CHAPTER 6

COLLECTION SYSTEM EVALUATION & RECOMMENDATIONS

Chapter Outline

CHAPTER 6 COLLECTION SYSTEM EVALUATION AND RECOMMENDATIONS

6.1. GENERAL

This section includes an analysis of the collection system. The first subsection focuses on operation, maintenance, and rehabilitation of the collection system. This is followed by an identification of shortcomings and the development of alternatives for potential improvements to the wastewater collection system, including gravity mains, forcemains, and pump stations.

This section addresses the following key questions:

- What are the current collection system operation and maintenance practices and how can they be improved?
- What are the existing collection system deficiencies?
- What collection system components are likely to become deficient during the planning period or prior to complete buildout of the system?
- What are the alternatives for correcting existing and projected deficiencies?

The existing and projected collection system deficiencies are presented along with a set of alternatives for addressing each of the deficiencies. The alternatives are evaluated against each of the collection system deficiencies to generate complete collection system recommendation. In **Section** 7, the treatment system is evaluated and alternatives for correcting treatment system deficiencies are identified and evaluated.

6.2. COLLECTION SYSTEM OPERATION, MAINTENANCE & REHABILITATION

This section discusses the need for sanitary sewer system maintenance and provides recommendations for the basic elements necessary for a maintenance program. The need for system-wide preventive maintenance is addressed first, then the general recommended approaches to collection system maintenance are outlined.

6.2.1 Need for System-Wide Preventive Maintenance

Maintenance of sewerage system is necessary to ensure the proper operation of the facilities and to obtain the full useful life of those facilities. Sanitary sewer systems represent significant investment of public capital. If a sewer system is allowed to fall into disrepair because of the lack of maintenance, it will not operate efficiently or as designed. Health problems and property damage may result from sanitary sewer backups, surcharging and/or overflows. Without proper maintenance, a system's capacity can be reduced by debris clogging, root intrusion growth, structural damage, infiltration and inflow (I/I), and other factors that eventually lead to failures throughout the system. Repair of failed sections of a sanitary sewer system are costly, quite often exceeding the original cost of construction. In spite of this, many jurisdictions do not adequately fund the level of maintenance necessary to protect their investment in the sewerage system. Collection system maintenance can be separated into two types: preventive and corrective.

Preventive maintenance involves scheduled inspection of the system and data gathering to identify problem areas and analysis of this data so that scheduled maintenance can be targeted at specific problems. As a general rule, as preventative maintenance increases, the amount of corrective maintenance required decreases.

Corrective maintenance, often referred to as emergency maintenance, is typically performed when the sewer system fails to convey sewage. Causes for initiating corrective maintenance may include blockages, solids buildup, excessive I/I, flooding and sewer breaks. Corrective maintenance requires immediate action, and the jurisdiction will typically pay a premium to have this work performed.

6.2.2 Present Maintenance Practices

Due to the City's size and current staffing, the City does not currently have an active collection system maintenance program. The City also does not own a vactor truck or any other cleaning or TV inspection equipment. Television inspection work is typically performed to troubleshoot problems and not at regular intervals. Where possible, minor emergency repairs are performed by City crews with City owned equipment. However, the City does not typically perform major repairs on most sewer mainlines. These services are typically contracted out.

6.2.3 Preventative Maintenance Program Recommendations

The following paragraphs outline some recommendations for implementing preventive and corrective maintenance throughout the City's sanitary sewer collection system. These include the following:

- Establish a systematic sewer cleaning and inspection program.
- Establish a sewer rehabilitation and replacement program for removal of I/I and replacement or repair of aging sewers.

6.2.3.1 Sewer Cleaning Program

It is important that the City establish a gravity sanitary sewer cleaning program. Regular cleaning is necessary to prevent blockages, grease accumulation and sediment buildup in sewer lines. Normally, sanitary sewers laid at steep grades require less frequent cleaning than those laid at flat grades. Sewers at flat grades can experience sedimentation and grease buildup problems and will require more frequent cleaning and maintenance. Since nearly all of the sewers in Dayton are laid at flat grades, routine cleaning is especially important.

As part of the cleaning program, it is important that the City keep records, including conditions encountered such as pipe failures, grease and solids buildup, and other problems. These records are useful in scheduling corrective work and to establish a long term cleaning frequency schedule for different sewers. As the database is established, a schedule for subsequent cleaning can be tailored to the physical character of each line, the area served, and its performance history. Specific problem areas requiring more frequent cleaning can be incorporated into this program.

6.2.3.2 Sewer Inspection Program

As the City's system continues to age and deteriorate, it is recommended that the City begin a regular inspection program. The inspection program should include both above ground and internal inspection of the sewer system.

Above ground inspection is performed by inspecting right-of-ways and easements and noting evidence of structural failure, flooding, manholes covers above or below the present level of streets, or other problems.

The two common methods of internal inspection are TV inspection performed in conjunction with the cleaning activities, and smoke testing. TV inspection of a sewer system utilizes a specially designed television camera and equipment to view the interior of the piping system. A videotape (or DVD) and written record of the inspection is generated and retained by the City. Leaking sewer service connections, debris or root buildup, structural failures, leaking joints and other problems can be easily identified and documented. TV inspection of sewers requires that the sewers be cleaned immediately prior to the inspection and that sewers not be surcharged during TV inspection.

Due to the high cost of purchasing TV inspection equipment, as well as operator training requirements, it can be more economical to contract out to private firms for TV inspection services rather than owning and operating the equipment. These private firms provide all personnel and equipment necessary to clean the sewer and perform the inspections. TV inspection of sewers is typically performed during the winter months so that sources of I/I can more easily be noted and identified. As the City continues to grow, it may become more economical for the City to own and operate TV inspection equipment. Regardless of wether the work is done "in house" or contracted out, the City should implement a TV inspection program targeted at inspecting every line in the system at 2 to 5 year intervals.

Smoke testing is conducted by blowing nontoxic smoke into the sewer system and observing the points at which it escapes. Smoke testing is typically performed during the summer months so that groundwater does not interfere with the smoke leakage paths. Smoke testing can be used to identify potential leaks into the system caused by broken pipes, bad joints, manhole failures, and similar deficiencies. Smoke testing is also very effective for locating storm sewer cross connections and illegal connections, such as roof and foundation drains. The equipment necessary to perform smoke testing is relatively inexpensive and can be purchased by the City.

6.2.3.3 Sewer Rehabilitation & Replacement Program

A sewer rehabilitation and replacement program should include mainline, manhole and service lateral rehabilitation or replacement. This type of sewer rehabilitation program is typically referred to as an I/I reduction program. The details of the recommended program are discussed below (see **Section 6.6.1**).

6.3. IDENTIFICATION OF COLLECTION SYSTEM DEFICIENCIES

The purpose of this section is to determine the components of the existing collection system that are or will become deficient. This includes components that lack capacity to convey existing peak flows or will lack capacity as flows increase due to growth. A number of existing collection system deficiencies were identified in **Section 4**. This section is intended to supplement those discussions. Together with the deficiencies listed in **Section 4**, the intent of this section is to present an overall list of known deficiencies that must be addressed by the City.

The existing sewage collection system was analyzed under projected peak flow conditions at the end of the planning period. In addition to the capacity of the gravity mains, the existing pump stations and force mains were analyzed for projected 20-year peak flows and UGB buildout flows. Discussions relating to each of these system components follow.

6.3.1 Gravity Main Capacity Analysis

The peak design flows developed in **Section 5** were used as the basis for a basin-by-basin evaluation of the existing sanitary sewer trunk lines. Pipe sizes, lengths, slopes, and locations were determined from City records. The evaluation was limited to the main trunk lines conveying sewage through the basins. This approach was taken since most of the pipes within a basin will actually encounter only a fraction of the total basin flow.

The capacity of the gravity mains was calculated assuming non-pressure flow (i.e., no surcharging) and utilized Manning's equation. The pipe roughness coefficient used in the Manning's equation varies according to the material used and the age of the pipe material. For this planning effort, a Manning's roughness coefficient of 0.013 was used regardless of pipe material. In theory, new PVC sewers have roughness coefficients as low as 0.009. However, sand, grit, and slime buildup on the pipe walls over time tend to render true values of 0.013.

