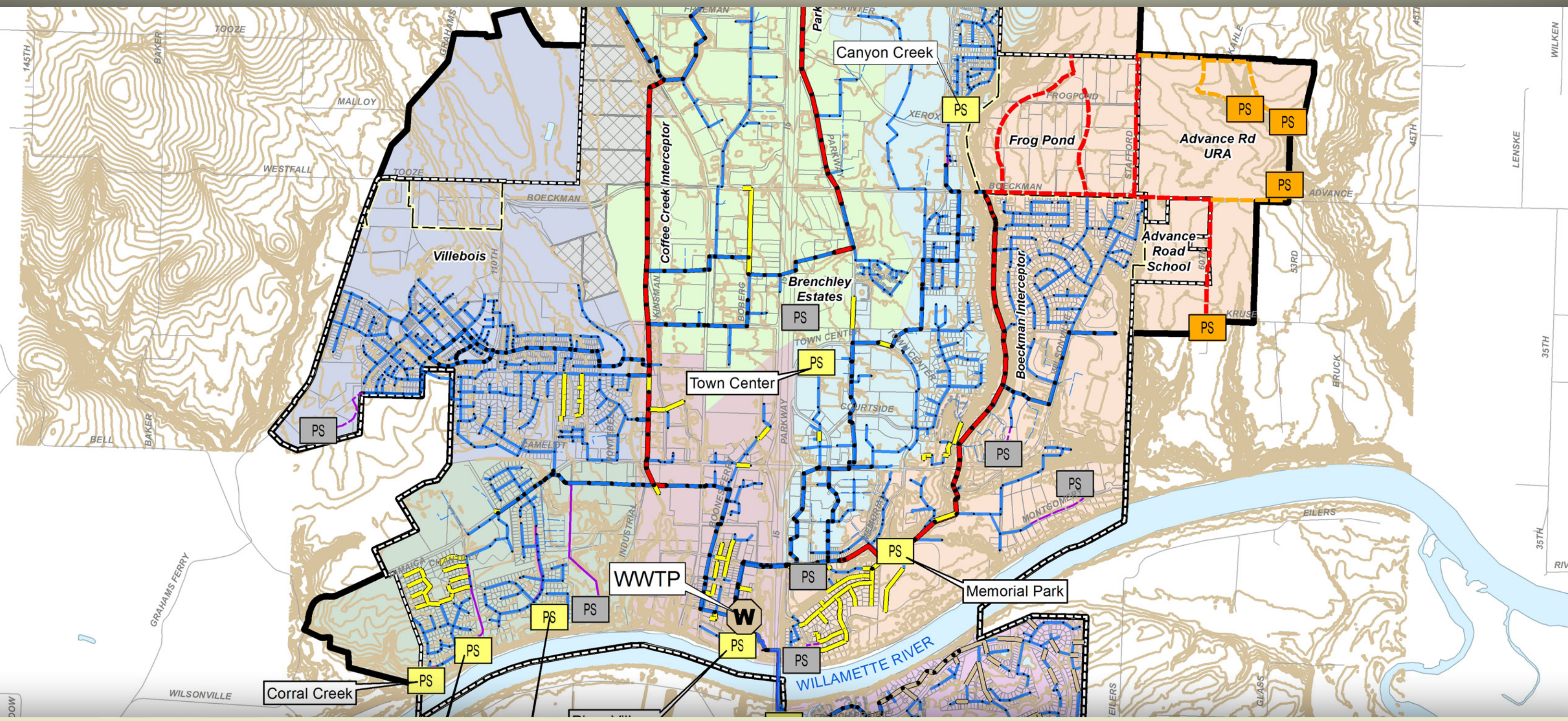
MURRAY, SMITH & ASSOCIATES, INC.
ENGINEERS | PLANNERS



CITY OF WILSONVILLE
WASTEWATER COLLECTION SYSTEM MASTER PLAN

NOVEMBER 2014

City of WILSONVILLE in OREGON

DRAFT-FINAL

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Ø	diameter
$	dollar
°F	degrees Fahrenheit
AC	asbestos cement
AF	agricultural/farm (zoning)
ASTM	American Society for Testing and Materials
AWWA	American Waterworks Association
BMP	best management practices
BPA	Bonneville Power Administration
CCCF	Coffee Creek Correction Facility
CCTV	closed-circuit television
CIP	Capital Improvement Program
CSMP	Collection System Master Plan
CWA	Clean Water Act
DBO	Design-Build-Operate
DEQ	Oregon Department of Environmental Quality
DI	ductile iron

DIA	diameter
DWF	dry weather flow
EDU	equivalent dwelling unit
EFU	exclusive farm or forest use (zoning)
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETC	etcetera
FEMA	Federal Emergency Management Agency
FD	future development (zoning)
FPS	feet per second
FT	feet
FT/SEC	feet per second
GIS	geographic information system
GPAD	gallons per acre per day
GPCPD	gallons per capita per day
GPD	gallons per day
GPM	gallons per minute
GWI	groundwater infiltration
HDPE	high density polyethylene
HP	horsepower
I-205	Interstate 205
I-5	Interstate 5
JAN	January
LID	low-impact development
LF	linear-feet
METRO	Metropolitan Service District
MG	million gallons
MGD	million gallons per day
MPPS	Memorial Park Pump Station
MSA	Murray, Smith & Associates, Inc.
MS4	municipal separate storm sewer system
NE	northeast
No.	number
NOAA	National Oceanic and Atmospheric Administration
NOV	November
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
NW	northwest
OAR	Oregon Administrative Rule
P&W	Portland and Western
PDC	planned development commercial (zoning)
PDCTC	planned development town center (zoning)
PDI	planned development industrial (zoning)
PDR	planned development residential (zoning)
PE	polyethylene

PF	public facilities (zoning)
PFC	public facilities corrections (zoning)
PFP	public facility plan
PGE	Portland General Electric
POTW	publically owned treatment works
PSU	Portland State University
PVC	polyvinyl chloride
PWS	public works standards
RAH	agricultural holding (zoning)
RDII	rainfall derived inflow and infiltration
RI	rural industrial (zoning)
RRFF5	rural residential (zoning)
SCADA	supervisory control and data acquisition
SDC	system development charge
SDR	standard dimension ratio
SE	southeast
SROZ	significant resource overlay zone
SSO	sanitary sewer overflow
SW	southwest
TMDL	total maximum daily load
TSP	transportation system plan
UD	United Disposal
UGB	urban growth boundary
UH	unit hydrograph
URA	urban reserve area
U.S.	United States
V	volt
WRWTP	Willamette River Water Treatment Plant
WSMP	water system master plan
WWF	wet weather flow
WWTP	wastewater treatment plant

ACKNOWLEDGEMENTS

The completion of this plan could not be accomplished without the historical knowledge and hands-on experience of the Wilsonville wastewater collection system. The support, professional courtesy and cooperation of the following city staff members have been instrumental in completing this document (listed alphabetically):

- Adams, Steve – Development Engineering Manager
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- Labrie, Jason – Public Works Supervisor
- Mangle, Katie – Manger of Long-Range Planning
- Mende, Eric – Capital Projects Engineering Manager
- Neamtzu, Chris – Planning Director
- Rothenberger, Susan – GIS and Mapping Technician
- Ward, Mike – Civil Engineer / Project Manager

EXECUTIVE SUMMARY

INTRODUCTION

The purpose of this wastewater Collection System Master Plan (CSMP) is to provide the City of Wilsonville (City) a guidance document that summarizes the needs of the collection system and assists in its sound stewardship. The primary goals of this CSMP include: (1) present criteria required for evaluating the system; (2) identify current and future system deficiencies and describe recommended improvements to correct them; and (3) provide planning-level cost information for general budgeting and the development of a prioritized Capital Improvement Program (CIP).

Study Area

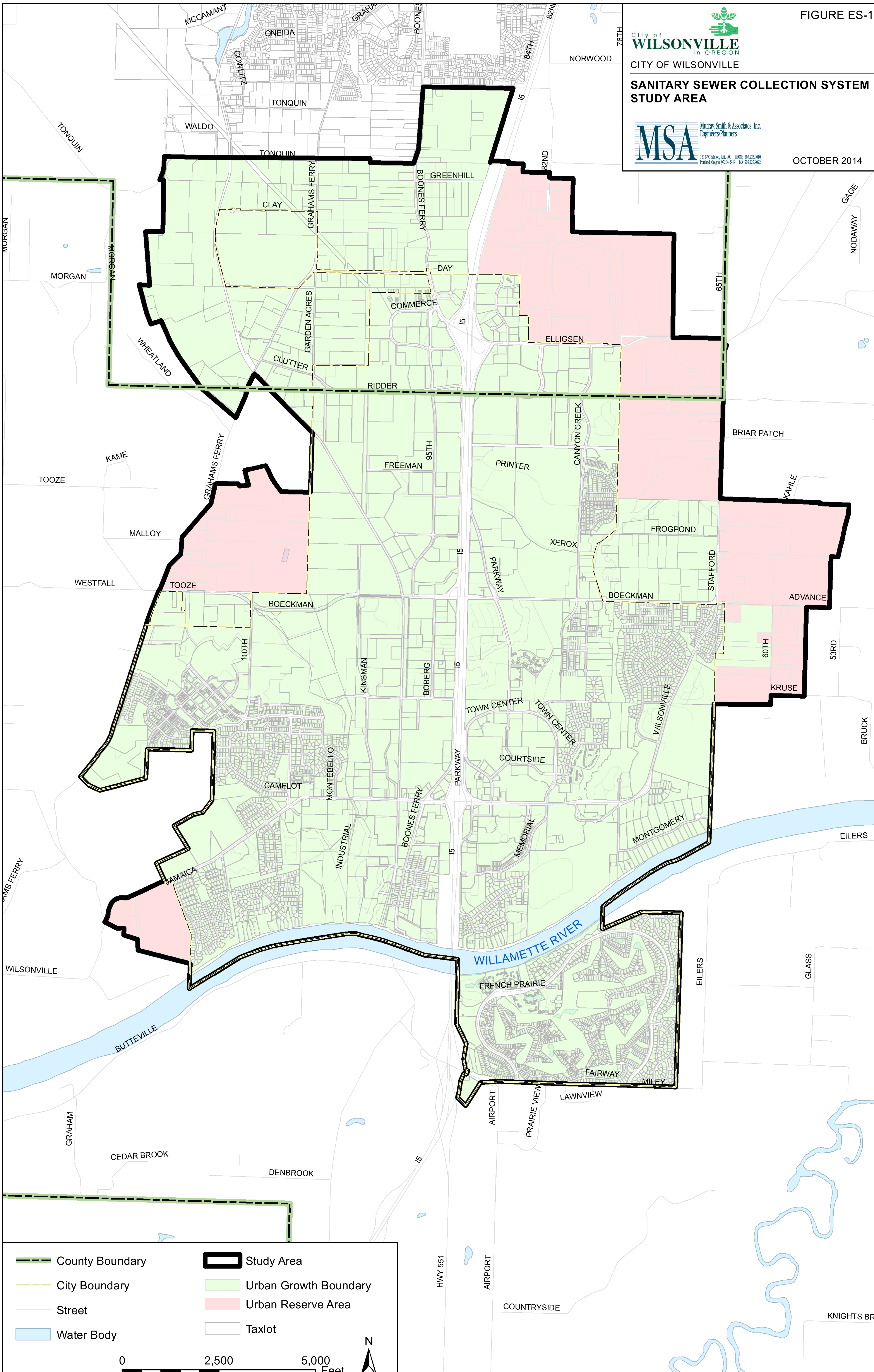
The study area for the CSMP, presented in Figure ES-1, includes the urban growth boundary (UGB), where the City currently provides wastewater collection service. Also included within the study area are urban reserve areas (URAs) identified by the Metropolitan Service District (METRO). Build-out of the UGB is estimated to occur over the next 20 years. Over the planning horizon, consideration will be given to incorporating the adjacent URAs into the UGB. Because wastewater flows from the URAs would likely impact the collection system, these future growth areas are also included within the study area.

The study area has been delineated at the northern border with the City of Tualatin, allowing service by gravity conveyance based on topography. The exact delineation of the Tualatin/Wilsonville service area will be further refined as future planning of the Basalt Creek Planning Area continues over the next several years.

Wastewater Collection System and Sewer Basins

Wastewater generated within Wilsonville is conveyed through a City-owned and operated sewer collection system. These wastewater flows are transmitted through both gravity and pumped pipelines to the Wilsonville Wastewater Treatment Plant (WWTP). The existing and future wastewater service areas are divided into seven primary basins, covering nearly 12 square miles. The primary basins and associated main interceptors are identified in red text in Figure ES-2.

The collection system is comprised of gravity pipes between 4 and 36 inches in diameter. The total length of the gravity collection system is approximately 69.5 miles, nearly 70% of which consists of pipelines 8-inches in diameter and smaller. The oldest portion of the collection system is referred to as Old Town and is located around the WWTP, Boones Ferry Road, Town Center and Charbonneau areas. The pipes within these areas are 35 to 40 years old and comprised primarily of original concrete pipe and manholes. As the collection system has expanded over time, newer piping generally consists of polyvinyl chloride (PVC) with concrete manholes.



