909	2,388,110	824,071	290,768	280,390	258,497	420,095	907,106
Minimum Target Balance	34,114	42,676	62,236	81,354	96,744	122,934	137,493	150,369
Sewer Bond Reserve - 452								
Beginning Balance	$ 467,571	$ 467,571	$ 467,571	$ 467,571	$ 564,035	$ 674,743	$ 882,154	$ 988,346
plus: Reserve Funding from New Debt	-	-	-	96,464	110,709	207,411	106,192	76,944
less: Use of Reserves for Debt Service	-	-	-	-	-	-	-	-
Ending Balance	$ 467,571	$ 467,571	$ 467,571	$ 564,035	$ 674,743	$ 882,154	$ 988,346	######
Minimum Target Balance	$ -	$ -	$ -	$ 96,464	$ 207,172	$ 414,583	$ 520,775	$ 597,719

401	Sewer Fund	826,879
403	Sewer Construction	1,852,718
405	Sewer PIF	759,700
406	Trunkline	-
407	Treatment Plant	-
452	Sewer Bond Reserve	467,571

City of Stanwood
Sewer Utility Rate Stud
Fund Activity

Funds	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Sewer Fund - 401 Perform Transfer?														
Beginning Balance	$ 510,615	$ 784,464	$ 846,459	$ 876,780	$ 907,188	$ 937,686	$ 968,275	$ 998,958	$ 1,029,736	$ 1,060,613	$ 1,091,589	$ 1,122,668	$ 1,153,852	$ 1,185,143
plus: Net Cash Flow after Rate Increase	282,722	290,105	311,382	409,489	462,172	513,477	564,200	614,442	665,346	715,798	765,789	815,314	864,368	912,943
less: Transfer of Surplus to Capital Fund	(8,874)	(228,110)	(281,061)	(379,081)	(431,674)	(482,888)	(533,518)	(583,664)	(634,470)	(684,821)	(734,710)	(784,130)	(833,077)	(881,543)
Ending Balance	**$ 784,464**	**$ 846,459**	**$ 876,780**	**$ 907,188**	**$ 937,686**	**$ 968,275**	**$ 998,958**	**$ 1,029,736**	**$ 1,060,613**	**$ 1,091,589**	**$ 1,122,668**	**$ 1,153,852**	**$ 1,185,143**	**$ 1,216,544**
Operating Reserves	*$ 181,219*	*$ 185,247*	*$ 189,361*	*$ 193,562*	*$ 197,852*	*$ 202,234*	*$ 206,710*	*$ 211,281*	*$ 215,951*	*$ 220,720*	*$ 225,592*	*$ 230,569*	*$ 235,652*	*$ 240,846*
Revenue Stabilization Reserve	*603,245*	*661,212*	*687,419*	*713,626*	*739,833*	*766,041*	*792,248*	*818,455*	*844,662*	*870,869*	*897,076*	*923,284*	*949,491*	*975,698*
Minimum Target Balance	*$ 784,464*	*$ 846,459*	*$ 876,780*	*$ 907,188*	*$ 937,686*	*$ 968,275*	*$ 998,958*	*$ 1,029,736*	*$ 1,060,613*	*$ 1,091,589*	*$ 1,122,668*	*$ 1,153,852*	*$ 1,185,143*	*$ 1,216,544*
Maximum Funds to be Kept as Operating Reserves	*$ 784,464*	*$ 846,459*	*$ 876,780*	*$ 907,188*	*$ 937,686*	*$ 968,275*	*$ 998,958*	*$ 1,029,736*	*$ 1,060,613*	*$ 1,091,589*	*$ 1,122,668*	*$ 1,153,852*	*$ 1,185,143*	*$ 1,216,544*
Info: No of Days of Cash Operating Expenses	*260*	*274*	*279*	*281*	*284*	*287*	*291*	*292*	*295*	*297*	*299*	*300*	*302*	*303*
Sewer Construction Funds - 403-407														
Beginning Balance	$ 907,106	$ 947,608	$ 1,199,021	$ 1,287,407	$ 1,798,378	$ 2,009,959	$ 2,099,915	$ 2,189,396	$ 2,279,762	$ 2,372,220	$ 2,465,718	$ 2,560,293	$ 2,655,993	$ 2,752,871
plus: Rate-Funded System Reinvestment	-	-	-	377,954	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485	496,485
plus: Transfer from Sewer Fund	8,874	228,110	281,061	379,081	431,674	482,888	533,518	583,664	634,470	684,821	734,710	784,130	833,077	881,543
plus: Grants / Developer Donations / Other Outside Sources	-	-	-	-	-	-	-	-	-	-	-	-	-	-
plus: PIF and Connection Charge Revenue	929,663	961,435	994,356	1,028,469	1,063,816	1,100,442	1,138,394	1,177,719	1,218,467	1,260,690	1,304,440	1,349,774	1,396,749	1,445,423
plus: Net Debt Proceeds Available for Projects	832,131	854,568	668,372	647,563	206,614	67,590	52,815	1,337,210	1,374,464	1,414,244	1,457,770	1,505,178	1,556,598	1,612,164
plus: Direct Rate Funding	-	-	-	-	-	-	-	-	-	-	-	-	-	-
plus: Interest Earnings	9,071	9,476	11,990	12,874	17,984	20,100	20,999	21,894	22,798	23,722	24,657	25,603	26,560	27,529
less: Capital Expenditures	(1,739,237)	(1,802,177)	(1,867,393)	(1,934,970)	(2,004,993)	(2,077,549)	(2,152,731)	(3,526,606)	(3,654,226)	(3,786,465)	(3,923,488)	(4,065,471)	(4,212,591)	(4,365,035)
Ending Balance	947,608	1,199,021	1,287,407	1,798,378	2,009,959	2,099,915	2,189,396	2,279,762	2,372,220	2,465,718	2,560,293	2,655,993	2,752,871	2,850,980
Minimum Target Balance	167,762	185,783	204,457	223,807	243,857	264,632	286,160	321,426	357,968	395,833	435,068	475,722	517,848	561,498
Sewer Bond Reserve - 452														
Beginning Balance	$ 1,065,290	$ 1,139,091	$ 1,214,883	$ 1,274,160	$ 1,331,592	$ 1,349,917	$ 1,355,911	$ 1,360,596	$ 1,479,192	$ 1,601,093	$ 1,726,522	$ 1,855,811	$ 1,989,304	$ 2,127,358
plus: Reserve Funding from New Debt	73,801	75,791	59,278	57,432	18,325	5,994	4,684	118,597	121,901	125,429	129,289	133,494	138,054	142,982
less: Use of Reserves for Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ending Balance	$ 1,139,091	$ 1,214,883	$ 1,274,160	$ 1,331,592	$ 1,349,917	$ 1,355,911	$ 1,360,596	$ 1,479,192	$ 1,601,093	$ 1,726,522	$ 1,855,811	$ 1,989,304	$ 2,127,358	$ 2,270,341
Minimum Target Balance	$ 671,520	$ 747,312	$ 806,589	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021	$ 864,021

401	Sewer Fund
403	Sewer Construction
405	Sewer PIF
406	Trunkline
407	Treatment Plant
452	Sewer Bond Reserve