Each of the major trunk sewers within each basin were analyzed with respect to three classes of deficiencies. These are; 1) sewers that lack capacity to convey existing peak flows, 2) sewers that are likely to lack the capacity to convey peak flows associated with growth during the planning period, and 3) sewers that are likely to lack the capacity to convey peak flows at buildout conditions. The City's gravity collection system includes sewers that fall into all three categories. These are discussed in greater detail later in this section. At a minimum the City will have to address sewers that fall into categories one and two during the planning period. Should any of the existing sewer lines that fall into the third category need to be replaced as part of I/I reduction efforts or other maintenance reasons, they should be sized to accommodate flows at buildout.

6.3.2 Infiltration and Inflow Analysis

As discussed in **Sections 4** and **5**, the City's gravity sewer system collects large amounts of I/I. Therefore, I/I is a significant problem that must be addressed by the City during and beyond the next planning period. The recommendations included herein include implementing a large-scale I/I reduction program. The purpose of this subsection is to evaluate the existing collection system to determine where I/I reduction efforts should be focused.

The City's existing I/I problem has been well documented. In 1977, Westech Engineering prepared a Sewer System Evaluation Study that identified problem I/I locations, cost estimates to repair the problem areas, and outlined a specific program for making I/I rehabilitation. Much of the work presented in that document is still relevant today. In 1977, Westech personnel collected flow measurements in the collection system and identified areas where the I/I problem is most severe. This work showed that the Main Central Basin collection systems gather the most I/I. The mainline section from MH 12 to MH 17 also showed large I/I collection. This observation is consistent with Westech's field investigation in 2010. This is not surprising since these are the older areas of the City where concrete piping was used to construct the collection system.

As discussed in **Section 4** Westech personnel measured I/I during the night of March 31, 2010. The results are summarized in Figure 4-4. Per the I/I measurement results all of the 1966 concrete pipe system has I/I rates greater than 20 gpd per foot of main line pipe. The worst I/I problems areas are those with rates greater than 30 gpd per foot of mainline. The mainlines with the worst I/I are listed in Table 6-1 from highest to lowest. The section of mainline with the highest I/I is located in the Main South basin from MH 11 to 17 and from MH 16 to 149 and produces, 123 gpd per foot of mainline or 418,903 gpd. This same section of pipe was also one of the worst offenders in Westech's 1977 Sewer System Evaluation Study discussed above. Also, this past winter the City had problems with the sewer in the area backing up into the school due to large amounts of I/I and inadequate sewer capacity.

Table 6-1 | Trunk Sewers with Severe I/I

Basin Name	MH to MH	Measure I/I Rate (gpd per foot of mainline)	Pipe Length (ft)	Installation Date & Pipe Type
Main South	11 to 17 & 16 to 149	123	1650	1966, concrete
9th Street Basin	42 to 44	109	670	1966, concrete
9th Street Basin	42 to 99	75	770	1966, concrete
Main Central	60 to 84	66	480	1966, concrete
Main North Basin	24 to 30 & 26 to 70	43	3,400	1966, concrete
Main North Basin	30 to 82 & 32 to 33	41	1,300	1966, concrete
Main Central	54 to 60 & 57 to 68 & 60 to 66	34	2600	1966, concrete

In short, the City's initial efforts should be focused on the main line sections listed in Table 6-1. After the I/I problem is corrected in these areas, the City should then move on to the remaining portion of the 1966 concrete sewer system. These are the areas with the most significant I/I problems and are the areas where the most significant I/I reductions for the least cost may be realized.

6.3.3 Pump Station Capacity Analysis

The four major pump stations within the City were analyzed for the anticipated flows at buildout for each basin as developed in **Section 5**. Existing pump capacities, as well as other pump station information (i.e., force main dimensions, pump data and capacities), was previously summarized in **Section 4**.

The existing pump station capacities were compared to the existing and projected peak hour flows at buildout conditions. Buildout conditions were considered for pump station sizing. New wetwells and forcemains should be sized for buildout conditions since these facilities are not suited for incremental expansion. However, during the design of the pump stations, it may be cost effective to initially size the pumps and other such mechanical equipment for some reasonable intermediate design year rather than the buildout condition.

All pumps were analyzed for pump capacity with the single largest pump out of service. Since all the pump stations are duplex stations, except the HWY 221 Pump Station, the capacity of each station is the capacity with a single pump in operation (i.e., 100% redundancy) per DEQ guidelines. The results of this analysis as shown in Table 6-2 confirmed that the City should expect to perform significant upgrades at all of the existing pump stations at some point during the planning period. Several stations lack the capacity needed to convey existing peak flows (i.e., 9th Street, Main, & Hwy 221) and will require upgrades early in the planning period. The other station (i.e., Palmer Creek) will reach capacity as the City continues to grow during the planning period and if the elementary school is transferred to this pump station as planned. The recommended improvements at each station are discussed in detail later in this section.

Table 6-2 | Summary of Pump Station Pumping Capacity Analysis

Pump Station	Existing Firm Capacity (gpm)	Existing Peak Flows (gpm)	Required 2035/ Buildout Capacity (gpm)	Recommended Upgrades (see discussions later in this section)
9th Street	± 266	± 567	± 723 (3)	-Replace station
Palmer Creek	± 111	± 82	± 150 (3)(4)	-May need to upsize pumps during the planning period if school abandons siphon.
Main Pump Station	± 900	± 2180(2)	± 3,100 / 4,500 (3)	-Replace station
HWY 221	± 0(1)	± 321	± 400 (3)	-Replace station

(1) P.S. only has one pump, therefore if it fails the firm capacity is zero, single pump capacity = 266 gpm.
(2) Includes discharge from 9th Street, Palmer Creek, HWY 221.
(3) At 2035 all basins will be built out except the Foster basin.
(4) Includes elementary school flows.

6.3.4 Forcemain Capacity Analysis

The four major forcemains within the City were analyzed for the anticipated flows at buildout for each basin as developed in **Section 5**. Existing forcemain sizes were previously summarized in **Section 4**.

The existing forcemain capacities were compared to the existing and projected peak hour flows at buildout conditions. Buildout conditions were considered for forcemain sizing. New forcemains should be sized for buildout conditions since these facilities are not suited for incremental expansion.

All forcemains were analyzed for capacity assuming the maximum flow velocity of 7 ft/s and a minimum flow velocity of 3.5 ft/s that is required to keep solids suspended. The results of this analysis are summarized in Table 6-3. The only forcemain that will need to be upsized during the planning period is the Main P.S. forcemain. The recommended improvements are discussed in detail later in this section.

Table 6-3 | Summary of Forcemain Capacity Analysis

Forcemain	Size (in)	Existing Capacity at 7 fps (gpm)	Existing Peak Flows (gpm)	Required 2035 Capacity (gpm)	Recommended Capacity Upgrades (see discussions later in this section)
9th Street FM	6	± 600	± 438	± 539	-none
Palmer Creek FM	3	± 150	± 82	± 153	-none
Main P.S. FM	8	± 1000	± 2180(1)	± 4,000	-New forcemain to WWTP -Bore forcemain under Yamhill River
HWY 221 FM	6	± 600	± 321	± 400	- none

(1) Includes discharge from 9th Street, Palmer Creek, HWY 221.

6.3.5 Collection System Improvements to Serve Currently Undeveloped Areas

There are a number of areas within the City that are currently undeveloped and lack gravity sewer service. New gravity mainlines and pump stations will need to be installed to serve these areas as they develop. Current City ordinances require that mainlines and pump stations required to serve these areas be installed at the expense of the developer. These lines should be sized as required to serve all upstream areas.

6.3.6 Summary of Collection System Deficiencies

The known deficiencies described in **Section 4** have been combined with the deficiencies described above to develop a complete list of collection system deficiencies. These deficiencies are listed in Table 6-4 for each of the sewer basins.