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The City owns and operates eight public pump stations (lift stations) of various sizes, which discharge wastewater through pressurized force main piping to the gravity trunk system. The largest and most significant pump station within the system is the Memorial Park Pump Station. In addition to these public pump stations, there are several privately-owned pump stations within the City maintained by their respective owners. Figure ES-2 shows the pump station locations throughout the system.

Flow Projection and Capacity Analysis

The CSMP documents existing wastewater flows and future flow projections based on designated land use. For future flow assumptions, all currently unsewered parcels within the UGB were assumed to be sewered. The capacity of the collection system was evaluated using an estimate of the total peak wastewater flow projected for both existing and future conditions.

The peak wastewater flow is a combination of dry weather flow (DWF), groundwater infiltration (GWI), and wet weather flow (WWF). DWF is the assumed wastewater base flow contributed by residents and businesses, and varies throughout the day in response to personal habits and business operations. GWI is water which enters the collection system through defective pipes, pipe joints, and manhole walls. GWI varies with groundwater depth and is generally seasonal in nature. WWF is stormwater inflow which enters the collection system during or immediately following a precipitation event. This water enters the system through leaky manhole covers and defective underground pipes, as well as through illegal direct connections such as roof drains, yard and area drains, and storm drains. Figure ES-3 illustrates how these flow components are combined to estimate the peak wastewater flow for all areas in the collection system.

Existing peak wastewater flows were derived from water usage records and flow measurement data collected at the wastewater treatment plant and several flow measurement sites over the past 7 years. Future flows were estimated assuming complete build-out of the City, including all parcels within the City limits and UGB, and development of specific areas of the URA, as currently defined by the City. Future peak wastewater flows used in analysis of the system were generated using a hypothetical winter rainfall event with a reoccurrence interval once in 10 years, or 10 percent probability, in accordance with City standards.

Three scenarios assuming relative low, medium and high development densities were applied to undeveloped areas, with the medium density scenario representing the average development potential. The low and high density scenarios were used to characterize system sensitivity to higher or lower peak flows, and provide an overall range of capacity-related improvements anticipated to be necessary as the City develops.

A computer model of the collection system was created using the Innovyze InfoSWMM software package to evaluate the capacity of the various system components under peak wastewater flows. To maximize accuracy of the analysis, the model was first calibrated using flow measurement data collected by the City during the most significant winter storm event in the recent past, the January 18-19, 2012 storm.

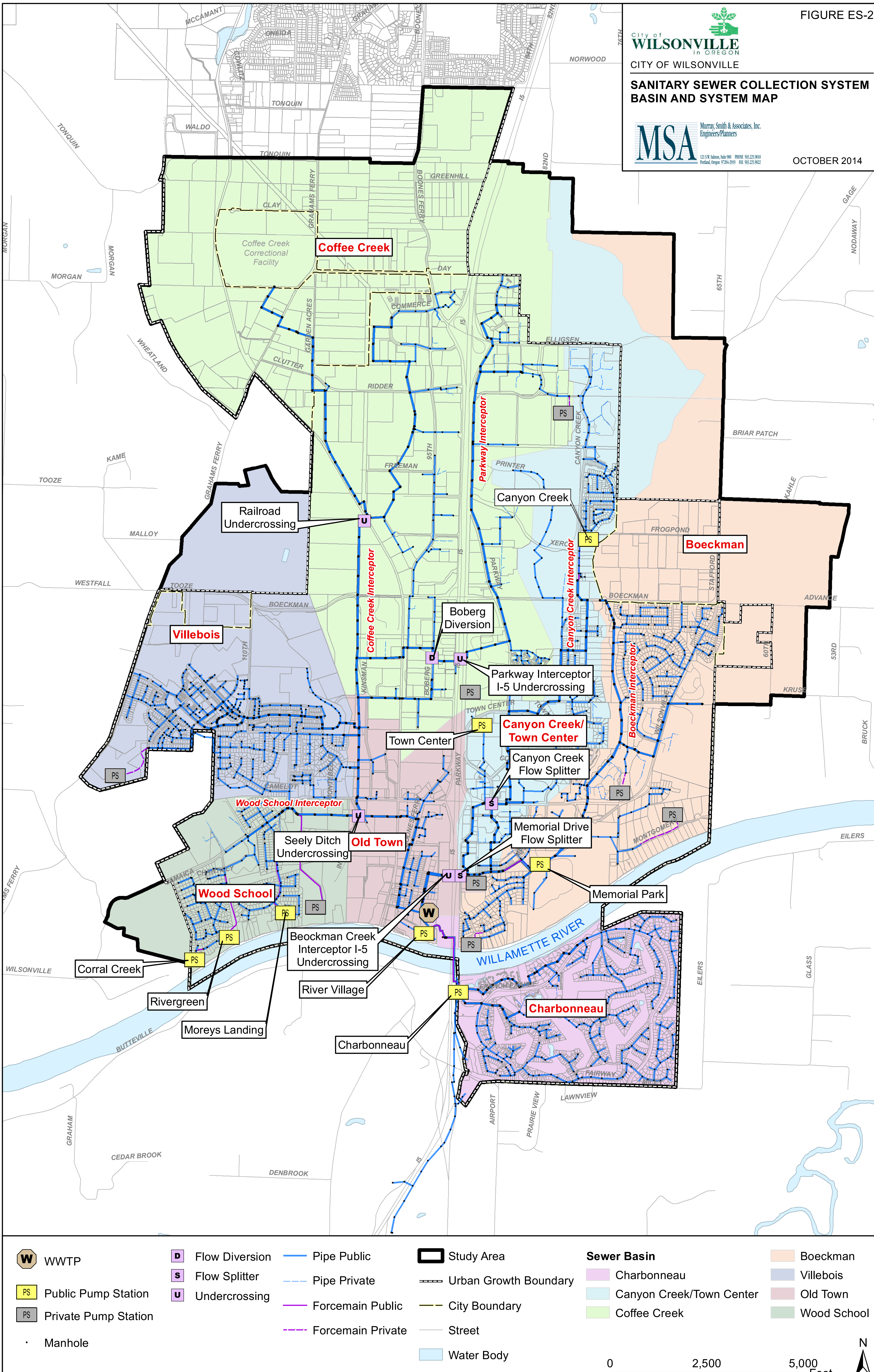
FIGURE ES-2
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
SANITARY SEWER COLLECTION SYSTEM
BASIN AND SYSTEM MAP
MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
OCTOBER 2014
Coffee Creek
Coffee Creek Correctional Facility
Parkway Interceptor
Canyon Creek
Boeckman
Railroad Undercrossing
Coffee Creek Interceptor
Canyon Creek Interceptor
Villebois
Boberg Diversion
Parkway Interceptor I-5 Undercrossing
Boeckman Interceptor
Town Center
Canyon Creek/ Town Center
Canyon Creek Flow Splitter
Wood School Interceptor
Seely Ditch Undercrossing
Old Town
Memorial Drive Flow Splitter
Memorial Park
Wood School
Beockman Creek Interceptor I-5 Undercrossing
Corral Creek
River Village
Rivergreen
Moreys Landing
Charbonneau
WILLAMETTE RIVER
WWTP
Public Pump Station
Private Pump Station
Manhole
Flow Diversion
Flow Splitter
Undercrossing
Pipe Public
Pipe Private
Forcemain Public
Forcemain Private
Study Area
Urban Growth Boundary
City Boundary
Street
Water Body
Sewer Basin
Charbonneau
Canyon Creek/Town Center
Coffee Creek
Boeckman
Villebois
Old Town
Wood School
0
2,500
5,000
Feet
N
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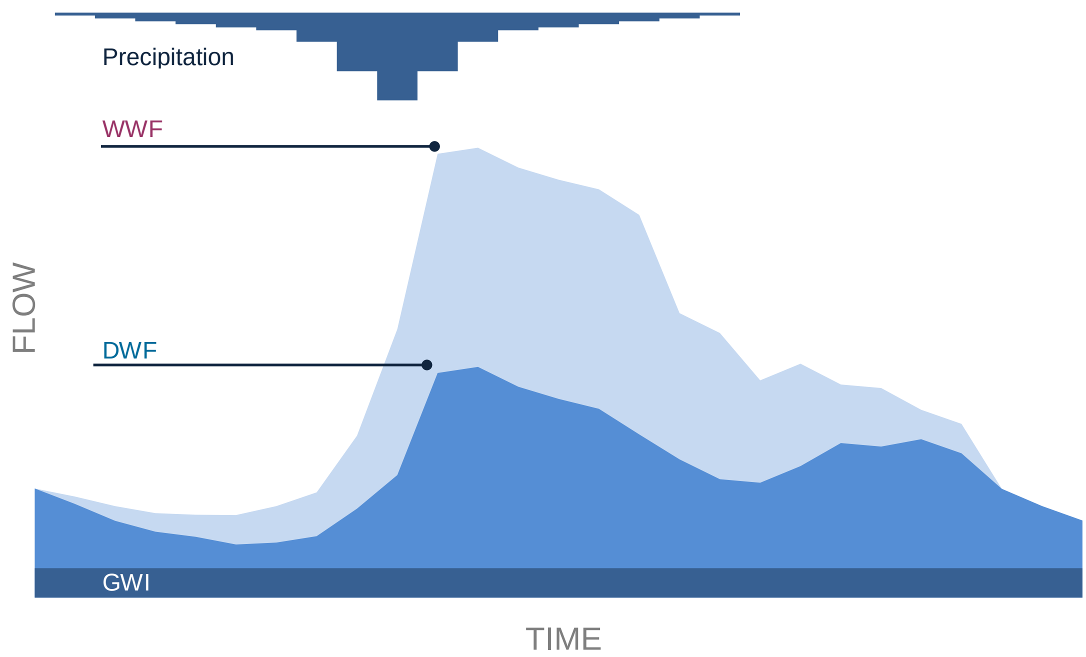
Figure ES-3 | Generic Schematic of Wastewater Flow Components



The system analysis identified components which do not meet minimum criteria as defined by City Public Works Standards and the Oregon Department of Environmental Quality (DEQ). The primary standard is that the depth of flow in all pipes must be less than the pipe diameter at peak flow. Where the pipe is flowing at greater than full depth, this condition is called "surcharged", and the pipe is considered to be capacity-deficient. Pump stations are considered deficient when they are not able to handle the peak flow with their largest pump out of service. Other criteria were also evaluated to identify areas where additional maintenance and flushing may be required due to low pipeline velocities.

Historic and Future Population Data

For consistency purposes, this wastewater CSMP utilized population projections previously developed for the City's 2012 Water System Master Plan (WSMP). Based on land use and densities outlined in the WSMP, a population build-out condition of 52,400 residents for the study area may be reached in the year 2045, assuming an annual growth rate of 2.9%.

The City selected the high density growth scenario for capital improvement selection and sizing. The peak total flow projections (DWF+WWF) at build-out conditions under the high density scenario are 17.9 million gallons per day (mgd) within the UGB and 23.5 mgd within the UGB and potential URA. Those improvements identified in the high density scenario, but not identified in the medium and low density scenarios were given lowest priority in the CIP. Improvements identified in all three scenarios or to serve future areas within the UGB were given highest priority in the CIP. Sizing improvements based on these flow projections accommodates the future population projections as well as industrial and commercial growth potential.

Condition Assessment Results

A general condition assessment for the gravity piping and pump stations was conducted. The majority of the City's gravity piping system is reported to function in good condition; however, known problem areas were identified within the Charbonneau basin and select areas containing concrete piping installed in the 1970s. Several pump stations that require regular maintenance were indicated. All of the City's pump stations are projected to require some level of condition-based upgrades within the CIP timeframe due to the wear of mechanical and electrical components.

Capacity Analysis Results and Capital Improvement Plan Summary

The capacity analysis indicated that there are no capacity-related restrictions under existing development conditions. To accommodate full build-out of the UGB, the collection system requires capacity upgrades at an estimated cost of $9.9 million over the next ten years. The collection system would require an additional $19.0 million of capacity upgrades to accommodate areas within the URA but outside the UGB. Capacity upgrade improvements related to future growth are funded by development through system development charges (SDCs). Memorial Park Pump Station, diversion structure, and flow splitter improvements in the CIP are required for both capacity and condition-based issues. The capacity portion of these improvements are also funded by development through SDCs. An additional $15.7 million in condition-based only improvements were identified over the 20-year planning horizon. The recommended CIP for the short-term period (next 5 years) includes $8.6 million in capacity and condition-based improvements.

Placeholder costs for new collection system infrastructure needed to serve future development within the study area were estimated. The new infrastructure costs will be entirely paid for by new development through a combination of SDCs and infrastructure constructed by developers. These costs are estimated at $114 million.

The overall CIP cost estimates are summarized in Table ES-1. Capital improvements are illustrated in Figures ES-4 (capacity upgrades), ES-5 (condition-based improvements), and ES-6 (new infrastructure).

It is recommended the City implement the short-term improvements identified in the CIP to address capacity and condition issues. It is also recommended that the City continue to improve the quality of available collection system information, through continued flow monitoring, and maintaining a consistent program of performing closed-circuit television (CCTV) inspections of all pipelines. Additionally, it is recommended the City reassess long-term improvements (beyond 6 years) by periodically updating the hydraulic model using actual development conditions and additional flow monitoring information.

