4. Wastewater Collection System

4.1. Introduction

Gig Harbor's original collection system, constructed in 1974-1975, served the downtown and south-of-downtown area. The original system was called ULID (Utility Local Improvement District) #1 and included six lift stations. ULID #2 was constructed to the south of ULID #1 in 1988 to serve areas south of the City, including portions of Soundview Drive, Harbor County Drive, Point Fosdick-Gig Harbor Rd, Olympic Drive, and Harborview Dr. ULID #3 was constructed to the north of ULID #1 in 1992 to connect the Gig Harbor collection system to areas north of the City, including the WCCC and portions of Burnham Drive. In addition, further system expansions were built under developer agreements. Currently, the City's collection system consists of approximately 150,000 feet of gravity sewers, over 32,000 feet of forcemains, and fifteen lift stations.

4.2. Existing Wastewater Collection System Facilities Inventory

4.2.1. Pump Stations

Table 4-1 presents a list of the pump stations and describes the pumps in each station.

Each pump station is a duplex facility, consisting of redundant pumps which allows peak flows to be met with one pump out of service for maintenance.

Table 4-1. Pump Station and Wet Well Configurations

Pump Sta. No.	Location	Pumps To	Year Const-ructed	No. of Pumps	Pump Type	Pump Mfr.	Flow (gpm/ pump)	Rated Head (ft)	Speed (rpm)	Horse Power (bhp)	Aux. Generator
1	Vernhardson St. & Randall Dr. NW	Vernhardson St. & N. Harborview Dr.	1975	2	Centrifugal	Allis Chalmers	50/100	58.4	1170	7.5	Yes
2	N. Harborview Dr. & Uddenberg St.	Harborview Dr. & Burnham Dr.	2006	2	Submersible	Wemco	500	51	1718	15	Yes
3	N. Harborview Dr. near WWTP	Wastewater Treatment Plant	2002	3	Submersible	KSB	2000 & 856	73 &60	1180 & 1765	65 & 25	Yes
4	Harborview Dr. & Rosedale St.	Harborview Dr. & Novak St.	1989	2	Centrifugal	Cornell	1104	54	1165	30	Yes
5	Harborview Dr. & Soundview	Harborview Dr. & Soundview	1973	2	Centrifugal	Allis Chalmers	100	47.4	1150	5	No
6	Ryan St. & Cascade Ave.	Ryan St. & Soundview Ave.	1973	2	Centrifugal	Allis Chalmers	100	81.0	1770	15	No
7	Hollycroft & Reid Dr.	Soundview & Olympic	1981	2	Submersible	Fairbanks Morse	250	115’	1750	25	Yes
8	Pt. Fosdick & Harbor Country Dr.	Soundview & Olympic	1988	2	Centrifugal	Cornell	674	115’	1760	60	Yes
9	Reid Dr. &50th St.	L.S. #7	1991	2	Centrifugal	Gorman-Rupp	140	51.5	1740	10	Standby gas motor
10	Forest Grove Apts.	Olympic Drive, MH #8-21	1990	2	Centrifugal	Hydronix	140	33	1725	7/5	Yes
11	38th Ave. & Woodland Creek	MH #8-31	1993	2	Centrifugal	Gorman-Rupp	137	90	1755	15	Yes
12	Woodhill Dr. & Burnham	Burnham Dr.	1995	2	Centrifugal	Cornell	1000(2)	115	1760	50	Yes
13	Peninsula HS	Purdy Dr. near Highway 16	1995 1994	2	Centrifugal	Cornell	200	180	1760	25	Yes
14	Wagner Way	Skansie	1999	2	submersible	Flyght	110	112	1755	15	Yes
16	McCormick Ridge	Canterwood Blvd.	2004	2	submersible	Hydromatic	133	120	1750	25	Yes

1. All pumps in Lift Station #3 have variable frequency drive.
2. Both pumps in Lift Station #12 have variable frequency drives.

