

Operations and Maintenance

7-1. INTRODUCTION

It is important for sewer utilities to have a program in place that ensures successful operation of the wastewater collection system and continuous reliability of critical system components. To address this need, this chapter discusses the components of the operation and maintenance (O&M) program for the City of Fife's (City) wastewater collection system. Pierce County currently serves a small portion of the City limits and Urban Growth Area (UGA). The City contracts with the City of Tacoma for wastewater treatment services. The City's wastewater is conveyed via Pump Stations 1 and 5 to the Tacoma Central Wastewater Treatment Plant No. 1 located at 2201 Portland Avenue, Tacoma, Washington. The treated effluent from the Tacoma Wastewater Treatment Plant is discharged into Commencement Bay. This chapter addresses responsibility and authority, normal system operation, routine and preventive maintenance, staffing and equipment requirements, new construction, records, safety and emergency response procedures.

One purpose of an O&M program is to maintain design functionality and to restore the system components to their original condition or maintain their current condition. Added benefits of a comprehensive O&M program include increased reliability, superior customer service, and lower maintenance costs.

7-2. PERSONNEL

The City is a municipal corporation that owns and operates a public sewer system within its City limits.

City Personnel

The City's Department of Public Works consists of divisions responsible for different areas of operation and maintenance. The divisions of the Public Works Department are Wastewater Collection, Streets, Building and Grounds, and Water.

The Public Works Department, specifically the Wastewater Collection Division, is responsible for the safe and effective operation and maintenance of the public sewer system. The Wastewater Collection Division functions under the direction of the Public Works Director.

The Wastewater Utility Superintendent reports to the Public Works Director 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 O&M staff consists of O&M personnel that function under the Wastewater Utility Supervisor. The sewer system tasks that are performed by the O&M staff include development review, inspection and testing; installation and repair of system facilities; routine operation and preventative maintenance; recordkeeping; administrative tasks and general clerical work; and corrective or breakdown maintenance required in response to emergencies.

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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 City is governed by a City Manager and a seven-member City Council. The Public Works Director manages Public Works. The Public Works Director is also responsible for the implementation of the Capital Improvement Plan and formulates the City budget for approval by the City Council.

There are 19 public works staff members, including managers, engineers, operators, field staff, and office staff; all of whom report to the Public Works Director. Public Works staff with regard to wastewater includes:

- One Superintendent of Public Works
- Three City collection system personnel

The field staff performs O&M on wastewater conveyance systems, water distribution systems, roads and parks.

7-3. NORMAL OPERATIONS

The existing system of pump stations, force mains, and gravity sewer lines within the City limits are shown in **Figure 1-1** in **Chapter 1**. All wastewater collected within the City's collection system is conveyed to Pump Station 1 (wastewater north of I-5) and Pump Station 5 (south of I-5) and then to the City of Tacoma for treatment and discharge. It is important to note that a small portion of sewer customers in the northeastern portion of the City limits and unincorporated UGA are served by Pierce County.

In **Chapter 1**, collection system pump station information is listed in **Table 1-2**, while the lengths of sewer pipe are listed in **Table 1-1**. The collection system staff is responsible for O&M for all 13 pump stations, pressure mains, and associated valves and gravity sewer pipes. Operating instructions for several of the pump stations are provided in the equipment supplier O&M manuals which are on file at the Public Works Department. Although Pump Station 9 is owned, operated, and maintained by the Puyallup Tribe, City staff are responsible for the force main.

Overall, the pump stations and collection system piping are in good working order and operate without significant maintenance issues. City staff should perform regular routine preventive maintenance of the pump stations and collection system to keep the system in good working order. Recommended preventive maintenance techniques to be employed by the collection system staff are described in subsequent sections.

Routine and Preventative Maintenance Criteria

Planning for future maintenance of wastewater system facilities should be considered as important as capital improvement planning or system expansion. If maintenance efforts are not expanded proportionately to system expansion, the reliability and efficiency of the system will be diminished. The City's goals for its collection system maintenance program should be to preserve

the value of the physical infrastructure and to ensure that all wastewater is conveyed safely, efficiently, and reliably. To accomplish these goals, a planned preventive maintenance program provides the most cost-effective method for performing the optimum level of maintenance activities at the lowest cost. In addition to the actual maintenance tasks for system facilities, scheduling, administration, inventory and record-keeping should be key components of the City’s maintenance program.