Table ES-1 Capital Improvement Program Summary (Estimated Total Costs)					
Improvement Category	Prioritization Category	Time Frame (Cost)[1, 2]			Total Cost
		0-5 Years	6-10 Years	11-20 Years	
Existing System Upgrades for Future Development	UGB	$3,080,000	$6,830,000	---	$9,910,000
	Advance Road URA	---	$7,510,000	---	$7,510,000
	URA	---	$300,000	$11,225,000	$11,525,000
	Total	$3,080,000	$14,640,000	$11,225,000	$28,945,000
New Infrastructure for Future Development	UGB	$29,170,000	$32,620,000	---	$61,790,000
	Advance Road URA	---	$7,440,000	---	$7,440,000
	URA	---	---	$44,840,000	$44,840,000
	Total	$29,170,000	$40,060,000	$44,840,000	$114,070,000
Condition Based	UGB	$5,566,000	$3,125,000	$6,993,000	$15,684,000

The CIP costs are summarized in Table ES-2 by funding mechanism including the following categories:

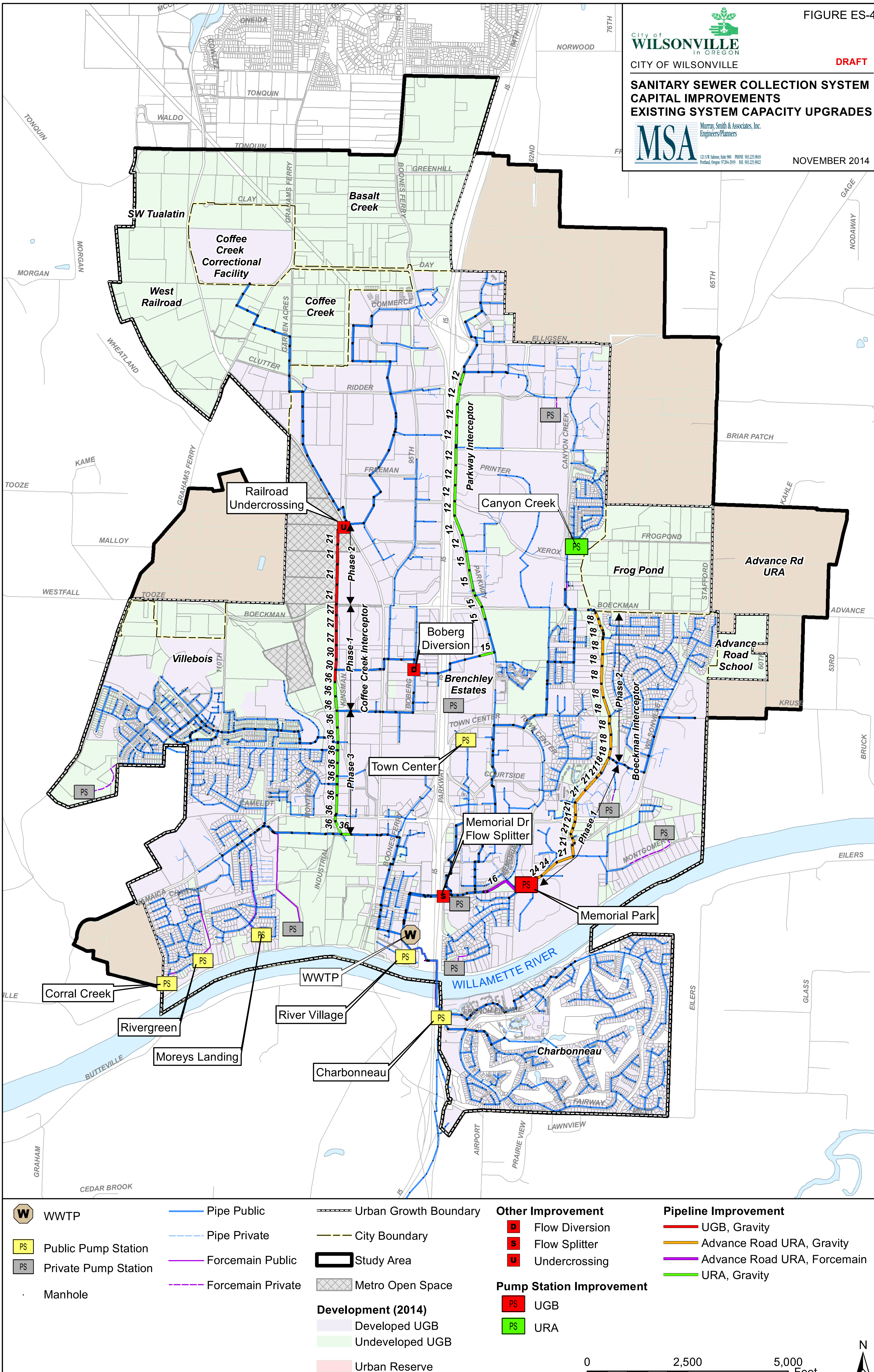
- City's Sewer Operating Fund – Condition-based improvements
- City's Sewer Operating Fund – Existing system upgrades [*Operating Fund Cost = Total Cost x (Peak Existing Flow / Peak Build-out Flow)*]
- City's SDC Fund – Existing system upgrades [SDC Fund Cost = *Total Cost x (1 - Peak Existing Flow / Peak Build-out Flow)*]
- City's SDC Fund – New Piping Infrastructure, Oversizing Component
- Developer Direct Contribution – New Piping Infrastructure, Non-oversizing Component
- Developer Direct Contribution – New Pump Stations and Associated Force mains (may require formation of reimbursement district)

Table ES-2 Capital Improvement Program Summary By Funding Mechanism (Estimated Total Costs)					
Funding Mechanism	**Prioritization Category**	**Time Frame (Cost)[1, 2]**			**Total Cost**
		0-5 Years	**6-10 Years**	**11-20 Years**	
City's Sewer Operating Fund - Condition Based	UGB	$5,566,000	$3,125,000	$6,993,000	$15,684,000
City's Sewer Operating Fund - Existing System Upgrades	UGB	$1,208,000	$1,364,500	---	$2,572,500
	Advance Road URA	---	$854,000	---	$854,000
	URA	---	$90,000	$4,017,000	$4,107,000
	Total	$1,208,000	$2,308,500	$4,017,000	$7,533,500
City's SDC Fund - Existing System Upgrades	UGB	$1,872,000	$5,465,500	---	$7,337,500
	Advance Road URA	---	$6,656,000	---	$6,656,000
	URA	---	$210,000	$7,208,000	$7,418,000
	Total	$1,872,000	$12,331,500	$7,208,000	$21,411,500
City's SDC Fund - New Piping Infrastructure, Oversizing Component	UGB	$4,430,000	$2,960,000	---	$7,390,000
	Advance Road URA	---	$390,000	---	$390,000
	URA	---	---	$7,430,000	$7,430,000
	Total	$4,430,000	$3,350,000	$7,430,000	$15,210,000
Developer Direct Contribution - New Piping Infrastructure, Non-oversizing Component	UGB	$23,380,000	$20,380,000	---	$43,760,000
	Advance Road URA	---	$3,180,000	---	$3,180,000
	URA	---	---	$36,070,000	$36,070,000
	Total	$23,380,000	$23,560,000	$36,070,000	$83,010,000
Developer Direct Contribution - New Pump Stations & Associated Force mains	UGB	$1,360,000	$9,280,000	---	$10,640,000
	Advance Road URA	---	$3,870,000	---	$3,870,000
	URA	---	---	$1,340,000	$1,340,000
	Total	$1,360,000	$13,150,000	$1,340,000	$15,850,000

Notes for Tables ES-1 and ES-2

Note 1. Cost estimates represent a Class 5 budget estimate, as established by the *American Association of Cost Engineers*. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -30 percent on the low end, and +30 to +50 percent on the high end, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate.

Note 2. See Section 7, "Capital Improvement Program" for additional cost assumptions and notes.



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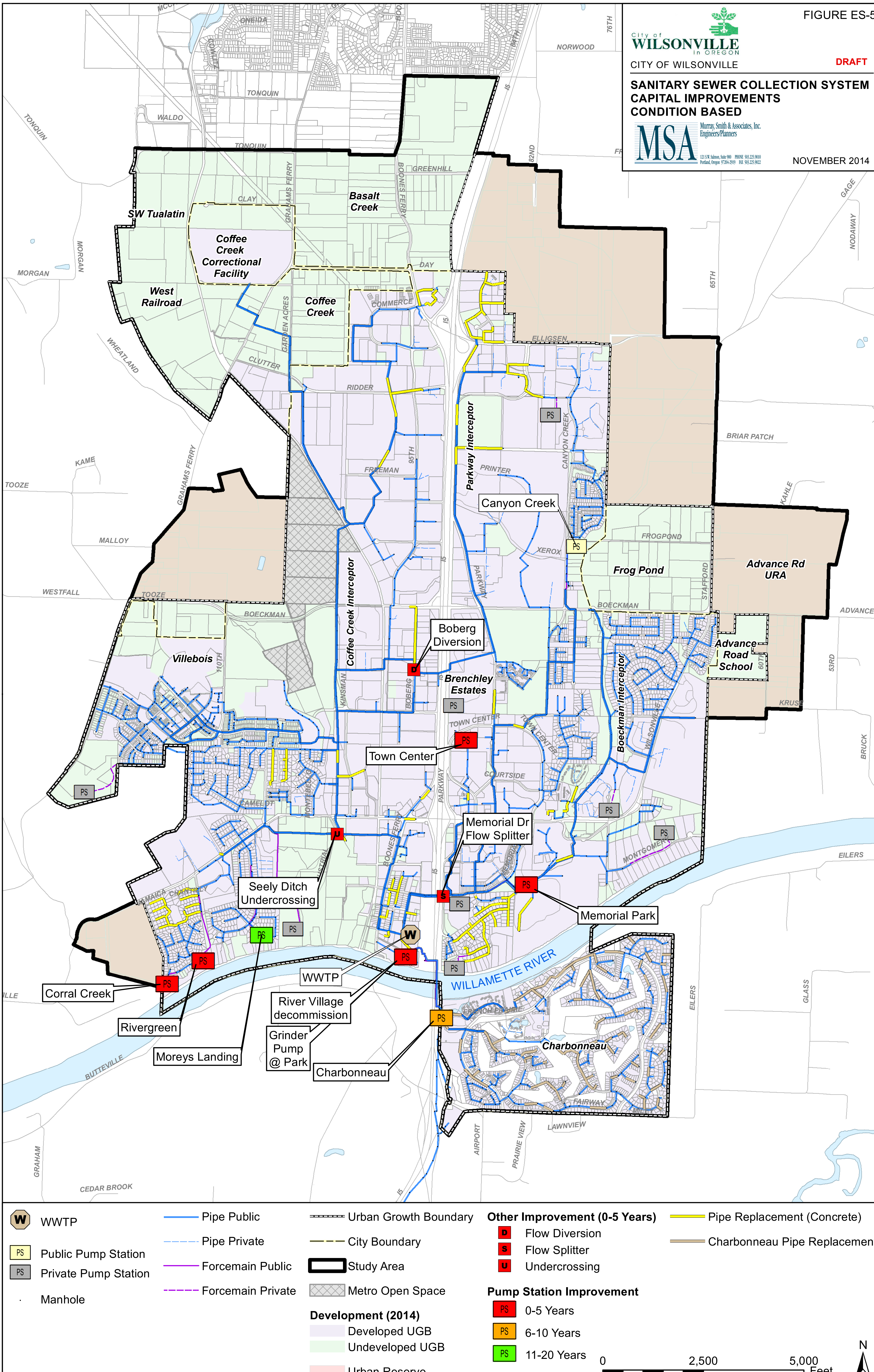