4.2.2. Collection and Conveyance Pipelines (Gravity and Forcemain)

Wastewater collected from residential, commercial, and industrial customers flows by gravity through piping to their respective basin's pump station. The 15 pump stations then pump the wastewater to adjacent basins via forcemains, with the network of gravity pipes and forcemains eventually discharging all of the wastewater to the WWTP.

The majority of the City's gravity sewer pipes are PVC. Some of the larger diameter pipes constructed under ULID #1 are concrete and some gravity pipes on steep slopes consist of ductile iron. All of the system's forcemains are ductile iron.

4.3. Wastewater Collection System Capacity Evaluation

A hydraulic model of the City of Gig Harbor sanitary sewer system was developed as part of this Wastewater Comprehensive Plan Update. The hydraulic model of the City's wastewater collection and conveyance system is aimed to improve the City's confidence in sizing and capacity needs of collection and treatment components, and will allow the City to perform future scenarios responding to growth, such as developer plans and applications. This model has three main functions: (1) to assess the ability of the existing system to convey current flows; (2) to make recommendations for future capital improvements to the sewer system; and (3) to determine the effects of individual future developments and additions to the system. The wastewater flow data input to the model are based on DFAM-WW flow projections.

This section describes the development and operation of the SewerCAD model to analyze the capacities of the existing lift stations, the pressure lines downstream of the lift stations, and the gravity lines that are immediately downstream of the discharge of the pressure lines. This evaluation of the collection system will provide a guide to the general level of ability to meet present and future flows. This analysis is a conceptual analysis and does not examine the conditions of the lift stations or pipelines. Also included in this chapter is a general description of the SewerCAD software, the assumptions used to model the City's sewer system, and model output results.

4.3.1. SewerCAD Modeling Software

SewerCAD is the City's wastewater modeling software because it can perform all the calculations that the City desires and can present the results in an easy to understand format. In addition, the City staff is familiar with Bentley products (WaterCAD is currently being used to simulate the water system) and will have fewer opportunities for confusion between the water and sewer software.

4.3.2. Model Assumptions

Assumptions pertaining to flow projections used in the development of the model are detailed in Chapter 3. The following general information and assumptions were used in the development of the hydraulic model:

Table 4-2. SewerCAD Model Scenarios

Parameter/ System Element	Value/ Assumption in SewerCAD
Gravity Pipes	• Mannings n = 0.010 • Max. d/D = 0.8 • Min./Max. Velocity = 2 fps/ 15 fps • Min./Max Cover = 8 ft/ 20 ft • Min./Max Slope = 0.0004 ft/ft/ 0.8000 ft/ft
Lift Station Wet Wells	• All future lift station wet wells were assumed to be circular with a 8.00 ft diameter • Fixed water levels in Steady State Analyses
Forcemains	• Min./Max Slope = 0.0004 ft/ft/ 0.8000 ft/ft • All future forcemains from lift stations were sized for 2025 PHFs • All forcemains within lift stations are negligible
Manholes	• Manholes rims are set equal to ground elevation • Ground elevations for all future manholes were estimated from 2 ft contour data from Pierce County • All future manhole sump depths are assumed to be 8 ft
Lift Station Pumps	• Relative Speed Factor = 1.00 • Controls during a Steady State Analysis were ignored. • All future lift station pumps were sized for 2025 PHFs and set a one-point design curves • Pumps within the lift stations will not be running simultaneously
Reuse Facility/ Forcemains	• Free Outfall • Forcemains from lift stations to reuse facilities were sized for 2025 PHFs

- All future sewer connections within the UGA were assumed to be served by Gig Harbor's conventional gravity sewer and lift station conveyance system
- Population growth and corresponding wastewater flows were distributed based on DFAM-WW methodology.
- All existing STEP systems will continue to be operated as STEP systems in the future
- Possible reuse facilities will be processing the wastewater from their respective basin, as well as the wastewater from upstream lift stations.