A preventative maintenance program involves defining the tasks to be performed, scheduling the frequency of each task and then providing the necessary staff to perform the task. An example preventative maintenance schedule is presented in **Table 7-1**.

**Table 7-1
Example Preventative Maintenance Schedule**

Component	Visitation Schedule	Maintenance Schedule
Gravity Sewer and Manholes	Every year	*Pipelines cleaned *Video inspected as required *Lines identified as potential problem areas are maintained on a quarterly basis *Manholes inspected
Force Mains	As necessary	*As necessary
Pump Stations	Weekly	*Inspected 2 times per week *Site cleaned monthly *Wet well vactored out 2 or 4 times per year depending on station needs
Generators	Weekly	*Fuel storage tanks are checked *Preventative maintenance checks by in-house mechanics twice per year *Annual servcies by generator manufacturer

Pump Station and Generator Maintenance

An inventory of the mechanical equipment at each of the City’s pump stations should be summarized in the O&M Manual for each pump station. Maintenance data sheets should be kept at each pump station in order to record pumping equipment alarms or errors and the action taken to resolve them. This data sheet is an important piece of information for tracking maintenance and overall equipment condition. Additionally, City staff should record pump run time to track operation of the pump stations.

Table 6-1 from the *Wastewater Collection Systems Management: Manual of Practice 7* (Water Environment Federation (WEF), 2004) summarizes recommended preventive maintenance tasks for pump stations. The WEF table is extensive, but can be used as a guideline for the scheduling of maintenance tasks. Current City procedures should be compared to those recommended in this table and revised wherever needed.

**Table 7-2
Typical Maintenance Tasks Record for Sewage Pump Stations**

Item	Weekly	Monthly	Quarterly	Yearly
Pump Station	Write down hours	Clean floats	Pump out and clean wet well	Paint interior and piping (5 years)
	Check pump cycle counter	Clean and sanitize dry well	Grease all pumps	Check all force mains that discharge to manholes
	Check wet well ventilation	Drain air compressors	Clean check valves	Check all electric panels
	Check for leaks in dry well	Clean out drain sumps		Inspect pump impellers
	Check sump pump			<u>Twice Per Year</u> Use portable generator to test transfer switches and proper electrical transfer at stations without onsite generators
	Check telemetry in pump stations			
Generators	Test run exercise	Check and top off fuel level		<u>Twice Per Year</u> Check Oil filter
	Check oil			<u>Twice Per Year</u> Check air filter
	Check coolant level			<u>Twice Per Year</u> Check battery fluid level and fan belts
				<u>Twice Per Year</u> Check battery terminals for corrosion
				<u>Twice Per Year</u> Check alternator output volts
				<u>Twice Per Year</u> Check RPM

Auxiliary and portable generators function as key backup systems for the pump stations. Five pump stations are equipped with on-site generators while eight are equipped with a portable generator connection. A portable generator is stored at Public Works until needed.

Manufacturer’s information on auxiliary generators is also available and contains standard maintenance recommendations. Maintenance of auxiliary and portable generators should be conducted as recommended in the O&M manuals for the individual generator units. Maintenance for the generators entails weekly run tests to ensure the operational ability during a power outage. Fuel, water, and oil levels should be checked and recorded as part of routine maintenance tasks. Mechanical maintenance should include service at regular intervals of approximately

6 months. Collection system staff should run each auxiliary generator for approximately 15 minutes each week.

Collection System Inspection

The major maintenance activities with respect to gravity sewers and manholes are periodic inspections and flushing. Inspections are typically done through visual investigation or closed circuit television (CCTV) technology. Cleaning and flushing of sewer pipe should be performed at regular intervals, while troublesome areas that have high rates of debris accumulation should be cleaned or flushed more frequently. This flushing addresses the accumulation of debris or other matter within pipes and manholes, thus limiting the potential for surcharging or flooding.

Structural conditions that should be evaluated during the inspection include: collapsed pipes, cracked pipes with or without deflection, pipe sags, cracked or open joints, holes in pipes, root intrusion, signs of pipe corrosion, protruding joint material, protruding lateral sewers, pipes with excessive debris, and side sewers with active infiltration and inflow (I/I). Manholes should be inspected and cleaned along with the pipe inspection. Deteriorating or non-functioning manholes should be replaced as soon as possible to prevent further system damage and I/I.

A primary maintenance issue with regards to a wastewater collection system is the accumulation of fats, oils, and grease (FOG). These contaminants are prevalent in the waste streams of restaurants, laundromats, and other commercial entities, and to a lesser extent, residential connections. The Fife Municipal Code addresses the requirement for specific businesses and waste producers to maintain adequate pretreatment for FOG prior to discharge into the sanitary sewer system.