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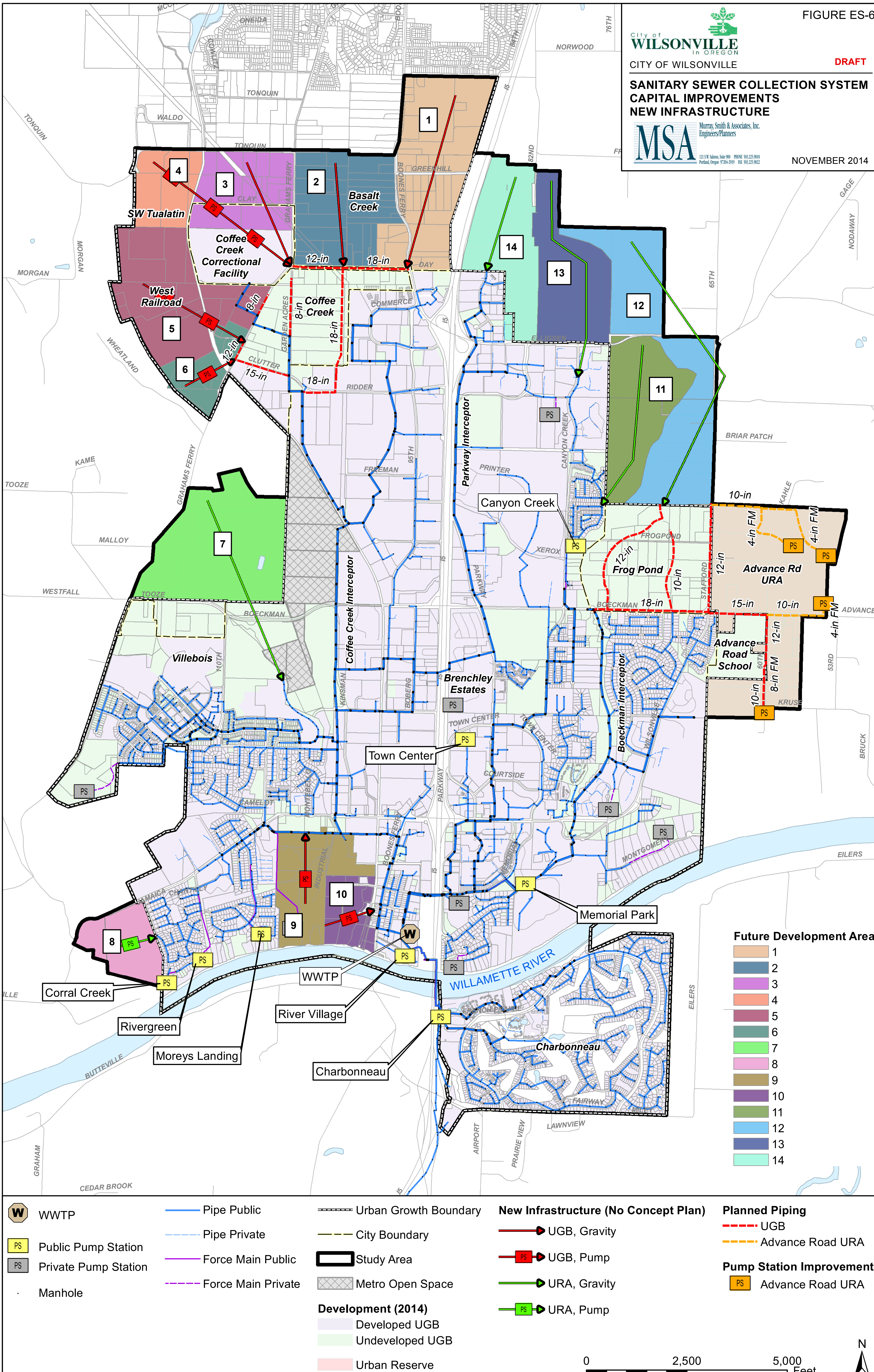
FIGURE ES-6
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
DRAFT
SANITARY SEWER COLLECTION SYSTEM
CAPITAL IMPROVEMENTS
NEW INFRASTRUCTURE
MSA
Murray, Smith & Associates, Inc.
Engineers/Planners
NOVEMBER 2014
SW Tualatin
Basalt Creek
Coffee Creek Correctional Facility
West Railroad
Coffee Creek
Parkway Interceptor
Canyon Creek
Frog Pond
Advance Rd URA
Advance Road School
Coffee Creek Interceptor
Villebois
Brenchley Estates
Boeckman Interceptor
Town Center
Memorial Park
WWTP
River Village
Corral Creek
Rivergreen
Moreys Landing
Charbonneau
WILLAMETTE RIVER
Future Development Area
1
2
3
4
5
6
7
8
9
10
11
12
13
14
WWTP
Public Pump Station
Private Pump Station
Manhole
Pipe Public
Pipe Private
Force Main Public
Force Main Private
Urban Growth Boundary
City Boundary
Study Area
Metro Open Space
Development (2014)
Developed UGB
Undeveloped UGB
Urban Reserve
New Infrastructure (No Concept Plan)
UGB, Gravity
UGB, Pump
URA, Gravity
URA, Pump
Planned Piping
UGB
Advance Road URA
Pump Station Improvement
Advance Road URA
0
2,500
5,000
Feet
N
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SECTION 1 | INTRODUCTION

INTRODUCTION

The purpose of this wastewater Collection System Master Plan (CSMP) is to update the City of Wilsonville (City) previous CSMP created in July of 2001.

This CSMP:

- Summarizes basic information describing the wastewater collection system.
- Describes the how the system components function.
- Presents technical criteria required for evaluating the system.
- Identifies current system deficiencies and describes recommended improvements to correct them.
- Identifies future system needs to accommodate future growth.
- Contains planning-level cost information for general budgeting and the development of a prioritized Capital Improvement Program (CIP).
- Provides reference document for City leaders, technical staff, consultants, customers and other interested parties about the existing system and future recommended improvements.
- Incorporates community values and priorities through input from a public open house process.
- Facilitates logical planning decisions and utility coordination relative to other City projects and programs.

PURPOSE

This CSMP provides a valuable tool to facilitate timely, orderly and efficient management of the City's wastewater collection system over the next 20 years. This document serves as a "Public Facilities Plan" for sewer collection systems according to Oregon Administrative Rule (OAR) 660, Division 11. This OAR stipulates that facility plans be developed as support documents for the City's Comprehensive Plan.

How This Plan Should Be Used

This CSMP serves as the guiding document for future collection system improvements, and should:

- Be reviewed annually to prioritize and budget needed improvements.
- Have its mapping updated regularly to reflect ongoing development and construction.
- Specific system improvement recommendations should be regarded as conceptual.

  The location, size and timing of projects may change as additional site-specific details and potential alternatives are investigated in the preliminary engineering phase of design.
- Be update and refined as preliminary engineering and final project designs are completed.

SCOPE

Murray, Smith and Associates, Inc. (MSA) were selected by the City in June of 2013 to provide municipal master planning services related to wastewater collection, and for updating the Geographic Information System (GIS) map of the collection system.

MSA worked closely with the City to develop a Scope of Work that provides the necessary guidance for both current and future wastewater management decisions. The Scope of Work included the following abbreviated elements:

- Compile and review flow monitoring data, pump station data, maintenance reports, maps, record drawings, aerial photography, topography, system base maps, City standards and other information pertaining to the physical sewage collection system.
- Review of City-furnished information relating to service study area, sewer drainage basins, and land use.
- Develop criteria for analysis of existing sewer systems and the design of future improvements.
- Develop sewage contributions for each sewer basin.
- Calibrate sewage contributions for each basin based on flow monitoring data.
- Identify significant Rainfall Derived Inflow and Infiltration (RDII) problems and develop recommended programs and improvements to reduce RDII.
- Conduct a hydraulic analysis of existing sewer mains.
- Determine existing deficiencies with respect to ultimate service requirements.
- Determine future collection facilities required to provide service for ultimate build-out within the study area.
- Based on system deficiencies identified, review wastewater system needs and alternatives to meet current and future wastewater flow conditions.
- Develop a CIP which prioritizes short-term and long-term improvements to meet the City’s anticipated system needs.
- Develop budget level cost estimates for those projects identified in the facilities plan. Funding alternatives will be identified which may be utilized by the City to finance the projects.
- Develop wastewater facilities plan map showing both existing and proposed wastewater facilities.
- Prepare a Collection System Master Plan document which describes and illustrates the results of the study.

ORGANIZATION OF THE COLLECTION SYSTEM MASTER PLAN

This master plan report is organized into seven sections, as described in Table 1-1. Detailed technical information and supporting documents for Sections 6 and 7 are included in the appendices.

Table 1-1 | CSMP Organization

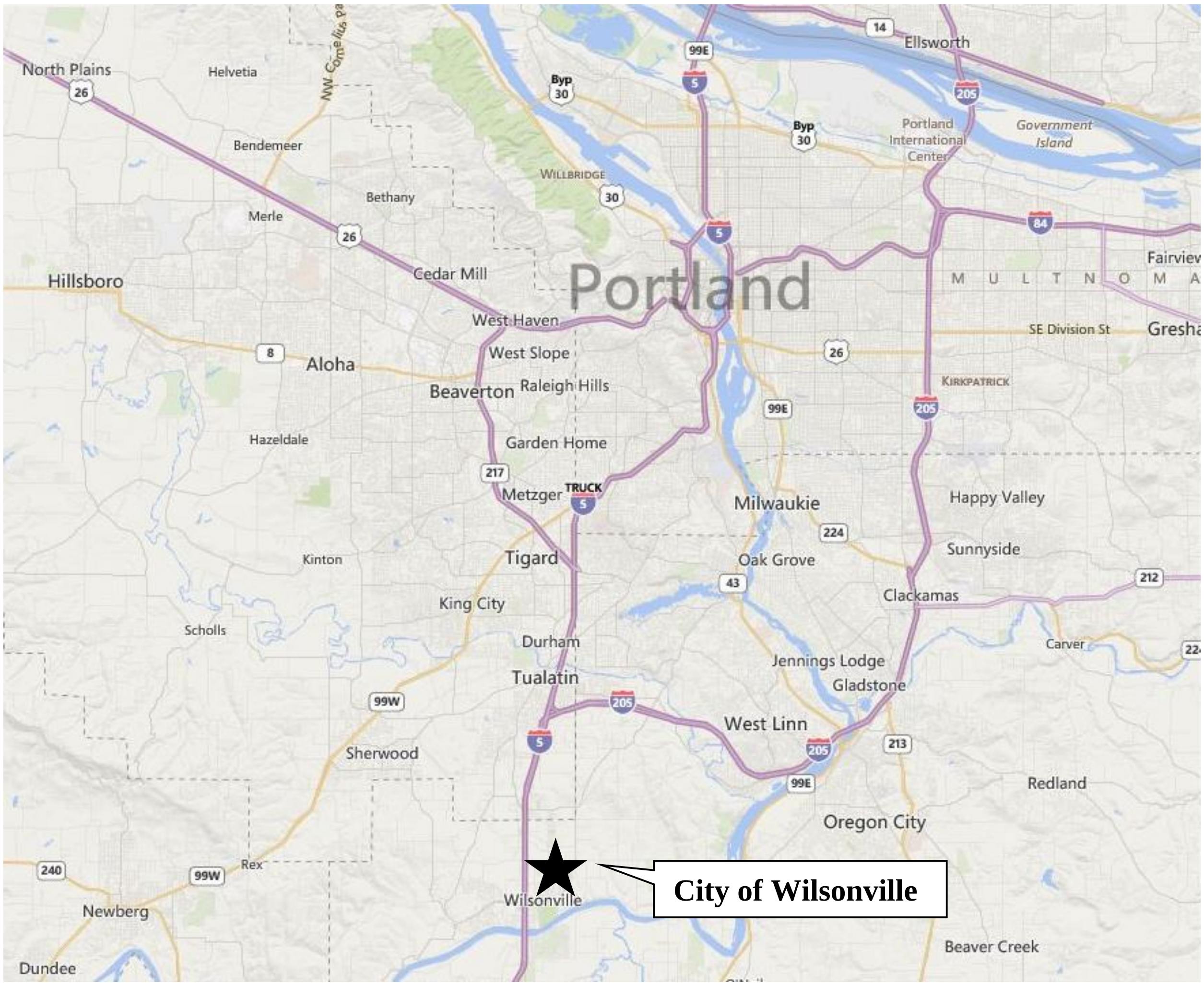
Section Number	Section Title	Description
Section 1	Introduction & Executive Summary	Explains the purpose and scope of the wastewater Collection System Master Plan; provides a summary of each section and overall recommendations.
Section 2	Study Area Characteristics	Outlines the wastewater collection system's characteristic setting, including geography, topography, climate, general soil conditions, and land use designations within the City.
Section 3	Existing System Conditions	Presents an overview of the existing system and key facilities, and describes the existing service area and extents of the current urban growth boundary (UGB).
Section 4	Regulations & Policies	Commonly occurring policies and guidelines for wastewater collection systems are summarized from federal, state, and local governance.
Section 5	Population & Flow Projection	Describes the development of dry weather and wet weather parameters to determine existing and future design flows.
Section 6	System Analysis	Provides a summary of the methodology and results of the system analysis, and the alternatives assessment used for minimizing capital and life cycle, collection system costs.
Section 7	Capital Improvement Program	Presents a proposed Capital Improvement Program (CIP) consisting of a prioritized list of recommended improvements to be conducted over the study period.
Appendix A	Model Calibration Plots	Includes plots of metered versus modeled flow rates for the hydraulic model calibration.
Appendix B	Hydraulic Analysis Mapping	Includes figures of improvement sensitivity analysis for high, medium, and low density build-out growth scenarios.
Appendix C	Basis of Opinion of Probable Costs	Presents project unit cost tables for collection system assets used to develop estimates for individual projects; provides the cost basis used in the alternatives evaluation of collection system improvements in Section 6; and the development of the final CIP budgets associated with the collection system improvements recommended for adoption by the City in Section 7.

SECTION 2 | STUDY AREA CHARACTERISTICS

INTRODUCTION

This section of the Collection System Master Plan (CSMP) outlines the wastewater collection system's characteristics including geography, topography, climate, general soil conditions, and land use designations within the City of Wilsonville (City). Land use designations are of particular interest when planning collection system infrastructure, as the wastewater loading varies by land use category and density. The City's socioeconomic conditions are also documented within this section, and include the major sources of commerce within the City and the historical population trends over the past three decades.