Table 6-4 | Summary of Collection System Deficiencies

Location	Description of Deficiency
9th Street Basin	
9th St. Pump Station	Lacks capacity to convey existing peak flows, antiquated pumps
9th St. Pump Station Forcemain	Inadequate downstream capacity
9th St. Trunk Sewer (9th St. P.S. to MH 34)	Lacks capacity to convey existing peak flows.
9th St. concrete pipe	High I/I, end of useful life
Undeveloped Areas	No sewer service
Palmer Creek Basin	
Palmer Creek Pump Station	Lacks capacity to convey peak flows at buildout.
Undeveloped Areas	No sewer service
Main North Basin	
Main North Trunk Sewer (MH 20 to MH24)	Lacks capacity to convey existing peak flows
Main North Trunk Sewer (MH 24 to MH28)	Lacks capacity to convey peak flows at buildout
Main North concrete pipe	High I/I, end of useful life
Underdeveloped Areas	No sewer service
Main Central Basin	
Main Central Trunk Sewer (Main P.S to MH20)	Lacks capacity to convey existing peak flows
Main Central Trunk Sewer (MH 20 to MH58)	Lacks capacity to convey existing peak flows
Main Central Trunk Sewer (MH19 to Overflow)	Lacks capacity to convey peak flows at buildout
Main Central concrete pipe	High I/I, end of useful life
Main South Basin	
Main Pump Station	Lacks capacity to convey existing peak flows, antiquated pumps
Main Pump Station Forcemain	Lacks capacity to convey peak flows at buildout
Main South Trunk Sewer (Main PS to MH 17)	Lacks capacity to convey existing peak flows.
Main South Trunk Sewer (MH3 to MH71)	Lacks capacity to convey existing peak flows.
Main South Trunk Sewer (MH71 to MH76)	Lacks capacity to convey peak flows at buildout.
Undeveloped Areas	No sewer service
HWY 221 Basin	
HWY 221 Pump Station	Lacks capacity to convey existing peak flows, single pump.
HWY 221 concrete pipe	I/I, end of useful life
Undeveloped Areas	No sewer service
Foster Basin	No sewer service
Kreder Basin	No sewer service

6.4. IDENTIFICATION OF COLLECTION SYSTEM ALTERNATIVES

Facilities planning requires the examination of a broad range of alternatives for each portion of the wastewater system. This section examines the alternatives for collecting wastewater within the study area and conveying it to the point of treatment. This section develops and screens wastewater collection alternatives using criteria such as land requirements, topographic constraints, reliability, operational flexibility, construction and long-term O&M costs, and regulatory restrictions. The alternatives listed in this section represent the tools used in the facilities planning effort to address the previously listed deficiencies in order to provide a comprehensive long-term solution for the City's collection system.

6.4.1 No Action

The no action approach implies that no improvements will be made to the existing collection system (other than maintenance or repairs). Obviously, this approach is recommended for those areas of the system which have sufficient capacity to convey the design flows and are in acceptable condition. Although this approach may be justified in isolated areas within the system on a case-by-case basis where there is insufficient capacity to convey peak design flows (i.e., minor surcharging for short periods of time), this approach is effectively eliminated by DEQ guidelines and regulations.

Although it is always an option to not improve the system, the result will be health risks, damages, and inconveniences where sewage collection and pumping facilities are inadequate. Furthermore, delaying required improvements almost inevitably leads to a greater future problem. However, to ensure that system improvements are justified, it is necessary to consider the costs and advantages of proposed improvements against the risks entailed by the no action alternative. It should be noted that since resources are limited and the sewer system cannot be upgraded all at one time, the phasing plan adopted by the City for the improvements will in effect require that the no action alternative be adopted on a temporary basis for all but the first phase improvements.

6.4.2 Reroute Sewage (Basin Transfer)

Under this scenario, sewage would be diverted or rerouted from one sewer basin or system to another. This approach is practical in cases where an existing sewer and pump station has capacity in excess of that needed to convey design flows from that basin, and where flow diversion is practical from a construction and topographic standpoint.

6.4.3 Upgrade Existing Collection System, Pump Stations, & Force Mains

This approach involves constructing replacement pipes and/or upgrading pump stations and force mains to provide adequate capacity for the design flows. This is the most obvious alternative since it provides assurance that the sewage collection system can convey the design flows through town and that overflows will be kept to a minimum, which in turn limits the City's liability.

6.4.4 Infiltration/Inflow Reduction

As stated previously and measured during the I/I field investigation, the collection system collects large amounts of I/I during the winter months. While reduction of the existing I/I flows and minimization of future I/I flows is important, experience in western Oregon has shown that the goal of complete elimination of I/I is unreasonable and largely unattainable. An understanding of I/I hydraulics is necessary to understand why this is so, and to illustrate the place that I/I reduction has in the overall management and improvement program.

As the sewers are repaired, the number of system faults in each area are reduced until the size and number of faults start to inhibit the flow of I/I into the sewers. When that happens, groundwater levels in the sewer trenches rise. Peak I/I flows are smaller, but as long as some faults remain at elevations generally below trench-water levels, the I/I flows several days after a precipitation period remain high. The relationship between ground water levels, precipitation and I/I is complex and transient.

Several options are available for reducing infiltration and inflow into the collection system. These include complete replacement of mainlines manholes and services, in place rehabilitation (i.e., pipe bursting, cured in place pipe, slip lining, grouting, etc.), and spot repairs. Selection of the proper technology must be done on a project by project basis to determine the most cost-effective approach.

The City of Dayton has approximately ±30,000 LF of concrete pipe that contributes significantly to I/I. Due to the large scale of this problem, the costs associated with I/I reduction is very high. Due to this large cost, we suggest that the City complete I/I reduction as funds become available. Currently, the City dedicates approximately $10,000 per year for I/I reduction projects.

6.4.5 New Trunk Sewers, Pump Stations, & Force Mains

The construction of new collection system components including trunk sewers, lift stations, and force mains is the only method considered herein for providing service to undeveloped areas. This method basically involves extending the conventional gravity collection system into the undeveloped areas and installing new pump stations where topographical limitations require. Septic tank effluent pumping (STEP) or Septic tank effluent gravity (STEG) collection systems were not considered practical given the City's reliance on a conventional gravity system and the potential deterioration of concrete components in the existing system from hydrogen sulfide present in STEP and STEG effluents.

6.5. EVALUATION OF ALTERNATIVES

Each of the alternatives listed previously were evaluated against each of the collection system deficiencies to determine the most cost-effective, long-term solution for the City's collection system. This section presents the results of this evaluation and summarizes the collection system recommendations. The City's goal is to develop a sewage collection system that not only meets existing needs, but also accommodates future development.

Shortcomings with the City's collection system include high amounts of I/I, lack of trunk sewer capacity and lack of pump station and/or forcemain capacity. The recommended improvements include the implementation of a full-scale I/I reduction program, trunk sewer upsizing, and pump station and/or forcemain upgrades. The following subsections include discussions on the various recommendations.

A conceptual design was developed for each major improvement project to determine the approximate size and features needed to convey the design flows. As part of this process, alternatives such as alignment, feasibility of reusing existing portions of the system were identified and evaluated. This involved evaluation of topographic opportunities, available vacant lands, and natural resource constraints with field reconnaissance to confirm the conceptual level feasibility of each alternative.

6.6. GRAVITY SEWER COLLECTION SYSTEM RECOMMENDATIONS

6.6.1 Recommended I/I Reduction Program

I/I is a significant problem that the City will need to begin addressing during the planning period. As an alternative to addressing I/I, the City could chose to collect, treat, and dispose of all existing and anticipated I/I. This would amount to the "do nothing" option with respect to the I/I problem. Without continued I/I reduction efforts, the amount of I/I in the existing system will continue to increase as the collection system continues to age. This increase in flow will exceed the capacity of sections of piping in addition to those currently at capacity. As a result, additional sections of collection piping would have to be upsized and pump stations and force mains would have to be oversized to handle the anticipated increase in I/I. Once collected and conveyed to the treatment plant, the I/I must be treated and disposed of. In order to treat the anticipated increase in I/I, the hydraulic capacity of the treatment plant would have to be oversized. All of these improvements would be in addition to the improvements listed in the recommended plan. As such, the "do nothing" alternative with respect to the I/I problem is not the least cost alternative. Even if this fact is ignored, the real problem with the "do nothing" approach is in relation to disposal at the WWTP. As the City continues to grow during and beyond the planning period, wintertime disposal will become a controlling factor with regard to the treatment facilities. This is due to the fact that the receiving waters have a limited capacity to accept treated wastewater. As such, the City will likely be limited on the amount of pollutants it will be allowed to contribute to the receiving stream. Since wastewater flows will grow as the City grows, the only way to maintain the pollutant loads to the river is to provide a higher level of treatment. As wastewater flows increase, eventually the City will be forced to produce a higher quality effluent than it currently does. If the I/I problem is not addressed, the City may be forced to make the modifications required to produce a higher quality effluent sooner than necessary. Given this fact, and the fact that the "do nothing" alternative with respect to the I/I problem is not the most cost effective solution, it will be dropped from further consideration.