Cleaning the collection system typically includes flushing/jetting with high pressure water. Cleaning is performed more often than inspection because it addresses the accumulation of debris which can occur randomly and cause hydraulic disruptions in a short period of time. The older portions of the City's sewer collection system should be given special attention during flushing because the potential for breaks in older sewer lines is higher. The flatter portions of the City's sewer collection system should be given more frequent attention because the potential for the accumulated of solids is higher in these areas. Odor complaints from residents can help identify areas in need of more frequent flushing or other maintenance. The deterioration of the older areas within the sewer collection system can be tracked through accurate maintenance records. Maintenance records can also be used to budget necessary repair and replacement projects.

Pump Station and Collection System Staffing Requirements

Pump station staffing requirements vary greatly depending on the size and complexity of the station as well as the scheduled maintenance routine. Inspection and maintenance staffing needs typically range from 0.05 to 0.5 full-time equivalent (FTE) per station. The City's pump stations are operated and maintained by three primary staff members, and other City staff members are called as needed. Pump Stations 2, 3, 4, 7, 8, 9, 10, 11, 13, and 14 require 0.05 FTEs each while Pump Stations 1, 5, 6, and 12 require 0.075 FTEs (50 percent more time) each. A total of 0.8 FTEs should be devoted to the pump stations. Fife contracts with Pierce County Health Department to provide a supervisory and support role and to assist with FOG code enforcement.

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Inspection and cleaning rates of sewer collection systems vary between 1,000 to 1,200 feet per day. The amount of sewer pipe that can be inspected each day varies depending on work schedules, the amount of cleaning required, time of day, and other physical limitations. Although there is no industry standard for cleaning intervals, a review of general sewer O&M literature suggests that cleaning between 5 and 40 percent of the collection system per year is acceptable. An inspection and cleaning rate of 125 feet per hour with a 2-man crew (truck driver and jet operator) and a target interval of 3 years was assumed to determine staffing requirements. An FTE is assumed to be equal to 1,768 hours in a year, assuming 10 holidays, 12 sick days, 2 training days, and an average of 15 vacation days. The required number of man hours is 255 for each crew member, which equates to 2 crew members at 0.11 FTEs devoted to the inspection and cleaning of the sewer collection system.

To summarize, a total of three FTEs should be dedicated to the City's wastewater system.

Maintenance Personnel Training

A well-trained staff is an essential part of an effective O&M program. Maintenance personnel should be familiar with maintenance equipment and procedures, as well as safety requirements and regulations. Training and certification criteria should be established for each job description and training conducted accordingly. Training activities should be considered to be as important as any other maintenance activity and should be included and budgeted into the regularly scheduled tasks. It is recommended that annual training and education be included in the annual budget amount.

7-4. NEW CONSTRUCTION

A major step towards preventing problems within the sewer collection system is proper installation at the time of construction. The City has adopted the Washington State Department of Ecology's "Criteria for Sewage Works Design," latest edition, in the City's Municipal Code.

Sanitary sewer standards for the wastewater system are discussed in **Chapter 3** and standard details are located in **Appendix I** of this General Sewer Plan. These standards should be continually reviewed and updated by engineering and maintenance personnel. Standard designs should be developed to minimize total life cycle costs, which include capital, O&M, and financing costs. Also, as the system becomes more complex, special attention should be given to its ability to function during emergency situations.

7-5. RECORDS

The implementation of an effective and efficient O&M program requires accurate record-keeping. Accurate maintenance records provide many benefits to the City, including the following:

- Identifying recurring problems and problem areas.
- Tracking pump station mechanical components.
- Estimation of man-hours required for various maintenance tasks.

- Identification of collection system components that are nearing capacity or the end of their useful life.
- Diagnosing and addressing I/I issues.

7-6. SAFETY

An important consideration of any successful maintenance program is the safety and well-being of all employees. The City's safety program addresses accidents, fall protection, confined spaces, and lockout/tagouts and includes the standards of the Washington State Department of Labor and Industries (L&I). The safety program addresses the situations that employees may encounter during the performance of operation and maintenance tasks. Field employees meet monthly for safety meetings, which include training and discussion of safety issues. Fife Public Works has a staff member who is dedicated internally to public works safety. This position reports to the Fife's city-wide safety manager and relies on Fife's library of safety procedures.