Figure 2-1 | Vicinity Map



GEOGRAPHY

The City is located along the Willamette River in Oregon's Willamette Valley, on the southern edge of the Portland metropolitan area (see Figure 2-1), approximately 17 miles from downtown Portland. The northern section of the City falls under the jurisdiction of Washington County; however, the majority of the City is situated in the southwestern part of Clackamas County. Neighboring cities are Tualatin to the north, Sherwood to the northwest, and Canby and Aurora to the southeast. Newberg, in Yamhill County, is approximately 14 miles west, along Wilsonville Road. The Willamette River separates the majority of the City from the Charbonneau district, a neighborhood within the city limits on the south side of the river.

TOPOGRAPHY

The study area is relatively flat, with the exception of steep slopes surrounding the natural drainage channels throughout the region (such as Boeckman Creek). Topography ranges from 375 feet above sea level at the northern end of the study area to 60 feet above sea level at the Willamette River near the Interstate 5 freeway crossing. Generally, the entire region slopes towards the Willamette River.

CLIMATE

The City is in the Marine West Coast Climate Zone. Temperatures are moderate year-round due to a marine influence from the Pacific Ocean that produces generally warm, dry summers and cool, wet winters. Precipitation primarily occurs during the winter months, with the wettest period from November through March. July and August are the warmest months, with an average high temperature of 81 degrees Fahrenheit (°F), and December is the coolest month, with an average low temperature of 34 °F. December is also the wettest month, averaging 6.62 inches of precipitation. Additional climate information is provided in Table 2-1.

Table 2-1 | Summary of Climatological Information*	
Record High Temperature	105°F
Average Annual High Temperature	63.5°F
Average Annual Low Temperature	44.3°F
Record Low Temperature	-15°F
Average Annual Rainfall	42.62 inches

**Note: Data source www.weather.com; zip code 97140*

STUDY AREA

The study area for the CSMP includes the urban growth boundary (UGB), where the City currently provides wastewater collection service as shown in Figure 2-2. Also included within the study area are urban reserve areas (URAs) identified by the Metropolitan Service District (METRO). Build-out growth is estimated to occur within the UGB over the next 20 years. As development trends towards this build-out condition over this planning horizon, the URAs are anticipated to be incorporated into the UGB.

The study area has been delineated at the northern border with the City of Tualatin, allowing service by gravity conveyance based on topography. The exact delineation of the Tualatin/Wilsonville service area will be further refined with future concept planning of Basalt Creek.

LAND USE AND ZONING

By state law, METRO is responsible for establishing the Portland metropolitan area's UGB, which includes Wilsonville. Land uses and densities inside the UGB are selected to support urban services such as police and fire protection, roads, schools, and water and sewer systems. Understanding land use and demographic characteristics within the study area is particularly important in collection system planning because of the impact they have on wastewater flow loading.

All parcels within the City have been assigned a METRO land use designation, which includes various categories of commercial, industrial, institutional and residential land uses. The City then assigns specific zoning within the broader land use designations. City zoning is shown in Figure 2-3 and summarized for existing and future development in Table 2-2. Flow projections and development densities for future development areas are summarized in Sections 5 and 6.

Table 2-2 | Land Use Summary

Zoning	Developed (gross acres)	Future Development UGB (gross acres)[1]	Future Development URA (gross acres)
Designated Category			
Residential	950	240	0
Commercial	310	30	0
Industrial	1000	140	0
Public	400	120	0
Village	110	70	0
Re-zone or Re-development Potential[2]			
Residential	110	260	800
Commercial	0	0	0
Industrial	30	1080	350
Public	20	40	0
Village	20	140	0
Total	**2,950**	**2,120**	**1,150**

Note 1. Excludes METRO open area designated lands.
Note 2. Areas of re-zoning or re-development potential include lands with existing zoning classification of future development, agricultural holding, exclusive farm use, and rural residential.

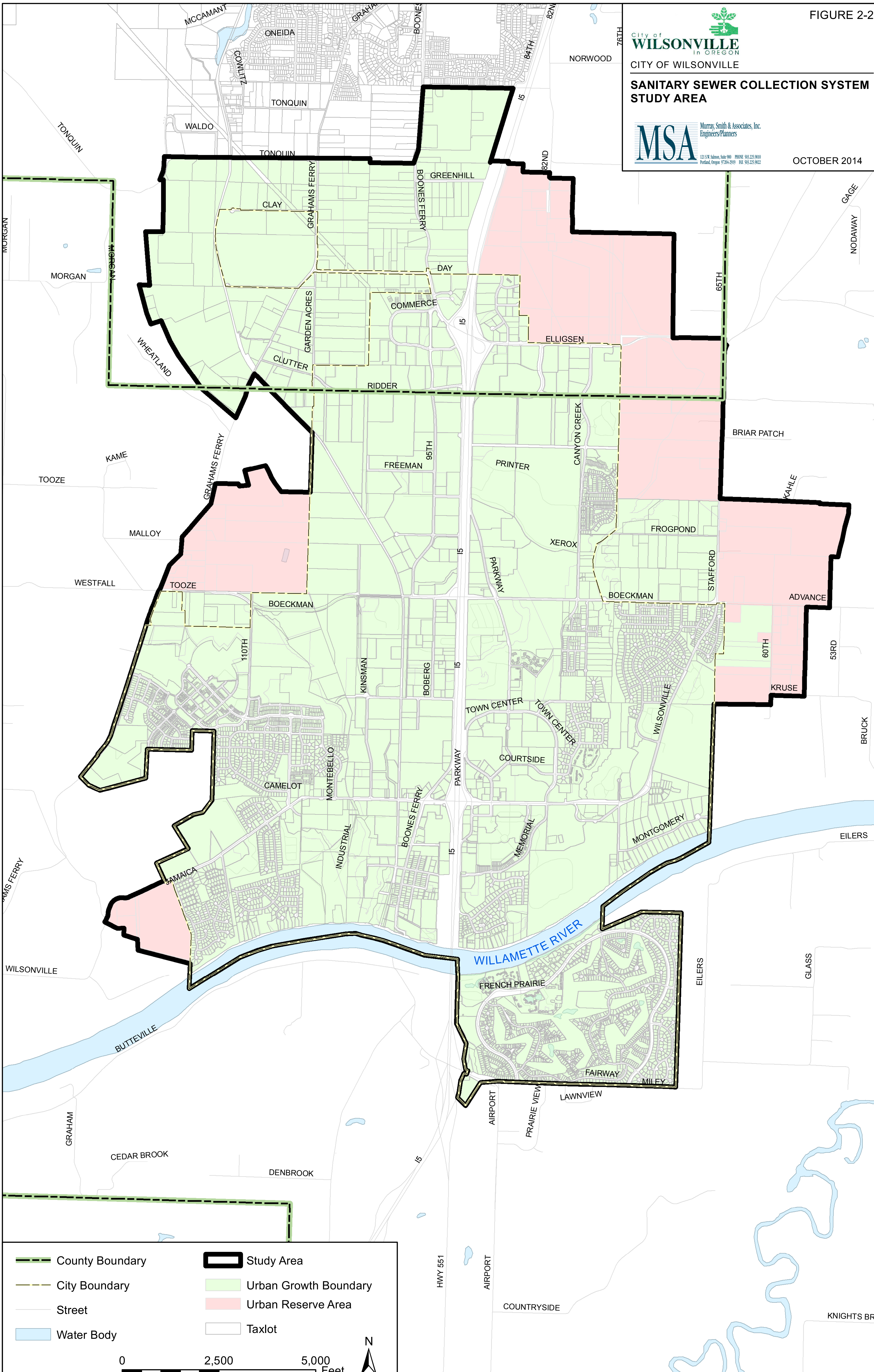


FIGURE 2-2
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
SANITARY SEWER COLLECTION SYSTEM STUDY AREA
MSA
Murray, Smith & Associates, Inc. Engineers/Planners
OCTOBER 2014
County Boundary
City Boundary
Street
Water Body
Study Area
Urban Growth Boundary
Urban Reserve Area
Taxlot
0
2,500
5,000
Feet
N
WILLAMETTE RIVER
MCCAMANT
ONEIDA
COWLITZ
TONQUIN
WALDO
NORWOOD
84TH
82ND
76TH
I5
GREENHILL
CLAY
GRAHAMS FERRY
BOONES FERRY
DAY
COMMERCE
GARDEN ACRES
ELLIGSEN
WHEATLAND
CLUTTER
RIDDER
MORGAN
65TH
GAGE
NODAWAY
BRIAR PATCH
KAME
TOOZE
FREEMAN
95TH
PRINTER
CANYON CREEK
KAHLE
MALLOY
FROGPOND
XEROX
PARKWAY
STAFFORD
WESTFALL
BOECKMAN
ADVANCE
110TH
KINSMAN
BOBERG
60TH
53RD
KRUSE
TOWN CENTER
WILSONVILLE
BRUCK
COURTSIDE
CAMELOT
MONTEBELLO
INDUSTRIAL
MEMORIAL
MONTGOMERY
EILERS
JAMAICA
FRENCH PRAIRIE
GLASS
BUTTEVILLE
FAIRWAY
MILEY
LAWNVIEW
AIRPORT
PRAIRIE VIEW
GRAHAM
CEDAR BROOK
DENBROOK
HWY 551
COUNTRYSIDE
KNIGHTS BRID
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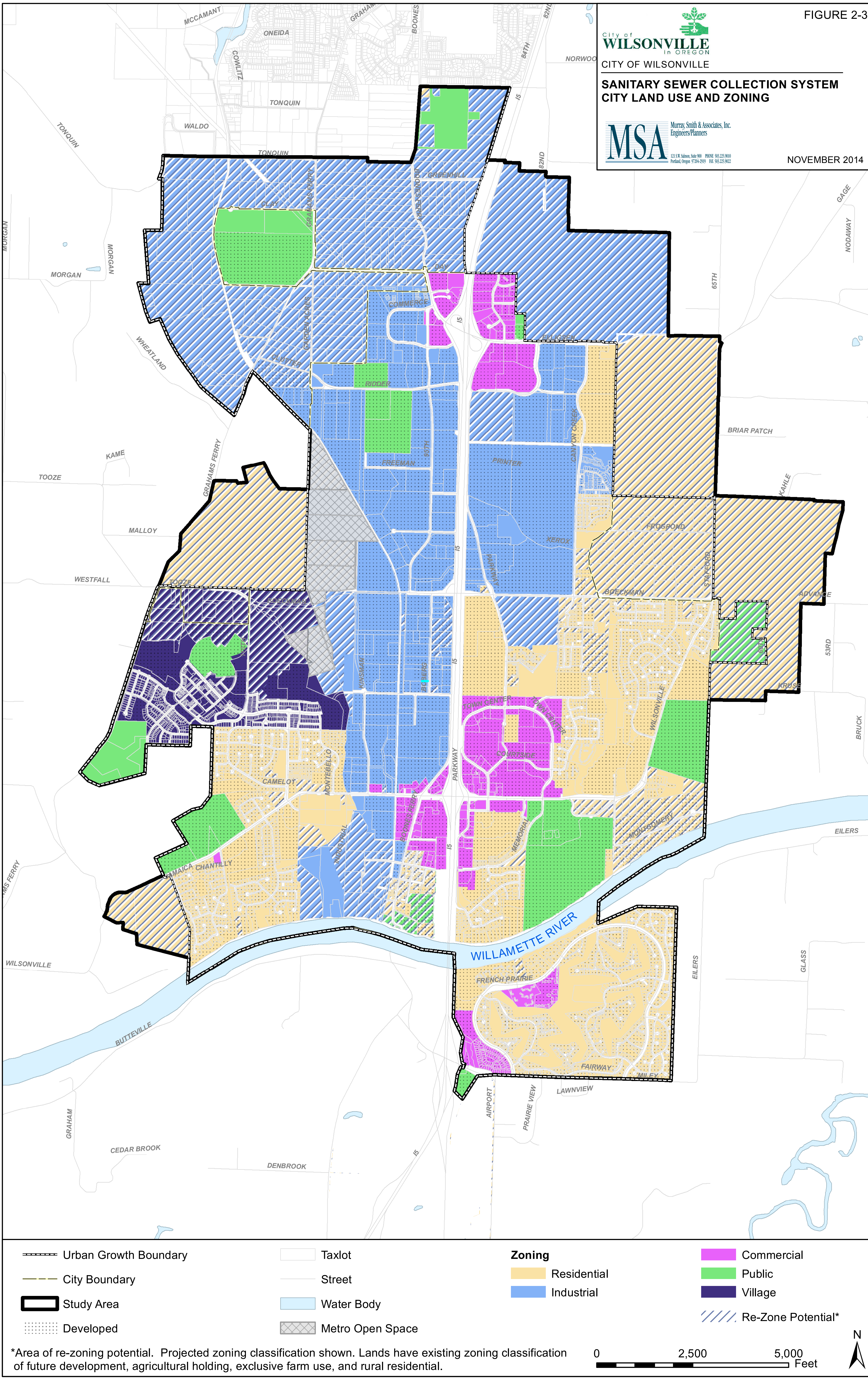

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FUTURE GROWTH AREAS

The study area includes 3,380 acres of undeveloped land designated for future development. Concept planning efforts are either underway or have been completed for three large development areas within the UGB and URAs, as summarized below and presented in Figure 2-4. Remaining study area lands outside the UGB not under concept planning are anticipated to be urbanized over a timeframe exceeding the 20-year study period. These remaining areas are included in the study to facilitate supporting service infrastructure sizing and prioritization.