The majority of the problems associated with the existing gravity collection system are the result of the age of the original 1966 gravity piping and the materials and construction methods used to install the system. The system is now more than 45 years old and is showing significant signs of deterioration. If all of the infiltration and inflow sources could be removed, the existing gravity piping would most likely have the required capacity to convey existing and projected peak flows. Although complete elimination of infiltration and inflow is not possible, it can be significantly reduced. Reducing the amount of I/I into the collection system has a number of benefits. Some of these are listed as follows.

- <u>Reduction in wintertime disposal requirements.</u> All of the infiltration and inflow that enters the collection system must be transported, treated, and disposed of as if it were domestic sewage. During the winter, the only disposal method available to the City is surface water discharge of the treated effluent. As described above, the DEQ limits the amount of treated wastewater that can be discharged by setting mass load limits. Efforts to reduce I/I will result in a decrease in the amount of treated wastewater that must be disposed of and will ultimately ensure that the City is in compliance with the mass load limitations set forth by the DEQ.

- <u>Reduces pumping costs</u>. In Dayton all wastewater that is collected from the users is pumped to the treatment plant, with sewage from some areas being pumped twice. As such, reducing the amount of I/I will decrease pumping costs.

- <u>Extends the life of the pumping and treatment facilities</u>. I/I utilizes capacity that could be used for wastewater. If the amount of I/I can be reduced, the time until the pumping and treatment facilities reach capacity can be extended.

6.6.2 Replace Under-Capacity Trunk Sewers

This approach involves replacing existing sewers with new pipes sized to provide the required capacity. This approach is the most obvious alternative since it provides assurance that the sewage collection system can convey the design flows through town and that overflows will be kept to a minimum which in turn limits the City's liability.

6.6.3 Collection System Improvements to Serve Undeveloped Areas

The only way to serve undeveloped areas is to construct new facilities. The collection system improvements to serve currently undeveloped areas have been partitioned into the individual projects listed in the recommended improvements to allow for inclusion in the CIP at the discretion of the City Council. It is assumed that developers will construct the trunk sewers and pump stations required to provide service to undeveloped areas. The final locations of the new pump stations and detailed alignment of the trunk sewers and force mains have not yet been determined and will be based on the proposed development pattern of the land being served by the facility. The locations shown later in this section represent the general location required for the facilities in order to serve the tributary drainage basins. Alternate locations proposed by developers should be considered only if they are capable of providing service to the entire basin.

6.6.4 Recommended Gravity Sewer Improvements

Brief descriptions of the recommended trunk sewer improvements for each basin are included in the following subsections. The recommended pump station, forcemain and trunk sewer improvements are shown in Figure 6-4. The recommended improvements and project costs are listed in Table 6-5. A detailed breakdown of the construction costs, contingency, design and administration/financing costs are included in Table G-1 of Appendix G.

Only the trunk sewer improvements in the 9th, Main North, and the Main South basins are required to meet existing peak flows. The remaining trunk sewer improvements are all required to address future growth. Therefore, the costs of these projects should be partially eligible for funding by the sewer SDC's.

As the I/I correction program is implemented, the flows should be evaluated to quantify any reductions in the amount of I/I. If during the implementation the I/I reduction program, significant reduction in the amount of I/I into the collection system is observed, the City may wish to reevaluate the pipe diameter recommendations listed in Table 6-5.

6.6.4.1 9th Street Basin

There are a few isolated parcels of undeveloped or underdeveloped land in the 9th Street Basin. Gravity sewer piping surrounds or is adjacent to these parcels. Therefore these areas can be served by sewer extensions. However, in some areas at the upper end of the basin where the public sewer lines are shallow, the adjacent parcels may need to install sewage ejector pumps to lift sewage into the public sewer system. No large diameter trunk sewers will be required to serve these areas except for a new trunk line adjacent to the 9th Street Pump Station. The recommended trunk sewer improvements are shown in Figure 6-4. These trunk sewer upgrades are largely required to relieve existing bottleneck. Therefore, it is anticipated that the costs of the recommended 9th Street trunk sewer improvements will mostly be borne by the existing ratepayers.

6.6.4.2 Palmer Creek Basin

The Palmer Creek Basin is nearly built out except for a couple of small undeveloped areas. As such, only short 8-inch sewer extensions are required to serve undeveloped areas. The existing trunk sewers are adequately sized to accommodate the peak flows to the station. Also, throughout the entire basin the sewer lines are constructed of PVC and are relatively new and will not require replacement during the planning period.

In 2009, the school district constructed a new 8-inch sewer line that connects the existing 8-inch line in Elizabeth Ct to the new school building and concession stands. The existing school buildings are still connected to the inverted siphon located at the northeast corner of the site. If the school expands in the future, or if the siphon stops working the school district could redirect sewer flows from the inverted siphon and/or any new expansion to the new sewer line connected to the 8-inch in Elizabeth Ct. At which time, the Palmer Creek Pump Station may need to be upsized to accommodate the increase flows. This new sewer connection effectively transfer's sewer flows from the Main South Basin to the Palmer Creek Basin.

6.6.4.3 Main North Basin

The Main North Basin includes a few parcels of undeveloped residential ground at the north end of the basin. The existing trunk sewers are not adequately sized to convey existing sanitary flows. The Main North Basin will also receive flows from Foster Basin during the planning period, with flows entering the basin just north of the intersection of Oak Street & 3rd Street (i.e., manhole 24). Upstream of 3rd street (i.e., manhole 24) the trunk sewer will also need to be upsized to convey flows during the planning period. Downstream of the Foster Basin connection (i.e., manhole 24) the trunk sewer should be upsized based on buildout flows, as this trunk sewer does not have capacity to convey even existing flows. The recommended trunk sewer sizes are illustrated in Figure 6-4.

6.6.4.4 Main Central Basin

The Main Central Basin is for the most part built out and includes only small areas of land that could be redeveloped. The Main Central Basin conveys flows from the Main North Basin to the Main Pump Station. Currently, the existing trunk sewer does not have the capacity to convey existing peak flows. The Main Central Basin receives flows from the Main North Basin at Manhole 20, and ultimately from the Foster Basin. The trunk sewer should be upsized from the Main Pump Station to the Main North Basin connection at Manhole 20 and from Manhole 20 west to 5th Street (i.e., Manhole 58) early in the planning period. In addition, the existing overflow needs to be upsized in case of a failure in the Main Pump Station. The recommended trunk sewer improvements are shown in Figure 6-4.

6.6.4.5 Main South Basin

The Main South Basin is currently built out except for some small areas that could be redeveloped increasing existing peak flows. The elementary school also has some undeveloped area remaining in the basin, although the elementary school may be transferred to the Palmer Creek Basin if the inverted siphon is abandoned. The Main South Basin also includes a large area along Lippincott's Gulch and Palmer Creek that is unsewered and undevelopable. Since this land is undevelopable, it was not included in the sewer capacity analysis.

The Main South Basin receives flows from the HWY 221, Palmer Creek and 9th Street Basins. The existing trunk sewers from the Main Pump Station west to the 9th Street Basin (i.e., Manhole 11) and from the Main Pump Station to the HWY 221 basin (i.e., Manhole 78) lack capacity to convey existing flows. Therefore, these trunk sewers should be upsized early in the planning period. The recommended trunk sewer improvements are shown in Figure 6-4.

As previously discussed the Main South basin receives flow from the 9th Street basin. The 9th Street basin is pumped to MH 17 in the Main South Basin, which flows by gravity to the Main Pump Station. As discussed in **Section 6.3.2** the sewer segment from MH 11 to MH 17 has the most I/I per foot of pipe in the entire City. In addition, the high school sanitary sewer discharges into MH 149 just upstream of MH 16. As previously discussed this trunk sewer is undersized and causes sewer backups into the high school. The section of trunk sewer from MH 11 to MH 17 will be costly to upsize because this existing section of trunk sewer is located at the back lot lines of two blocks of existing homes. Two homes are actually constructed over this section of pipe. Therefore, there are two options available to increase sewer capacity. First, we could reroute the 9th St Pump Station forcemain to MH 80, bypassing this portion of the trunk sewer. This would allow the City the option to repair the I/I from MH 11 to MH 17 with trenchless methods as funds become available rather than complete removal and replacement. The second option, would be to upsize the existing trunk sewer from MH 11 to MH 17 this would be the costliest of the two. However, this option would remove the worst I/I in town and would provide sewer capacity in this are throughout the planning period. Both options are shown in Figure 6-4.