4.3.3. Model Development

The City of Gig Harbor used a number of different sources of information on the configuration of the lift stations and sewer lines to be analyzed in order to produce an acceptable analysis of the system. The following information was used:

- Wastewater Basin Boundary Map showing the delineation of the basin boundaries
- ULID (Utility Local Improvement District) #1-3 maps, which provided information for most of the system, including manhole sizes and elevations, pipe inverts and lengths, and some wet well levels and lift station configurations
- A large number of record drawings, mostly in digital form, but some in hard copies, providing much of the same information as the ULIDs for locations not covered by those drawings

- Information, in hardcopy form, on each of the lift stations, including the number and type of pumps and, in most cases, the pump curve and settings
- Historic daily rainfall and wastewater effluent flow data for each of the lift stations and the WWTP from 2003 to 2006
- Information, in hard copy form, of approximate locations of sewer line additions
- AutoCAD drawings containing manhole, gravity lines, forcemain, and lift station layers, as of 2006.

What is Included in Model

Initially, a preliminary model which included the "backbone" of the City's sewer collection and conveyance system, was built within the modeling system. Specifically, the "backbone" of the conceptual model included the following elements:

- All municipal lift stations, including known wet well and pumping information
- Assumed control settings (pump on/off) based on water levels within wet wells for all current municipal lift stations
- Pressure pipelines, which exit the existing lift stations
- Gravity lines that transfer water from the discharge point of a lift station to the next downstream wet well or the Wastewater Treatment Plant (WWTP)
- A minimum of one gravity pipeline and manhole upstream of every lift station
- Predefined profiles that include the alignment from each of the lift stations to the WWTP

The preliminary hydraulic model was then expanded by adding additional gravity pipe segments and manholes based on record drawings provided by the City. Specifically, the model expansion included:

- Approximately 300+ additional gravity pipe segments and manholes to the conceptual model "backbone"
- Six additional lift stations in future wastewater basins: 15A, 17A, 18A, 19A, 20A, and 21A. Lift station 21A is currently being constructed.
- Assumed control settings (pump on/off) based on water levels within wet wells for all future municipal lift stations
- Pressure pipelines, which will exit the future lift stations
- One gravity pipeline and manhole upstream of all future lift stations, including lift station 21A.
- Three possible satellite reclamation facilities located in wastewater basins 1, 8, and 12.

- Current and projected average dry weather flow (ADWF) and Peak Hour Flow (PHF) scenarios developed using the DFAM-WW projected flows, which were uniformly allocated to manholes based on the number of manholes upstream of a lift station.

How Information was Input

All system elements (manholes, pipes, pumps, wet wells, pressure mains, etc.) were manually built within the SewerCAD model to represent each system element using an AutoCAD file containing the base sewer system as a guide. However, the information from the record drawings were not manually inputted into each of the system elements as they were drawn within SewerCAD. Instead, the information from the record drawings, such as ground, pipe inverts, manhole sump depths, etc., was organized within a series of Excel databases. These Excel databases were then "synchronized" into the model, allowing the information from the databases to be inputted for each system element without having to manually change the information for each individual element within the model.

While the synchronizing method works for inputting most of the information in the model with the Excel databases, several element features had to be inputted directly into the modeling software. The features that cannot be synchronized in include:

- Pipe diameter sizes
- Pump controls that manage when pumps are turned on or off
- Pump status
- Forcemain check valves

The record drawings present a relatively complete picture of the existing collection system with much useful information. However, some of the drawings are in excess of 30 years, while others provide conflicting information. When information on different record drawings for the same system element was found to conflict, in general, the most recent record drawing was used, granted the most recent record drawing indicated the necessary information, or the conflicting data was verified by the City. In addition, 2 foot- contour data obtained from Pierce County GIS Division was used to confirm and verify any data conflicting between the record drawings and datums used.

4.3.4. Simulation of Flows in the System

Two types of flows are simulated in the model; average dry weather flow (ADWF) and peak hour flow (PHF). Basin flows are based on DFAM-WW flow projections intended to reflect current and future sewer and demographic information. The ADWF for each basin was divided by the number of manholes in the model for each basin and that flow value was then applied to each manhole within that basin. Thus, every manhole within a particular basin in the model contributes the same ADWF to its respective downstream gravity pipe. The purpose of using the ADWF within in the model is to evaluate the level of calibration between the hydraulic model output and recorded historic wastewater flows.