Basalt Creek Planning Area

The 847-acre Basalt Creek Planning Area is an industrially and commercially zoned tract of land between Tualatin and Wilsonville. The exact boundary delineation between the two municipalities has yet to be determined. The need to plan this area is driven not only by expected growth within Wilsonville, but the future growth anticipated in surrounding areas targeted for industrial development, such as the Tonquin Employment Area and the Coffee Creek Planning Areas.

The Basalt Creek Planning Area includes the SW Tualatin area and the West Railroad area. It is bound to the north by the City of Tualatin, to the east by Interstate 5, to the south by the Coffee Creek Planning Area, and to the west by the Portland & Western Railroad. The planning effort began in 2013 and is being jointly led by the City and Tualatin. The timeline for actual development within this planning area is projected to occur over the next 6 to 15 years.

Coffee Creek Planning Area

The Coffee Creek Planning Area is a proposed 216-acre industrially zoned tract of land within the northern portion of the City's UGB. It is primarily located in unincorporated Washington County, with a small triangle (south of Clutter Road) located in unincorporated Clackamas County. The area is bound by Day Road and the Coffee Creek Correctional Facility to the north, the existing City limits to the east, and the Portland & Western Railroad to the south and west. This planning effort was undertaken in 2007 by the City of Wilsonville. The timeline for actual development within this planning area is anticipated to occur over the next 2 to 8 years.

Frog Pond Planning Area

The Frog Pond Planning Area is a 500-acre planned region on the east side of the City, and includes URAs adjacent to Advance Road. It is bound to the north by SW Kahle Road, to the east by a property boundary midway between SW 60th Avenue and SW 53rd Avenue, to the south by Boeckman Road and SW Kruse Road, and to the west by Boeckman Creek. Concept planning efforts are nearing completion as of September 2014 and are being led by the City of Wilsonville. The timeline for build-out of the area is projected to span decades, however the properties within the UGB are anticipated to develop over the next 1 to 5 years. The areas in the Advance Road URA are anticipated to develop over the next 6 to 15 years.

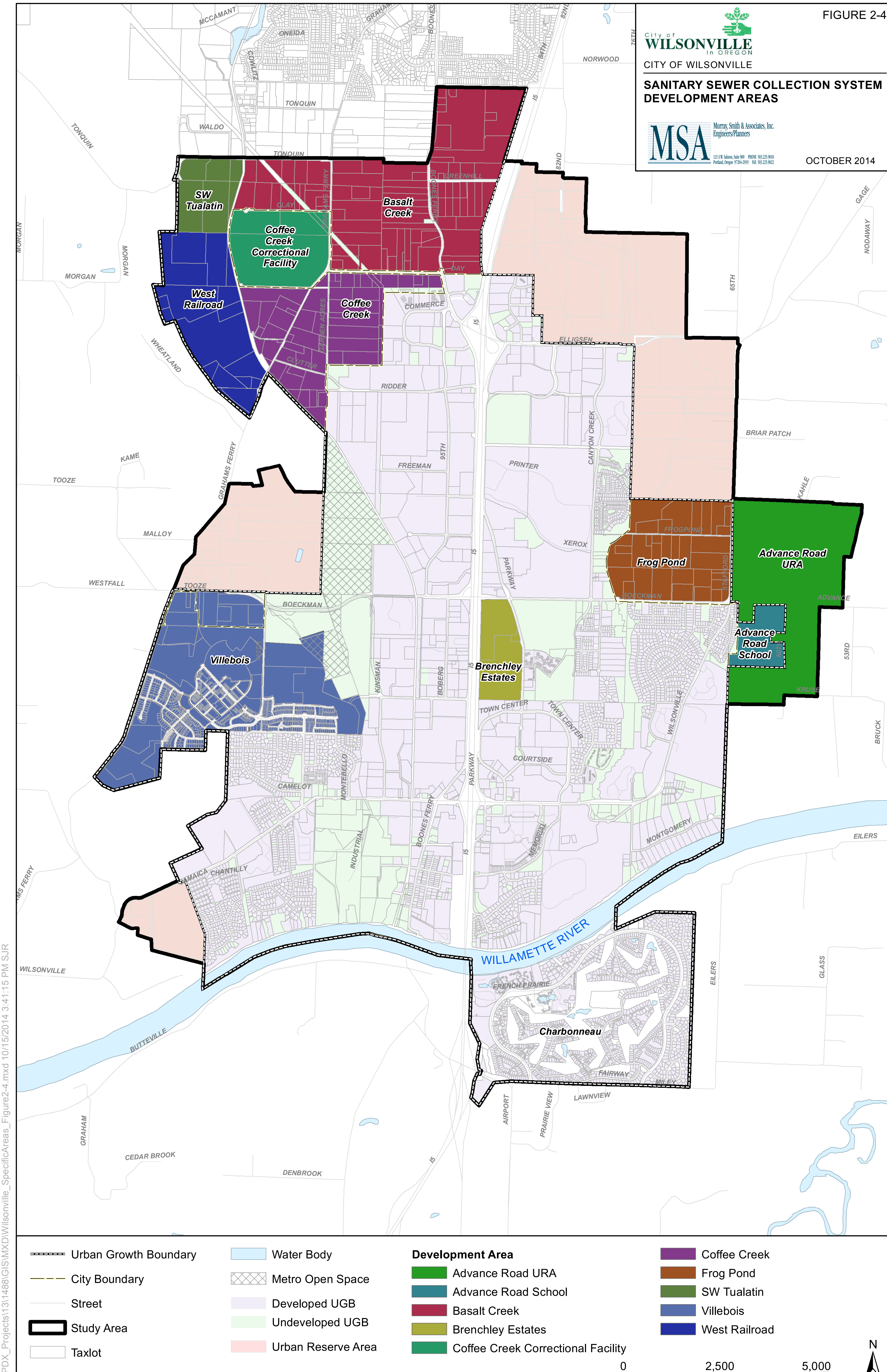

FIGURE 2-4
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
SANITARY SEWER COLLECTION SYSTEM DEVELOPMENT AREAS
MSA
Murray, Smith & Associates, Inc. Engineers/Planners
OCTOBER 2014
SW Tualatin
Basalt Creek
Coffee Creek Correctional Facility
West Railroad
Coffee Creek
Frog Pond
Advance Road URA
Advance Road School
Brenchley Estates
Villebois
Charbonneau
WILLAMETTE RIVER
TONQUIN
WALDO
NORWOOD
GREENHILL
CLAY
DAY
COMMERCE
ELLIGSEN
RIDDER
FREEMAN
PRINTER
XEROX
TOOZE
MALLOY
WESTFALL
BOECKMAN
TOWN CENTER
COURTSIDE
CAMELOT
MONTGOMERY
EILERS
ADVANCE
KRUSE
FRENCH PRAIRIE
FAIRWAY
LAWNVIEW
BUTTEVILLE
WILSONVILLE
CEDAR BROOK
DENBROOK
I5
Urban Growth Boundary
City Boundary
Street
Study Area
Taxlot
Water Body
Metro Open Space
Developed UGB
Undeveloped UGB
Urban Reserve Area
Development Area
Advance Road URA
Advance Road School
Basalt Creek
Brenchley Estates
Coffee Creek Correctional Facility
Coffee Creek
Frog Pond
SW Tualatin
Villebois
West Railroad
0
2,500
5,000
Feet
N
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GEOLOGY, SOILS AND GROUNDWATER

Detailed information on the soils found throughout the study area are summarized in the U.S. Soil Conservation Service's *Soil Survey of Clackamas and Washington Counties* (1991). This survey identifies the soil types for construction considerations and potential response to rainfall-derived inflow and infiltration. In general, the soils within the study area produce a moderate to high rainfall response in terms of stormwater runoff. Conversely, these soils typically infiltrate rainfall at a low to moderate rate. The Natural Resources Conservation Service (NRCS) indicates that no locations within the study contain bedrock at the ground surface; however, well logs were referenced from the Oregon Water Resources Department with mixed results. There are numerous domestic water wells within the study area that report encountering rock within 10 feet of the ground surface.

The surface water hydrology varies considerably and is influenced by rainfall. Generally, groundwater is well below the surface and does not impact construction within the study area. However, shallow groundwater conditions likely exist in certain areas, particularly in poorly draining soils with a perched water table. These conditions are more prevalent in proximity to wetlands, small creeks and springs.

NATURAL RESOURCE AREAS

Natural resources are natural materials occurring in nature, and include air, water, plants, animals and soil. The Willamette River and its tributary streams are a significant natural resource that the City has conserved through enactments of protective ordinances.

Historically, the City has managed natural resources through the establishment of Primary Open Space and Secondary Open Space zoning areas. Recently, salmonids in the Willamette River have been designated as threatened under the Endangered Species Act (ESA), prompting the City to categorize salmonid habitats as Significant Resource Overlay Zones (SROZ).

Surface Water

The primary surface water feature of the area is the Willamette River, which conveys drainage from nearly 11,500 square miles of tributary area originating on the western slopes of the Cascade Mountains roughly 50 miles south of Eugene. The river is fed by four local tributaries within the study area: Coffee Lake Creek/Seely Ditch, Arrowhead Creek, Boeckman Creek, and Meridian Creek. Surface water provides the principal source of potable water for the City of Wilsonville, in addition to acting as the disposal route for stormwater drainage and treated wastewater.

Historically, rivers and streams have been influenced by land and water management practices such as agricultural irrigation. These practices, in combination with Oregon's hot, dry summers, affect aquatic habitat. The Oregon Department of Environmental Quality (DEQ) has designated the Willamette River as "Essential Fish Habitat" and a "Water Quality Limited" stream.

Floodplain

A floodplain is an area of land adjacent to a river or stream that experiences flooding during periods of high discharge. A floodplain is a natural place for a surface water to dissipate its energy during periods of heavy rainfall. To protect these natural resources from infill, the City has enacted restrictions on development within the floodplains under their jurisdiction. Some infrastructure installed prior to these restrictions remains in place, such as the City's sewage lift station within Memorial Park.

HAZARD AREAS

According to the *Clackamas County Natural Hazards Mitigation Plan* (University of Oregon Community Service Center, 2012), the area surrounding the City is at risk for several types of natural disasters. This plan describes historical impacts, general location, extent, and severity of past natural hazard events, and the probability of future events. Table 2-3 summarizes all the hazards for which the City is at risk, however in terms of the wastewater collection system, susceptibility to flood is the greatest concern. Official flood hazard maps for the City area and Clackamas County are published by the Federal Emergency Management Agency (FEMA). Likewise, official earthquake fault lines are documented by the Oregon Department of Geology and Mineral Industries.

The Natural Hazard Risk Assessment probability scores address the likelihood of a future major emergency or disaster within a specific period of time, as follows:

- High = One incident likely within a 10- to 35-year period.
- Moderate = One incident likely within a 35- to 75-year period.
- Low = One incident likely within a 75- to 100-year period.

The vulnerability scores address the percentage of population or region assets likely to be affected by a major emergency or disaster, as follows:

- High = More than 10% affected.
- Moderate = 1%-10% affected.
- Low = Less than 1% affected.

Table 2-3 | Probability and Vulnerability Assessment – Clackamas County

Drought	Moderate	Low
Earthquake	Low	High
Extreme Heat	Moderate	Moderate
Fires	Moderate	Moderate
Flood	High	Moderate
Landslides	High	Low
Volcano	Low	High
Wind Storm	Moderate	Low
Winter Storm	High	Moderate

MUNICIPAL WATER SYSTEM

The City operates and maintains a municipal water system that provides potable drinking water to residents within the City limits. The municipal water system is supplied by treated surface water withdrawals from the Willamette River to the Willamette River Water Treatment Plant (WRWTP). This state-of-the-art facility produces high-quality finish water which is pumped into transmission mains for distribution throughout the City. The City shares ownership of the WRWTP with the Tualatin Valley Water District.

The majority of the City's dry weather wastewater flow comes from customers' use of the municipal water system. Thus, wastewater flows and municipal water demand follow a similar diurnal cycle throughout the day. The municipal water system experiences a much higher demand in the summer, due to irrigation.

MUNICIPAL STORMWATER SYSTEM

City ordinances prohibit a combined stormwater and wastewater sewer system. The City has provided a Municipal Separate Storm Sewer System (MS4) through construction of nearly 55 miles of pipes and 6,300 storm structures including inlets, outlets and manholes. A significant portion of the City's stormwater conveyance system consists of natural and constructed open channels, which are collectively about 14 miles long. There are no known interconnections between the stormwater and sanitary sewer systems.

ENERGY PRODUCTION

The City's electrical energy provider is Portland General Electric (PGE). The Bonneville Power Administration (BPA) routes electrical transmission lines through City; however, PGE distributes power to residential, commercial, industrial and municipal users. Northwest Natural Gas provides natural gas within the City limits.