6.6.4.6 HWY 221 Basin

There is a significant amount of residential land in the HWY 221 Basin that is undeveloped. At buildout there are only a couple of the pipe mainlines that will need to be upsized. However, as long as development densities do not exceed the design criteria set forth in **Section 5**, the existing network of gravity sewer piping should have the capacity to convey the flows from all newly developed areas. The facilities plan includes only minor trunk sewer upsizing just upstream of the pump station in the HWY 221 Basin as illustrated in Figure 6-4.

6.6.4.7 Foster Basin

The entire Foster Basin is unsewered at the present time and is mostly developed as oversize or acreage residential lots. The entire basin is currently outside the City Limits and inside the UGB. Any development in this area must be accompanied by large-scale infrastructure improvements. Under buildout conditions, it is envisioned that a new pump station and forcemain will be required to convey wastewater from the center of the basin near the gully east to Foster Rd, then south down Foster Rd to the north end of the Main North Basin across HWY 18. Wastewater will ultimately flow from Foster Basin through the Main North Basin, the Main Central Basin and into Main South Basin where it will enter the Main Pump Station and be pumped to the WWTP. The recommended improvements and forcemain size improvements are shown in Figure 6-4.

6.6.4.8 Kreder Basin

The majority of the Kreder Basin is undeveloped at the present time except for the existing WWTP and the RV park. About half the basin is currently inside the City Limits, while the other half is inside the UGB but outside the City limits. Any development in this area must be accompanied by large-scale infrastructure improvements. Under buildout conditions, and assuming this area is not used for the WWTP expansion, a new pump station and forcemain will be required to convey wastewater to the new WWTP. These possible improvements are not shown on Figure 6-4 as they depend on the final location of the new WWTP. The only improvements required during the planning period in this basin is to reroute and connect the RV Park pump station forcemain to the new 16-forcemain or the new WWTP headworks.

6.6.5 Pump Station Recommendations

In most cases, the proposed pump station improvements are limited to a single feasible alternative (i.e., replacement or reconstruction). The following is an evaluation of each pump station based on the general evaluation criteria discussed in the previous sections. The location of the recommended pump station improvements are shown in Figure 6-4. The total project estimates for each of the pump station improvement projects are listed in Table 6-5. A detailed breakdown of the construction costs, contingency, design and administration/financing costs are included in Table G-1 of Appendix G.

6.6.5.1 9th Street Pump Station

The 9th Street Pump Station lacks the capacity to convey existing peak flows. The structural and mechanical elements of the system are over 45 years old. Due to the age and condition of the station, it has reached the end of its design life and should be replaced during the planning period. Upgrades are recommended early in the planning period. None of the existing pumping facilities will be salvaged except for the existing wetwell. The existing facilities are now near the end of their useful life and cannot be relied upon to provide reliable service through the next planning period. As such, the only real alternative for upgrading the station is to construct a new pump station (utilizing the existing wetwell if possible).

The 9th Street Pump Station is located on the northeast corner of 9th Street and Ferry Street, within the Ferry Street right-of-way (refer to Figure 6-1 for a proposed layout). The recommended improvements consist of new submersible pumps (duplex station with two equally sized pumps) and control equipment, control panel, backup generator, and valve vault. The control panel and auxiliary power generator could be added east of the existing wet well and may require an easement from the property owner. This location should be sited so that additional equipment is located out of the Ferry Street right-of-way to allow public works access without diverting traffic. All other design criteria should be in accordance with Table 3-2. The total project cost for the new station including construction, engineering, legal, and administration costs is estimated to be approximately $490,000. This figure includes a cost for land acquisition of $20,000. Prior to budgeting these improvements, the land acquisition costs should be confirmed.

6.6.5.2 Palmer Creek Pump Station

The Palmer Creek Pump Station is the newest pump station in the City. Currently, it has the capacity to convey existing peak flows. The entire station is less than 5 years old.

The Dayton Grade School currently discharges sewage in a siphon that enters the Main South basin. However, this siphon is antiquated, AC pipe without maintenance access, and will likely be abandoned during the planning period. As a result, the school will likely construct a new service lateral and convey sewage flows to the Palmer Creek Basin. This increased flow, coupled with the development in the basin, will require the Palmer Creek Pump Station to be upsized. The pump station capacity can be increased by increasing the size of the submersible pumps. The pump station components are adequately sized to accommodate the increased flows. Since the pump station will require upsizing due to the increased flows from the Elementary school basin transfer, the school district will likely be responsible for paying for the pump station capacity increase. Therefore we have not included upsizing costs during the planning period.

6.6.5.3 Main Pump Station

The Main Pump Station lacks the capacity to convey existing peak flows. Most of the structural and mechanical components of the station are over 45 years old. Due to the age of the station, it will reach the end of its useful life during the planning period. For these reasons, upgrades are recommended early in the planning period.

The existing station is located in the Ferry Street right of way (east of 1st Street). The recommended location for the new station is immediately north of the existing station. The new pump station location will not fit completely within the Ferry Street right of way (refer to Figure 6-2). Therefore, land acquisition will be required to construct the new pump station. Another possible pump station location would be to the south of the existing pump station. Again the new pump station will not fit entirely in the Ferry Street right of way. Yamhill County owns the parcel directly to the south and operates it as a County park and boat ramp. At either location significant fills would be required to raise the new pump station site above the 100-year flood plain

The recommended improvements consist of a new wet well with submersible pumps, a new control panel, valve vault and auxiliary power generator. A quadplex station with a total of four pumps is recommended. Two of the pumps will be smaller jockey pumps of equal size used to convey low flows. The remaining two pumps will be larger primary pumps used to convey large flows. Due to the age and condition of the pump station, the only potential component of the existing pump station that could be salvaged would be the existing wetwell. In addition a new alarmed overflow will also be required, as the existing overflow is not alarmed. As described in previous sections, the existing facilities are near the end of their useful life and cannot be relied upon to provide adequate service through the next planning period. All other design criteria should be in accordance with Table 3-2. The total project cost for the new station including construction, engineering, legal, and administration costs is estimated to be approximately $1,848,000. This figure does not include costs for the design or construction of the new forcemain. The recommended forcemain improvements are discussed in **Section** 7.

6.6.5.4 HWY 221 Pump Station

The HWY 221 Pump Station structural and mechanical components are over 45 years old. Due to the age and condition of the station, it has reached the end of its design. The HWY 221 Pump Station has only a single pump and does not meet DEQ design guidelines for pump stations. For these reasons, upgrades are recommended early in the planning period.

The existing pump station is located south of the HWY 221 bridge on the east side of the highway within the ODOT right-of-way, north of the westbound lane travel lane. As such, any pump station maintenance requires Public Works to cone off a section of the west bound lane. This is not a safe access location along the state highway.

The new pump station could be constructed on the west side of HWY 221, west of the existing station within ODOT right-of-way. Refer to Figure 6-3 for a schematic layout of the new pump station location. As illustrated in Figure 6-3, the new pump station will require a new sanitary sewer pipe line crossing HWY 221, wetwell, valve vault, control panel and auxiliary power generator. The new highway sewer crossing would consist of a new gravity sewer line and a new 6-inch forcemain. The new 6-inch forcemain will also need to be connected to the existing 6-inch forcemain at the HWY 221 bridge crossing.

This proposed pump station location would allow public works to pull completely off of the highway to perform routine maintenance, providing a much safer work environment than the present pump station location. Other sites for the pump station were also considered. One option would be to move the pump station northeast of the existing location. However, this option was ruled out due to the location of the neighboring house and steep slopes that would be cost prohibitive to mitigate for. Another possible site would be to move the pump station to northeast parallel to HWY 221 several hundred feet. This alternate site is also cost prohibitive due to the location of existing homes, the steep bank and the location of the lowest sanitary sewer connection.

It is envisioned that the new pump station will be designed in accordance with the design criteria listed in Table 3-2. The recommended project budgets for the improvements are $1,080,000. This figure includes land acquisition of $20,000. Prior to budgeting these improvements, the land acquisition costs should be confirmed.