The following section includes applicable recommended and required safety provisions for confined spaces, electrical and mechanical equipment, fire hazards, and health hazards.

Confined Spaces

The principle hazards associated with confined spaces, including wet wells, sewer manholes, and sewage pump stations, are oxygen deficiency, explosions, and toxic gases. Oxygen deficiency occurs whenever air is displaced by some other gas, which may or may not be toxic.

L&I has established regulations governing entrance into confined spaces in Washington Administrative Code (WAC) 296-809. The regulations include the completion of a Confined Space Entry Permit, the establishment of Safe Operating Procedures, and the completion of a Confined Space Pre-Entry Checklist.

A minimum of two individuals are required when any work is to be accomplished within pump stations, wet wells, or sewer manholes that are considered confined spaces. A gas monitor is required for measuring oxygen levels, explosion potential (LEL), and toxic gases. The gas monitor must be used to continually monitor gas levels while any person is within the confined space. Rapid changes in gas levels can occur in sewage effluent due to upstream spills or discharges which can lead to rapid atmospheric changes. The gas monitor will sound an alarm if a critical level for a measured gas is reached.

A portable air blower should be available to the operator whenever work in manholes or wet wells is performed. The air blower can be used to provide ventilation in confined spaces; however, the motor should be kept away from the opening to the space to avoid the ignition of explosive gases that may be present.

City confined space procedures should be reviewed with maintenance personnel on a regular basis and revised as new regulations and equipment evolve.

Electrical and Mechanical Equipment

The presence of electrical mechanical equipment at the sewage pump stations may present hazards to personnel during the performance of O&M tasks. Precautions should be taken whenever working on or near the pump station mechanical and electrical equipment.

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Rubber mats should be placed on the floor in front of all electrical control panels. When working on any piece of electrical equipment, the operator should ensure that all switches are opened and tagged, all electrical equipment is grounded, and all exposed wire is taped. All portable power tools, extension cords, and lights should be of the three-wire grounding type.

Exposed shafts and belts are hazardous items of mechanical equipment that can be found in sewage pump stations. Belts and shafts should be enclosed in sheet metal or wire guards. When work is being conducted on any piece of equipment with exposed shafts or belts, the item of equipment should be taken offline so that it will not start.

Other safety precautions that should be observed by City personnel are to avoid contact with energized circuits or rotating parts, to avoid bypassing or rendering inoperative any safeguards or protective devices, and to avoid extended exposure in close proximity to machinery with high noise levels.

Fire Hazards

Fires are possible in any area of a sewage pump station if debris is allowed to accumulate. Precautions should be taken to reduce the possibility of a fire. Oily rags should be kept in a tightly sealed metal can, preferably at a location away from the sewage pump station. All areas should be kept free of clutter or debris, especially if flammable in nature. Gasoline or solvents should only be used in well-ventilated areas, away from sources of ignition. A carbon dioxide type, dry chemical, or foam fire extinguisher should be permanently mounted at each sewage pump station. The extinguisher should be tagged and checked semi-annually to ensure that it is operational.

Health/Safety

The possibility exists that any particle of wastewater may contain disease causing bacteria. Operators should take precautions to avoid disease at all times. Principle water-borne diseases include typhoid fever, dysentery, Giardia, Cryptosporidium, infectious jaundice, and tetanus. Immunization against some of the diseases is possible and all operators should be vaccinated periodically. Operators should take individual precautions to avoid disease, including the following:

- Keep hands below collar when working at sewer facilities.
- Wear rubber gloves whenever directly handling sewage.
- Disinfect hands with hot water and soap or antibacterial lotion before eating.
- Treat minor cuts and wounds immediately.

Additionally, an emergency first aid kit should be kept in each City vehicle and other convenient locations, so as to be readily available to operators.

7-7. EMERGENCY RESPONSE

The operation of the sewer system under emergency conditions is an important responsibility of the City's staff. Emergency response procedures should be rehearsed and reviewed by personnel on a regular basis.

It is important to estimate the degree in which system facilities may be vulnerable to various types of emergency situations in order to identify system weaknesses. The emergency response plan should also include information regarding which facilities would be vulnerable to various types of emergency events and recommended actions that City staff could take to help mitigate the problem.

The City does not maintain 24-hour/7-days-a-week staffing but instead pays for an on-call staff member to respond to emergencies, evaluate conditions, and call in additional staff as appropriate.

PRELIMINARY

PRELIMINARY