SOCIOECONOMIC ENVIRONMENT

Economic Conditions and Trends

The City generally has a favorable job market and a strong workforce. Commerce moves easily through the City, which is strategically located along the I-5 and I-205 corridors, railroad lines and the Willamette River. The City's economy is predominately based on the manufacturing and industrial industries, wholesale and retail trade, and other services. The percentage of individuals between the ages of 20 and 64 in the City's workforce (62.8 percent) exceeds the national average of 52.9 percent.

Wilsonville's Center for Economic Development reports that the City exceeds several economic and educational metrics, as follows:

- Data from 2011 reports show that the City's per capita income ($30,187) and median household income ($55,316) exceed Oregon's average.

- The percentage of the City's (25 and older) population who have a bachelor's degree or higher is 25.9 percent. This surpasses the City of Portland's educational attainment rate of 22 percent.

The City's education system is primarily served by the Wilsonville-West Linn School District; however, both the Canby School District and the Sherwood School District educate students at the fringes of the City. The City is home to a branch of the Clackamas Community College, which has a satellite campus on Town Center Loop.

Population

Based on data from the U.S. Census, the City's population has seen steady growth over time, with a reported population in 2010 of 19,509. Since the U.S. Census undertakes population surveys only once every decade, the Portland State University (PSU) Population Research Center supplements projected populations annually within Oregon. The projected population for the City in 2013 was 21,550. Detailed information related to historical populations and trends is provided in Section 5, "Population and Flow Projections."

SECTION 3 | EXISTING SYSTEM DESCRIPTION

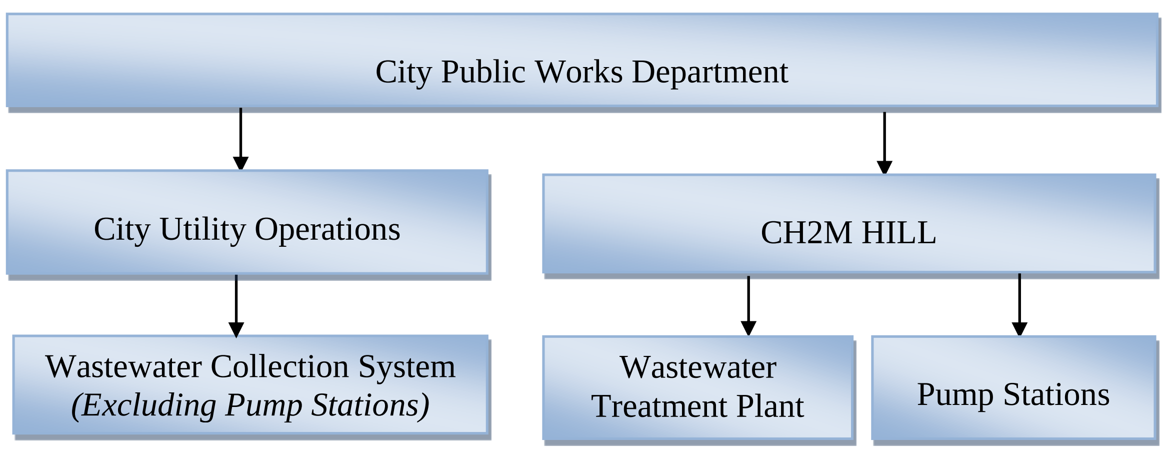
INTRODUCTION

While the scope of this study is limited to the wastewater collection system, a brief account of the entire collection and treatment system structure is provided within the following section. The City's wastewater collection system is approximately 35 to 40 years old and contains approximately 70 miles of sewer pipeline, 1,700 manholes and 8 public pump stations. The system collects nearly equal quantities of residential and non-residential wastewater, which is ultimately conveyed to the Wastewater Treatment Plant (WWTP), located in the southern end of the City along the Willamette River.

UTILITY MANAGEMENT STRUCTURE

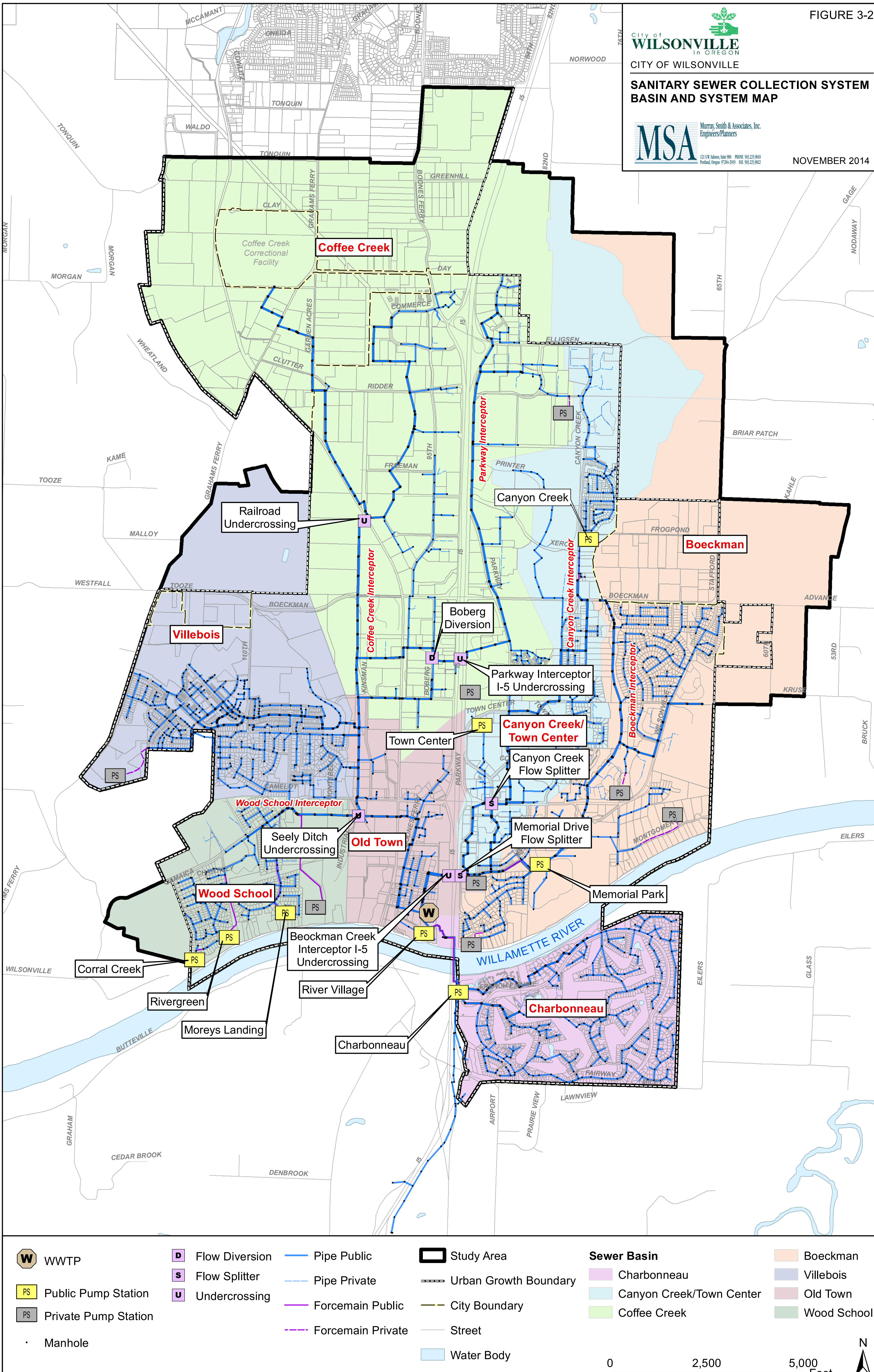
Operating within the Public Works Department, the City's wastewater collection system provides utility service to over 5,000 customer accounts. The Department's Utilities Supervisor and maintenance staff members are responsible for conducting sewer collection system operation and maintenance, with the exception of the City's pump stations. Oversight and operation of the City's pump stations and WWTP have been contracted by the City to CH2M HILL. This service contract will expire in 2026, and contains an option for renewal. The generic organizational structure for the City's wastewater collection and treatment system is shown in Figure 3-1.

Figure 3-1 | Wastewater Collection and Treatment System Organization Chart



SUMMARY OF COLLECTION SYSTEM FACILITIES

The City's wastewater collection system, illustrated in Figure 3-2, consists primarily of manholes, gravity pipelines, pump stations (lift stations) and force mains that convey wastewater to the WWTP. The gravity pipelines convey wastewater from the residential and commercial areas and route them to the major interceptors. Due to the varied topography in the City, several pump stations are required to convey sewage to the WWTP.



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WASTEWATER COLLECTION SYSTEM SEWER BASINS

The existing and future service areas are divided into seven primary basins, covering nearly 12 square miles. The primary basins are shown in Figure 3-2, summarized in Table 3-1 by land use, and described below. The major infrastructure are mentioned in the basin descriptions and described in more detail later in the section. The City's primary sewer basins are roughly divided by Interstate 5, which runs north and south through the center of the study area. This splits the basins into East Side and West Side categories as follows:

East Side Basins

Boeckman Basin

The Boeckman Basin is on the City's east side, bounded to the south by the Willamette River and to the north by the Frog Pond area. The future Urban Reserve Area (URA) may extend the basin north of Elligsen Road. Residentially zoned areas comprise the major wastewater contributions to the basin, with the Wilsonville High School and Boeckman Creek Primary School contributing non-residential wastewater. The basin comprises 800 acres of tributary area including undeveloped areas in the Urban Growth Boundary (UGB) and an additional 480 acres in the URA.

Major infrastructure within the Boeckman Basin include the Boeckman Interceptor (formerly called the High School Interceptor), Memorial Park Pump Station (MPPS), and Boeckman I-5 Undercrossing.

Canyon Creek / Town Center

The Canyon Creek / Town Center Basin is on the City's east side, bounded to the south and east by the Boeckman Basin, and to the north by the UGB. The future URA may extend the basin north of Elligsen Road and east of Stafford Road. The basin is evenly split between generating wastewater flows from residential, commercial and industrial land uses. The basin comprises 560 acres of tributary area including undeveloped areas in the UGB and an additional 260 acres in the URA.

Major infrastructure within the Canyon Creek / Town Center Basin include the Canyon Creek Interceptor, Canyon Creek Pump Station, and the Canyon Creek Flow Splitter.

Charbonneau

The Charbonneau Basin is on the east side of the City and is unique in terms of its age and isolated nature. The Willamette River effectively separates the basin from the remainder of the City, with the basin located on the south side of the river. The basin encompasses 240 acres of primarily residentially zoned land, and is bound by the UGB. The Charbonneau area was one of the first planned communities in Oregon, with development beginning around 1972 and continuing through the 1980s. The utility infrastructure installed to support the development is showing signs of fatigue. A City study, entitled *Charbonneau Consolidated*

Improvement Plan (Weigel, August 4, 2014), notes, "…sewer conditions observed include collapsed pipe, pipe separation, offset joints, major blockages and pipe sag."

Major infrastructure within the Charbonneau Basin includes the Charbonneau Pump Station.

West Side Basins

Coffee Creek

The Coffee Creek Basin is the City's largest, and consists primarily of industrially zoned land, with a commercial component near Elligsen Road, and residential areas within the Brenchley Estates and Ash Meadows developments. The majority of the basin is on the west side of the City, bound to the north and west by the UGB and to the south by the Villebois Basin. The basin comprises 2,220 acres of tributary area including undeveloped areas in the UGB and an additional 120 acres in the URA.

Major infrastructure within the Coffee Creek Basin include the Coffee Creek Interceptor, the Parkway Interceptor, the Parkway Interceptor I-5 Undercrossing, the Railroad Undercrossing, and the Boberg Diversion Structure.

Old Town

The Old Town Basin is located on the west side of the City, along the northern bank of the Willamette River. The basin is bound to the south by the Willamette River, to the west by the Wood School and Villebois Basins, to the north by the Coffee Creek Basin, and to the east by the Boeckman Basin. This area is comprised primarily of commercially zoned land; however, there is a residential component to the wastewater loading from properties along the river. The basin comprises 290 acres of tributary area including undeveloped areas in the UGB, with no additional acreage in the URA.

Major infrastructure within the Old Town Basin include the Coffee Creek Interceptor, the Boeckman Creek Interceptor, the Boeckman Creek Interceptor I-5 Undercrossing, the Seely Ditch Undercrossing, the River Village Pump Station, and the WWTP.

Villebois

The Villebois Basin is on the City's west side, bounded to the west by the UGB, to the south by Wood School Basin and to the east by the Coffee Creek Basin. The basin is the City's newest residential development area and has filled approximately half of its defined area with new single- and multi-family homes. The basin comprises 540 acres of tributary area including undeveloped areas in the UGB and an additional 200 acres in the URA.

Major infrastructure within the Villebois Basin include the Villebois Interceptor.

Wood School

The Wood School Basin is comprised of mainly residential areas, with an industrial area along the Willamette River. This west side basin is bordered by the Willamette River to the south, the UGB to the west, and Villebois Basin to the north. The basin comprises 350 acres of tributary area including undeveloped areas in the UGB and an additional 70 acres in the URA.