6.6.6 Forcemain Recommendations & Yamhill River Crossing

As shown in Table 6-3 the only forcemain that will require upsizing during the planning period is the Main Pump Station forcemain, although the 9th Street Pump Station will be rerouted to a new discharge point. The existing Main Pump Station forcemain across the Yamhill River is suspended on the existing wooden pedestrian bridge. As noted in **Section 4**, the existing Yamhill River pedestrian bridge (at the easterly end of Ferry Street) is near or at the end of its design life, and will require increasingly expensive repairs in the coming years. This bridge is not expected to last through the planning period of this facilities plan.

ODOT's Tier 2 Draft Environmental Impact Statement for the Newberg-Dundee Bypass (released in June 2010) includes a plan to replace the existing pedestrian bridge with a new vehicular bridge at the same location (i.e., to connect Kreder Road and Ferry Street across the Yamhill River). However, the timeframe for this new bridge is highly uncertain, as it is dependent on federal funding. Since the City expects to have to replace the existing forcemain early in the planning period, it does not appear feasible to wait until the new ODOT Ferry Street bridge is complete in order to replace the river crossing.

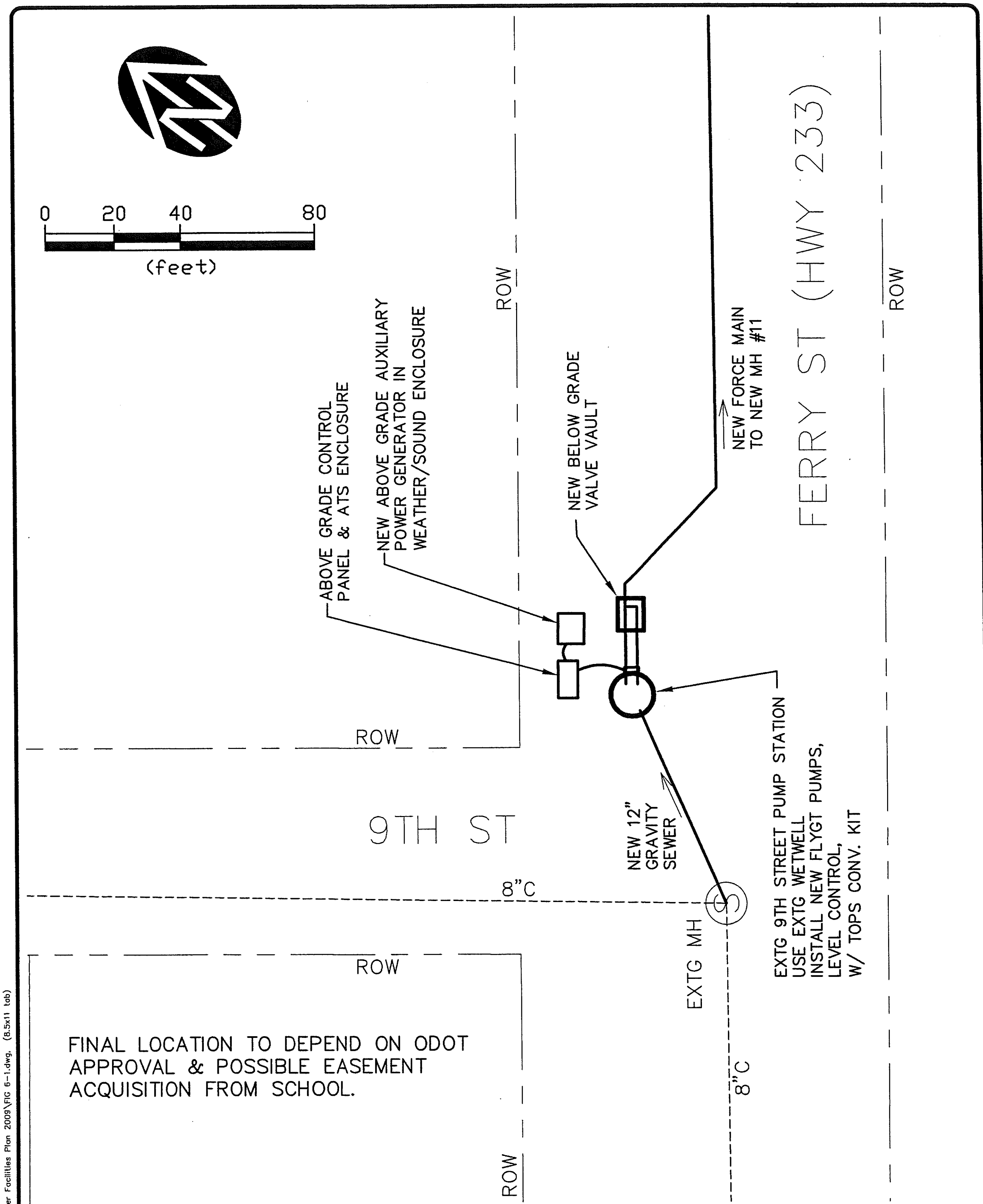
As discussed in **Section 4**, the City hired OBEC in 2008 to prepare a technical memo which included a life expectancy and cost analysis for the Ferry Street Bridge (See Appendix E). Per the OBEC technical memo, the Ferry Street Bridge contains many timbers that are close to the end of their useful life. Maintenance costs will continually increase as the bridge ages and could need replacement soon. The replacement costs of the Ferry Street Bridge were estimated to range from approximately $3.8 to $6.9 million depending on bridge type. Given the cost associated with ongoing bridge maintenance and/or replacement of the pedestrian bridge, and the anticipated timeframe for the new ODOT bridge, the following alternatives were developed.

One long-term option would be to eliminate reliance on a pedestrian bridge entirely, and install a new 20-inch (OD) sanitary sewer force main under the Yamhill River using directional drilling. The likely pipe material would be HDPE DR 9.0 with an internal diameter of 15.3 inches. Preliminary estimates for directionally drilling under the Yamhill River and extending the forcemain to the new headworks is approximately $1,835,000 estimated costs (for both the sanitary sewer force main and the 12-inch water main are $2,913,000). These estimates can be refined once the geotechnical investigation has been completed. Assuming that the pedestrian bridge would be removed during the 20 year planning period, this option would require both sanitary sewer force main and waterline to be drilled under the river. This option would eliminate the ongoing maintenance associated with exposed pipelines suspended from bridges, and is substantially less expensive than a new pedestrian bridge.

Another option evaluated was to route the forcemain to the HWY 18 bridge north of town and hang the force main from this bridge. In discussions with ODOT about this option, ODOT indicated that this existing bridge was not designed to accommodate additional pipelines of this type, and that this option may require upgrades to the existing bridge to ensure that its integrity is not compromised. A detailed structural evaluation of the existing bridge to determine the feasibility of installing the forcemain on the bridge is beyond the scope of this plan.

The use of the HWY 18 bridge crossing alternative will require the installation of approximately 4,800 feet of additional 16-inch force main (i.e., from Kreder Road to HWY 18, along HWY 18 to Dayton interchange, and then south along 3rd Street to Main Street and then to the Main Pump Station). Based on estimated pipeline costs from Appendix G, this additional transmission main would be about $705,000, plus the cost of the bridge crossing work itself. Given that this approach would require that the existing water transmission main (which also hangs on the pedestrian bridge) also be relocated to the HWY 18 bridge, and the fact that the additional water main would add approximately (±3,400 feet), this option appears to be significantly more expensive than the directional drill alternative.

If the existing HWY 18 bridge is replaced as part of the ODOT work on the Newberg-Dundee Bypass, the new bridge could conceivably be designed to accommodate the water & sewer pipelines. However, since the timeframe for the new forcemain replacement is expected to precede the ODOT bypass work, and given the cost for the additional pipelines, installation on the new bridge is not considered to be a viable option, and is not considered further. It is not considered feasible to install the new larger diameter force main on the existing pedestrian bridge. Therefore, we recommend that the City plan for installing a new force main under the river via directional drilling.