The PHF values are also based on DFAM-WW flow projections. The PHF values incorporate I&I within the system, as well as the maximum expected flows the system may encounter during a storm event in order to evaluate the capacity of pipes and pumps. The PHF values were also distributed throughout the service area by dividing the basin PHF by the number of manholes in the model and then applied to each manhole within that basin.

By distributing the ADWF and PHF values throughout the service area by manholes, the method ensures that the entire average dry weather and peak hour flows are specific for that particular basin. The method also allows each basin to be analyzed separately, which may otherwise be difficult for the larger downstream basins that have contributing flows from upstream lift stations.

4.3.5. Model Scenarios

The wastewater system was analyzed under numerous scenario-alternative combinations within the model. SewerCAD enables "parent-child" scenarios. Parent scenarios are "base" scenarios that include all system elements for that year. Child scenarios inherit the system elements from the parent scenario; however, the child scenarios allow specific alternatives from the base scenario. Alternatives within SewerCAD may include various system conditions, such as with or without the reclamation satellite facilities, or changes in pipe/pump sizing, etc. Table 4-3 summarizes the scenario-alternative combinations analyzed in the model.

A capital improvement plan (CIP) scenario was analyzed for years 2008, 2025, and 2050 (buildout). These scenarios are utilized to denote system elements that may need capacity improvements, which include pipe/manhole sizing, etc. In addition, three possible water reuse satellite locations have been identified by the City and were incorporated within the scenario analysis for years 2025 and 2050. These satellite locations are located in Basins 1, 8, and 12.

Table 4-3. SewerCAD Model Scenarios

Base Scenario	Child Scenario	Alternative
Year 2005	2005 ADWF	
	2005 PHF	
Year 2025	2025 PHF	
	2025 CIP	
	Year 2025 With Reuse	2025 PHF With Reuse
		2025 CIP With Reuse
Year 2050	2050 PHF	
	2050 CIP	
	Year 2050 With Reuse	2050 PHF With Reuse
		2050 CIP With Reuse

The 2008 ADWF scenario was utilized to calibrate the model. Calibration consisted of inputting the 2008 ADWFs into the SewerCAD model, running the scenario, and comparing the outputted flows with the recorded historic ADWF data. By comparing the

historic and DFAM-WW projected flows, the model was developed to reflect the actual operating characteristics of the City's wastewater collection and conveyance system with an improved level of confidence in the output.

PHF and CIP scenarios for years 2025 and 2050 consist of PHF values for their respective years. 2025 and 2050 PHF scenarios include all current system elements, future lift stations, and a minimum of one gravity pipeline and manhole upstream of the future lift stations. The CIP scenarios for those years include necessary system improvements required to meet peak flows.

The PHF and CIP with reuse scenarios consist of PHF values for their respective years. The scenarios with the reuse option include all current system elements, future lift stations, a minimum of one gravity pipeline and manhole upstream of the future lift stations, and all three possible reuse facilities in wastewater basins 1, 8, and 12. The reuse scenarios assume that the facilities will be processing the wastewater from their respective basins and all upstream lift stations, thereby reducing the flows downstream to the WWTP. The CIP scenarios with the reuse option for the respective years also include necessary system improvements required to meet peak flows.

4.3.6. Hydraulic Model Results and Analysis

Manholes, Forcemains, and Gravity Pipes

The system capacity analysis within the model indicates that the system in general has the capacity to handle both current and 20-year peak flow conditions. This is also the case for the scenarios that include the three possible reuse locations. In the 2008 and 2025 PHF Scenarios and the 2025 and 2050 PHF Scenarios with Reuse, there are no manholes, forcemains, or gravity pipes that were found to surcharge during peak hour flows.

However, the hydraulic model revealed three pipe sections that will not have the capacity to handle build-out peak flows. Table 4-4 indicates the three pipe sections that were found to surcharge within the 2050 (buildout) PHF Scenario. The table lists the current pipe capacity, the design pipe capacity, the current pipe size, and the recommended replacement pipe size.