WE
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CITY OF DAYTON, OREGON — WASTEWATER FACILITIES PLAN

NEW 9TH STREET PUMP STATION SCHEMATIC

FIGURE **6–1**

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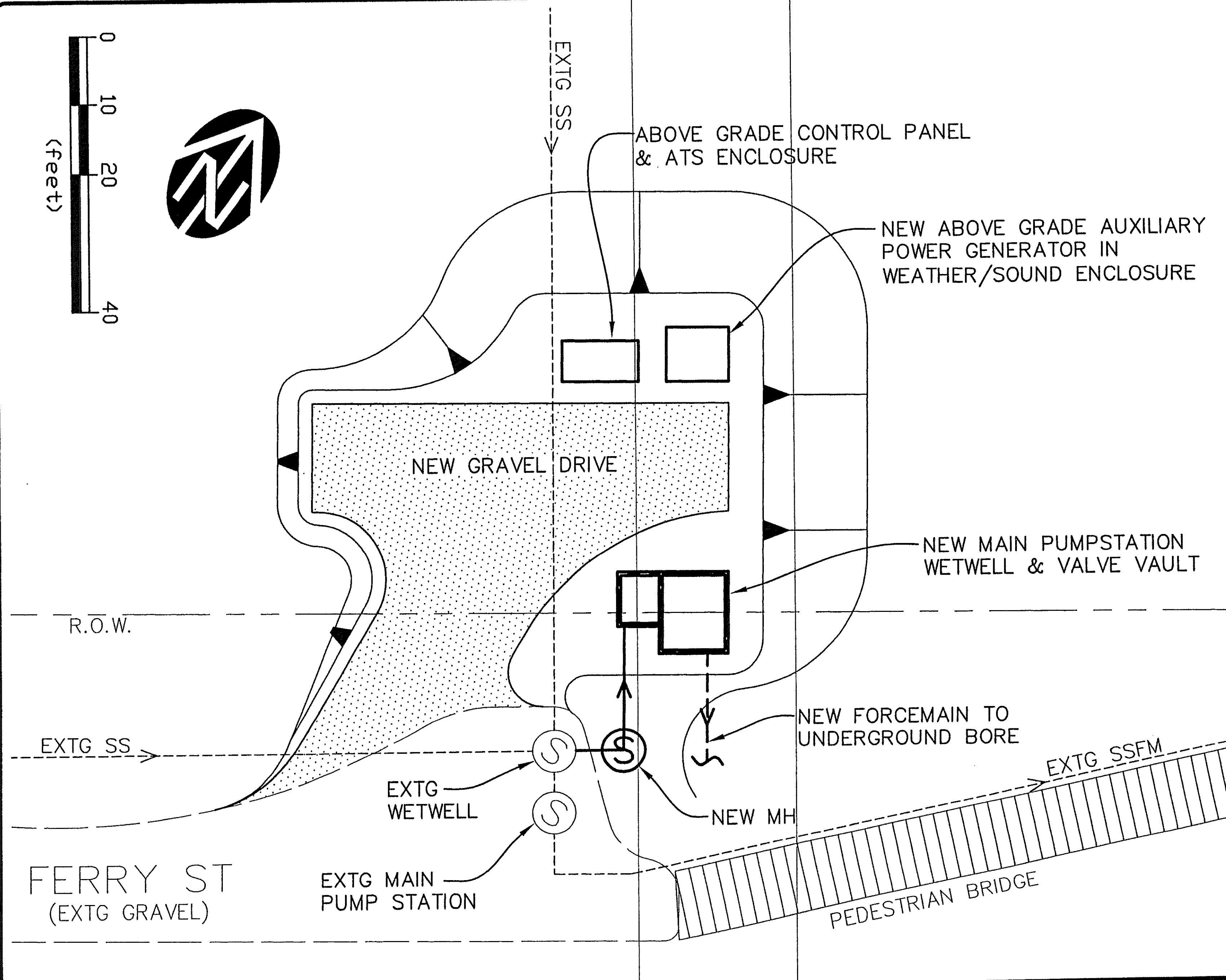

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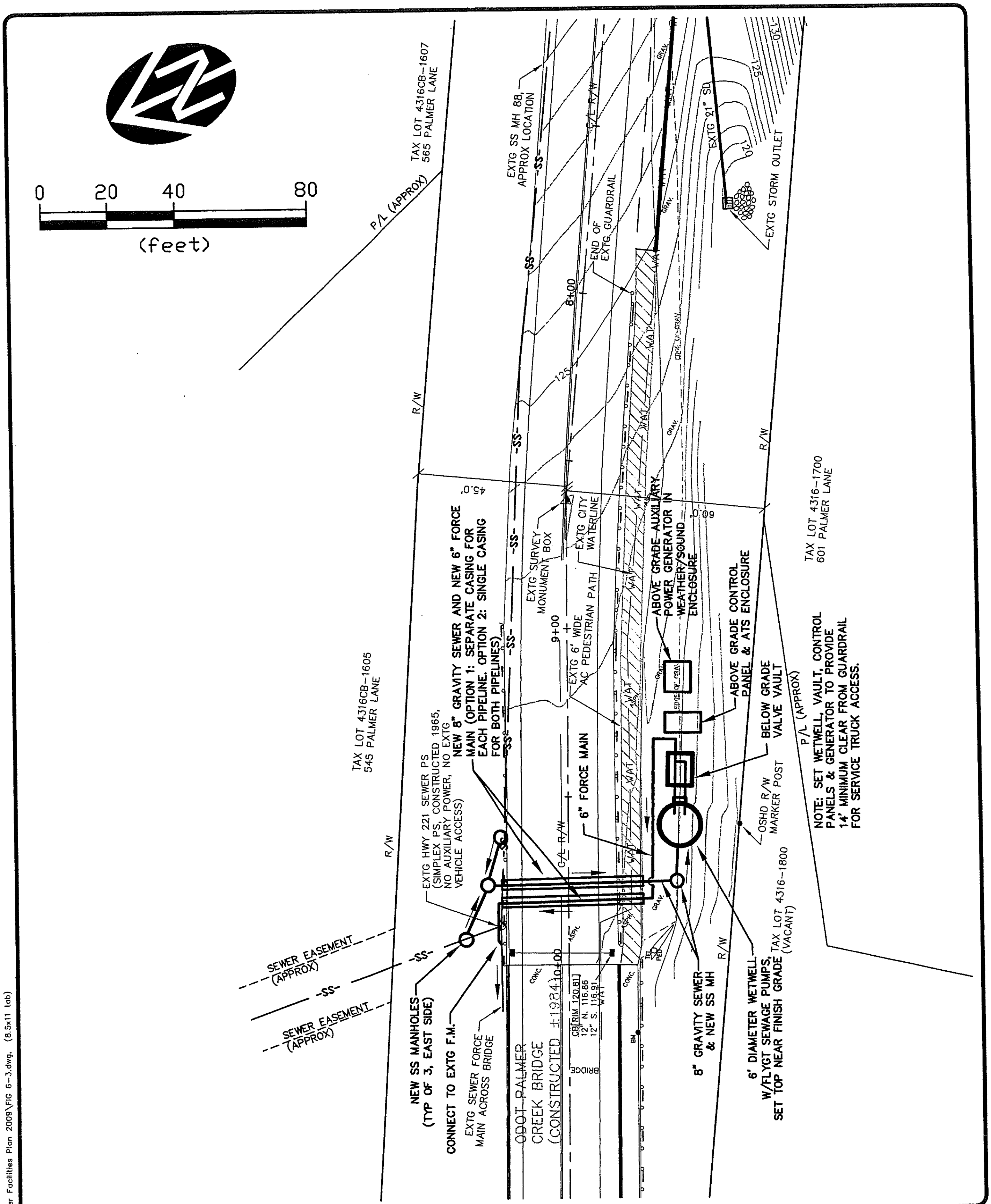
CITY OF DAYTON, OREGON — WASTEWATER FACILITIES PLAN

NEW MAIN PUMP STATION SCHEMATIC

FIGURE 6-2

JOB NUMBER 2609.3010.0



WESTECH ENGINEERING, INC. CONSULTING ENGINEERS AND PLANNERS 3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302 Phone: (503) 585-2474 Fax: (503) 585-3986 E-mail: westech@westech-eng.com	SCALE HORIZ: 1" = 40' VERT: – DSN. DM DRN. TMT CKD. JW DATE: JUN 2011	CITY OF DAYTON, OREGON — WASTEWATER FACILITIES PLAN NEW HWY 221 PUMP STATION SCHEMATIC	FIGURE 6–3 JOB NUMBER 2609.3010.0

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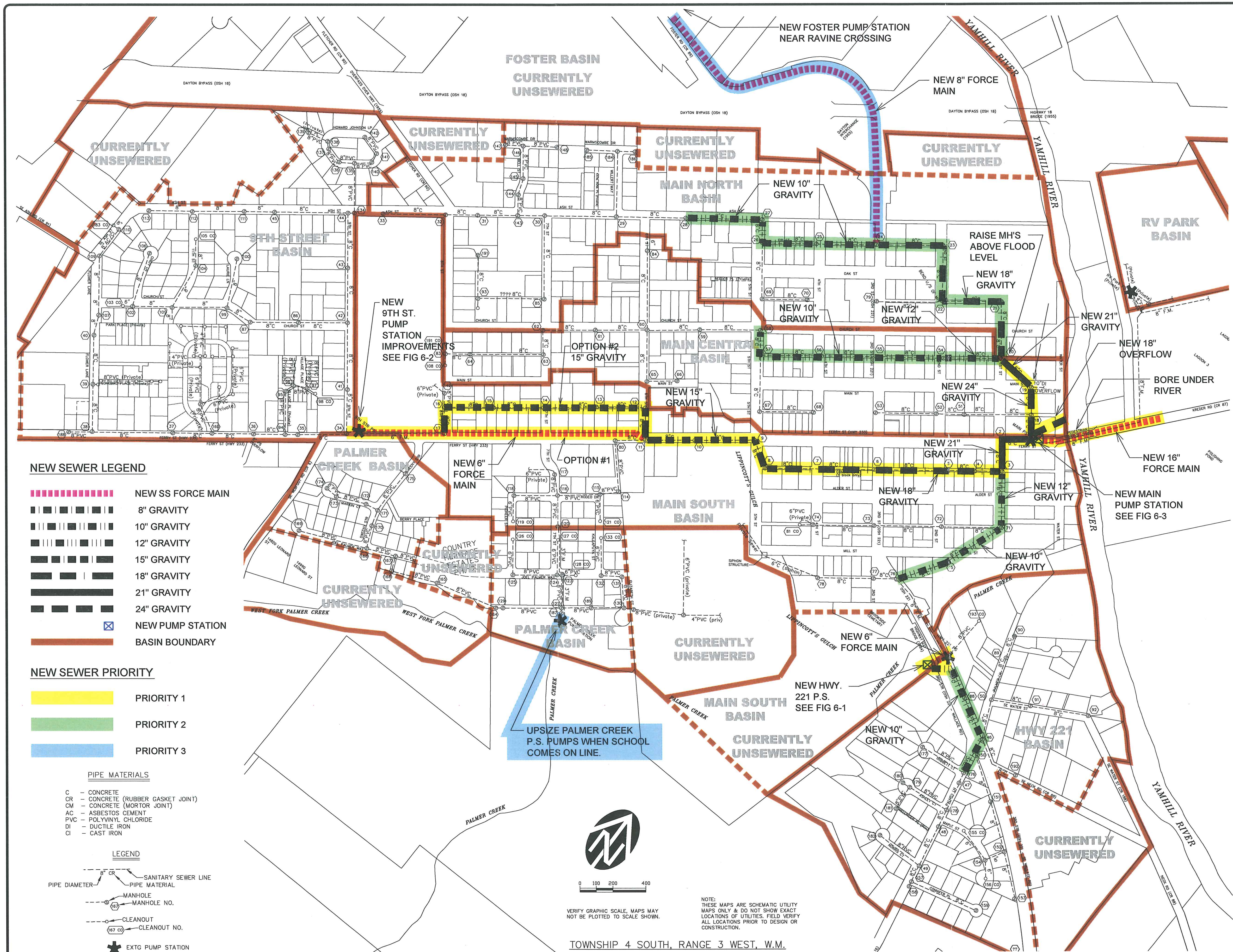

CITY OF DAYTON, OREGON

RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS FIGURE 6-4 (BUILDOUT)

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FIGURE 6-4

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6.7. SUMMARY OF RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS

The improvements outlined in Table 6-5 of this report are shown in Figure 6-4. These improvements will result in a sewage collection system with the capacity needed to convey flows from within the planning area assuming development to zoning densities shown. The proposed improvements are intended to minimize the amount of new piping which must be installed, as well as to minimize the unnecessary replacement of existing sewer mainlines. The proposed trunk sewer system improvements largely follow existing street or alley right-of-ways through the community along existing sewer alignments. As such, the alternative alignments are limited. Construction of the recommended new sewers to address capacity issues will also result in a decrease in the I/I contributions as the existing concrete sewers are replaced with new sewers of PVC pipe material.

The improvements address existing deficiencies, as well as potential deficiencies at the end of the planning period. Trunk sewer sizing is based on buildout of the UGB since trunk sewers are not suited for incremental expansion. Only the improvements that address the existing deficiencies are required at this time. The remaining deficiencies are growth dependent. Of these, some may be required before the end of the planning period and some may not. Nonetheless, should any of the sewer trunk sewers be replaced as part of the I/I correction work, they should be sized in accordance with the recommendations listed in Table 6-5 and assume UGB buildout, regardless of whether or not the mainline lacks capacity at the time of construction. The improvements are prioritized in **Section 8** of this report.

The alignment of future lines through the undeveloped portions of town has not yet been determined. The final alignment of sewer lines in these areas should be determined as property develops. Sewer lines should be placed within right-of-ways whenever possible. If the City Limits or UGB are expanded in the future, the sewer system should be re-examined to determine where additions are needed and if alternate alignments are justified. The capacity problems in the collection system are well documented. Any additional development upstream of the identified bottlenecks prior to the implementation of the recommended improvements will exacerbate the capacity problem and will result in additional surcharging of sewers and possible overflow or flooding of homes or businesses.

Table 6-5 | Recommended Collection System Improvements

Project Location(s)	Existing Size/ Capacity	Length (ft)	Recommended Size/Capacity	Total Estimated Project Cost (1)
Main Pump Station (Ferry & Water)	900 gpm (3)		4,000 gpm (4)	$1,728,000
Main Pump Station Force Main (to WWTP) & Bore Under the Yamhill River	8	0	16	$1,835,000
Kreder Basin				
Reroute RV Park Forcemain	6	700	6	$137,000
9th Street Basin				
Ferry Street (9th Street P.S. to MH 34)	8	100	12	$38,000
9th Street Pump Station	266 gpm (3)		540 gpm (4)	$473,000
9th Street P.S. Force Main (P.S. to MH 11)	6	1,550	6	$307,000
Main Central Basin				
Main Street (MH 19 to Overflow)	12	300	24	$73,000
Main Street (MH 19 to MH 20	8	300	21	$89,000
Ferry Street (Main Pumps Station to MH 19)	8	320	24	$100,000
1st Street (MH 20 to MH 54)	8	360	12	$117,000
2nd Street (MH 54 to MH 58)	8	1,260	10	$350,000
Main South Basin				
Ferry Street (Main Pump Station to MH 3)	8	400	21	$124,000
1st Street (MH 3 to MH 8)	8	1,360	18	$448,000
5th Street (MH 8 to MH 11)	8	860	15	$227,000
1st Street (MH 3 to MH 71)	8	350	12	$100,000
1st Street (MH 71 to MH 76)	8	750	10	$201,000
HWY 221 Basin				
HWY 221 Pump Station	0 gpm (3)		400 gpm (4)	$1,042,000
HWY 221 P.S. Force Main (connect to existing)	6	120	6	$23,000
HWY 221 P.S. (Old PS Wet Well to MH 176)	8	950	10	$230,000
Main North Basin				
1st Street (MH 20 to MH 24)	8	1,425	18	$396,000
3rd Street (MH 24 to MH 28)	8	1,315	18	$413,000
Palmer Creek Basin				
Palmer Creek P.S. Uprades When School Connects	111 gpm		150 gpm	$135,000
Foster Basin				
New Foster Pump Station			1,000 gpm	$1,350,000
New Foster Pump Station Force Main		3,750		$744,000
TOTAL				**$10,680,000**

(1) Cost are 2011 dollars, assume dry weather construction, publicly bid project, ENR 20 Citites Index = 9,103. See Section 3.4 for basis of project cost estimates (i.e., 10% contingency, 20% engineering, 5% legal, permits, and administration.)

(2) Costs will increase over time due to inflation.

(3) Firm capacity with the single largest pump out of service. Based on this requirement, the HWY 221 Pump Station firm capacity is zero because it only has a single pump.

(4) Recommended pump station capacity is based on peaking factors and is not based on actual data.