Table 4-4. SewerCAD Model Pipe Capacity Deficiencies

Location	Description	Buildout Flow in Pipeline (gpd)	Existing Pipe Capacity (gpd)	Existing Pipe Diameter (in)	Replacement Pipe Diameter (in)	Length (ft)
Harborview Dr	MH 3-26 to MH 3-27	2,475,230	2,419,460	15	18	200
Harborview Dr	MH 3-27 to MH 3-25	2,475,230	2,419,460	15	18	175
Harborview Dr	MH 3-25 to MH 3-24	2,452,320	2,397,100	15	18	240

In all scenarios within the model, there were several gravity pipes and forcemains that did not meet the velocity design constraint of 2.0 to 15.0 fps and/or the cover design constraint of 8.0 to 20.0 ft. The amount that the gravity pipes or forcemains did not meet the design constraints was not significant enough to cause concern. However, forcemains that did not meet the minimum velocity constraint were noted, due to odor control issues the low velocity may cause.

WWTP and Reuse Facilities

Within the model, the WWTP and possible reuse facilities were modeled as an "outfall", which only indicates how much wastewater flows through the facilities. The projected amount of flow through the reuse facilities may be used for sizing purposes, but no further detailed analysis of specific reuse facilities has been conducted. However, detailed analysis of the WWTP sizing, capacity, and treatment, is presented in Chapter 5.

Lift Stations

Available pump curves and settings for all current pumps were implemented within the model, with the exception of LS 7 where a pump design head and discharge was input into the model to calculate a maximum head and discharge for a generic pump curve. The hydraulic model does not take into account such factors as age, condition, etc., and scenarios continue with the assumption that lift station pumps are operating within their design efficiency range. Consequently, further analysis for individual lift stations was performed.

Using an excel spreadsheet, the pump curve was plotted against the system head curve, which took into account the forcemain size and the lift station and forcemain friction and minor losses. In order to analyze whether the pumps had capacity to handle current and future flows, the projected future flows were also plotted against the pump and system head curves. The intersection of the pump and system head curves indicates the operating point of the system. A pump was determined to have capacity for projected flows when the operating point of the system was operating at a discharge higher than the projected flows.

4.4. Collection System Deficiencies and Needs

Although Infiltration & Inflow (I&I) is the significant component impacting capacity in the collection system and interflow of stormwater runoff resulting from rainfall appears to be primary factor, the existing pump stations, forcemains, and gravity pipelines appear to have adequate capacity for current and future wastewater flows. It is estimated that the future dry weather flow in the collection system will increase compared to the total flows (including I&I) that currently exist in the collection system.

Based on the collection system evaluations and City staff observations and experiences, the deficiencies and limitations in the existing wastewater collection system are summarized below; projects to address the deficiencies are presented in Chapter 7.

- Many of the current lift stations are in poor condition, beyond its service life, or will not have the capacity for future peak flows. These lift stations will required replacement or may need pump replacements.
- A small number of pipe sections will not have capacity for future peak hour flows. These pipe sections will need to be replaced.
- Some of the lift station pumps will require additional capacity when replaced.
- For new (replacement or future) sewer pipelines, the City desires that the maximum depth be no greater than 25 feet; however depths greater than 25 feet may be necessary in limited areas where accepted by the City on a project and site specific basis.
- Wastewater flows are not currently measured in the collection system and lift stations. This issue makes wet weather flow management from I&I difficult to address. Collecting daily rainfall data and installing flow meters at the pump stations will help address this issue.
- To accommodate future growth within the City, the current system will require expansion to include lift stations, forcemains, and gravity sewer extensions.
- Further evaluation is needed to prioritize I&I reduction projects and identify potential cost effective remedies in the wastewater collection system.
- Further evaluation is needed to determine the benefits of reuse and reclamation facilities within the system. Reuse and reclamation is discussed further in Chapter 6.

These system deficiencies are addressed in the Capital Improvement Program in Chapter 7.