Major infrastructure within the Wood School Basin include the Wood School Interceptor. There are several pump station within the basin, which include the Corral Creek, Rivergreen, and Morey's Landing pump stations.

Table 3-1 | Sewer Basin Area Summary

Basin Name	Trunk Sewer	Other Infrastructure	Residential (acres)	Commercial (acres)	Industrial (acres)	Vacant in UGB (acres)	Vacant in URA (acres)	Total Area (acres)
Boeckman	Boeckman Interceptor	MPPS; Boeckman I-5 Undercrossing	460	10	--	330	480	1,280
Canyon Creek / Town Center	Canyon Creek Interceptor	Canyon Creek Pump Station; Canyon Creek Flow Splitter	150	150	150	110	260	820
Charbo-nneau	--	Charbonneau Pump Station	230	10	--	--	--	240
Coffee Creek	Parkway & Coffee Creek Interceptors	Parkway Interceptor I-5 Undercrossing; Railroad Undercrossing; Boberg Diversion Structure	150	90	790	1,190	120	2,340
Old Town	Boeckman & Coffee Creek Interceptors	Boeckman Creek Interceptor I-5 Undercrossing; Seely Ditch Undercrossing; River Village Pump Station; WWTP	70	30	110	80	--	290
Villebois	Villebois Interceptor	--	180	--	--	360	200	740
Wood School	Wood School Interceptor	Corral Creek; Rivergreen; and Morey's Landing pump stations	210	--	--	140	70	420
Totals	--	--	1,450	290	1,050	2,210	1,130	6,130

GRAVITY PIPELINES

The collection system is comprised of gravity pipes between 4 and 36 inches in diameter, as illustrated in Figure 3-3. The oldest portion of the collection system, which is 35 to 40 years old, is located around the WWTP, Boones Ferry Road, Town Center and Charbonneau areas and is comprised of original concrete pipe and manholes. The collection system has expanded, and the newer piping consists of PVC with concrete manholes for pipes 18 inches and smaller. A map illustrating the age of the system throughout the City is provided in Figure 3-4 and the materials as located within the collection system in Figure 3-5.

The smaller system pipelines convey wastewater to the larger trunk sewer pipes which are called interceptors. Table 3-2 summarizes pipeline lengths by diameter and basin as listed in the City's GIS. Table 3-3 summarizes pipeline lengths by age and material. The major interceptors are described below with pipeline lengths and diameters presented in Table 3-4.

Boeckman Interceptor

The Boeckman Interceptor spans more than 15,100 feet. The upper and main branches of the interceptor collect wastewater from the Boeckman Basin. In addition to the Boeckman Basins, the lower branch also collects wastewater from the Canyon Creek Basin. The inteceptor begins at Boeckman Road where its upper northwest branch conveys flows southerly along Boeckman Creek. The interceptor also has an upper northeast branch (High School Interceptor), which conveys wastewater southerly under SW Wilsonville Road. These two branches merge near Hathaway Park, where they convey wastewater south through the interceptor's main branch. The main branch continues southerly along Boeckman Creek to Memorial Park, where the interceptor discharges into the Memorial Park Pump Station.

The Memorial Park Pump Station force main discharges into the interceptor's lower branch which conveys wastewater west under Memorial Drive. The lower branch interceptor encounters the Memorial Drive Flow Splitter at Memorial Drive on the east side of I-5. This flow splitter is just upstream of the Boeckman Creek Interceptor I-5 Undercrossing, which passes flows to the west under I-5 via parallel pipelines. The Boeckman Interceptor then continues to convey wastewater through its lower branch to the WWTP.

Memorial Drive Flow Splitter

A flow splitter is located in a manhole near the intersection of SW Parkway Avenue and Memorial Drive, downstream of the Boeckman Creek Interceptor and Memorial Park Pump Station, and east of Interstate 5. Construction of the flow splitter box and the related parallel sewer was completed in 1996. Flows are split into an existing 15-inch diameter reinforced concrete pipe and a parallel 18-inch diameter PVC pipe; both run west under Interstate 5 and combine again along Fir Street.

I-5 Undercrossing

The I-5 Undercrossing consists of flows from the Boeckman Interceptor and Canyon Creek Interceptor through a 15-inch and an 18-inch diameter gravity trunk line. Flows are conveyed from east to west under Interstate 5. As previously discussed, the Memorial Drive Flow Splitter on the east side of Interstate 5 divides the primary interceptor flows into two trunk lines before wastewater cross under the freeway, which remain separated until passing south of 4th Street on the west side of Interstate 5.

Canyon Creek Interceptor

The Canyon Creek Interceptor spans more than 19,300 feet and serves the Canyon Creek/Town Center Basin. The interceptor begins near a residential subdivision at the intersection of Canyon Creek Road and Printer Parkway, where its upper northeast branch conveys flows southerly along Canyon Creek Road. The upper northeast branch discharges to the Canyon Creek Pump Station near SW Copper Creek Loop. The force main from the pump station discharges near Boeckman Road, which conveys wastewater south under Canyon Creek Road South. The interceptor continues under SW Daybreak Street, where it merges with the upper northwest branch at the intersection of SW Canyon Creek Road. The upper northwest branch conveys wastewater from the north to Printer Parkway, collecting flows from the City's larger industrial customers such as Mentor Graphics and Xerox.

Once these two branches merge at SW Daybreak Road, they continue south under SW Canyon Creek Road through the interceptor's main branch. The main branch continues west and south through the Town Center development until reaching Wilsonville Road. The Canyon Creek Flow Splitter then bisects wastewater into parallel pipes that convey flows southerly, where they discharge into the Boeckman Interceptor's lower branch under Memorial Drive.

Canyon Creek Flow Splitter

A flow splitter manhole is located near the intersection of SW Wilsonville Road and Town Center Loop West, and is intended to split the flow from the Canyon Creek Interceptor through parallel 15- and 18-inch lines. The 15-inch line runs south under Southwest Parkway Avenue, while the 18-inch line travels east under SW Wilsonville Road before turning south under SW Rogue Lane. The flow split is achieved through two outlet pipes connected to the manhole.

Charbonneau Interceptors

The Charbonneau Interceptors span more than 6,700 feet and serve the Charbonneau Basin. The upper north branch begins near the intersection of SW French Prairie Road and SW Old Farm Road and meanders to the southwest apart from any dedicated roadway alignment, until reaching the Charbonneau Pump Station. The upper south branch begins near the end of SW Mariners Drive, and conveys wastewater to the northwest where it joins the upper north branch at the Charbonneau Pump Station.

The Charbonneau Pump Station conveys wastewater northerly, over the Willamette River, in a force main attached to the Boone Bridge (I-5 Bridge). The force main discharges into the Charbonneau Interceptor lower branch, near the end of SW Tauchman Street. From this location, the lower branch conveys wastewater northwesterly to the WWTP.

Parkway Interceptor

The Parkway Interceptor (formerly named the Burns-West Interceptor) serves the area of the Coffee Creek Basin primarily east of I-5. The interceptor spans 17,250 feet and begins just north of Elligsen Road, at the intersection of SW Parkway Avenue and SW Salish Lane. The interceptor primarily follows the alignment of Parkway Avenue, conveying flows to the south through the upper branch. The upper branch turns west and travels towards I-5 near the Brenchley Estates subdivision. Upon reaching I-5, the interceptor encounters the Parkway Interceptor I-5 Undercrossing.

Once downstream of the undercrossing and west of I-5, the interceptor conveys flows towards the Boberg Diversion Structure which is located on Boberg Road north of SW Barber Street. This diversion structure routes wastewater through the Parkway Interceptor's lower branch with overflows to a lateral pipeline heading south on Boberg Road. Both pipelines discharge into the Coffee Creek Interceptor at SW Kinsman Road.

Parkway Interceptor I-5 Undercrossing

The Parkway Interceptor I-5 Undercrossing consists of a single 12-inch diameter gravity trunk line that conveys flow from east to west under Interstate 5. The crossing commences just west of the Brenchley Estates subdivision, located between Interstate 5 and Southwest Ash Meadows Circle. The crossing emerges on the west side of Interstate 5 near Boones Ferry Road, just upstream of the Boberg Diversion Structure at Boberg Road.

Boberg Diversion Structure

A diversion structure is located in a manhole on Boberg Road north of SW Barber Street in the Parkway Interceptor. The flow is diverted to the north and south along Boberg Road and conveyed to the Coffee Creek Interceptor on SW Kinsman Road. The north diversion is the primary flow path. During high flows, a knife gate allows sewage to spill into an elevated pipe directing it towards the southern diversion piping.

Coffee Creek Interceptor

The Coffee Creek Interceptor (formerly named the United Disposal Interceptor) spans approximately 27,700 feet. The upper branches serve the Coffee Creek Basin west of I-5. In addition to the Coffee Creek Basin, the main branch serves the Villebois Basin, and the lower branch serves the Villebois, Wood School, and Old Town Basins. The interceptor begins with an upper northwest branch at the Coffee Creek Correctional Facility (CCCF). The upper northwest branch conveys flows to the south and east, primarily following the alignments of SW Garden Acres Road, Peters Road, and the P&W Railroad. The upper northwest branch merges with the upper northeast branch just upstream of the railroad undercrossing. The upper northeast branch originates near SW Commerce Circle, conveying wastewater to the south through a meandering alignment apart from a formal roadway alignment.

Once wastewater leaves the railroad undercrossing, it continues southerly through the Coffee Creek Interceptor's upper branch. The alignment of this branch is to the east of several large tracts of METRO owned properties designated as open space. The upper branch ends near SW Barber Street, where wastewater from the Parkway Interceptor's lower branch is received.

Once receiving wastewater from the Parkway Interceptor's lower branch, the Coffee Creek Interceptor's main branch continues to the south following the alignment of Coffee Lake Creek. The Villebois Interceptor discharges into the main branch approximately near SW Evergreen Drive. The main branch continues to follow a southerly alignment along Coffee Lake Creek until just south of the intersection with SW Wilsonville Road.

Wastewater carried through the main branch merges with flows from the Wood School Interceptor near SW Ore Pac Avenue, which also demarcates the beginning of the Coffee Creek Interceptor's lower branch. The lower branch flows to the east, and upon reaching SW Boones Ferry Road, turns to the southwest following this roadway's alignment. A final turn to the east is conducted at SW 3rd Street, where the lower branch conveys wastewater to the WWTP.

Railroad Undercrossing

The Railroad Undercrossing occurs at the intersection of the Coffee Creek Interceptor with the P&W Railroad. The undercrossing occurs slightly southwest of the intersection of Freeman Drive and 95th Avenue, where Kinsman road projected northerly would intersect the rail alignment. This railroad undercrossing creates a significant sewer capacity constraint, which is described in greater detail within Section 6.

Villebois Interceptor

The Villebois Interceptor spans 6,700 feet and serves the Villebois Basin. The interceptor begins near the intersection of SW Orleans Avenue and Costa Circle East. It follows the alignment of SW Orleans Avenue to the east, until the intersection of SW Barber Street. The interceptor follows the alignment of SW Barber Street easterly, until reaching the intersection of SW Montebello Drive. The Villebois Interceptor terminates at the discharge point into the Coffee Creek Interceptor main branch, near SW Evergreen Drive.

The Villebois Interceptor north branch is a recently constructed spur off the primary interceptor. The north branch was built to accept future flows from UGB growth and potential basin expansion into the URA, north of SW Tooze Road.

Wood School Interceptor

The Wood School Interceptor spans approximately 3,300 feet and serves the Wood School Basin. The interceptor commences near the Inza Wood Middle School along SW Wilsonville Road. The interceptor conveys flows to the east, following the alignment of SW Wilsonville Road. Upon reaching the intersection with SW Brown Road, the interceptor turns to the southeast, until it meets the projected alignment of SW Ore Pac Avenue, where it turns due east and terminates at the connecting point to the Coffee Creek Interceptor lower branch.

Seely Ditch Undercrossing

This undercrossing occurs at the Seely Ditch, located near the intersection of Industrial Way and Wilsonville Road. The existing 10-inch undercrossing has minimal slope.

Table 3-2 | Gravity Pipe

Diameter (inches)	Length by Basin (feet)							Total Length (feet)
	Charbonneau	Canyon Creek / Town Center	Boeckman	Coffee Creek	Villebois	Wood School	Old Town	
4	0	260	740	0	80	0	0	1,080
6	3,450	2,010	1,130	1,030	440	250	410	8,720
8	53,770	31,960	43,840	29,470	50,470	25,300	11,410	246,220
10	240	4,210	3,660	10,770	3,960	2,650	620	26,110
12	2,920	10,730	6,900	10,860	0	0	0	31,410
14	0	0	740	160	0	0	0	900
15	3,800	4,860	570	6,950	5,030	1,470	2,270	24,950
16	0	150	0	0	920	0	320	1,390
18	20	2,530	1,400	3,400	0	0	1,980	9,330
21	0	0	0	5,990	550	0	210	6,750
24	0	210	0	1,780	0	0	130	2,120
27	0	0	0	360	0	0	0	360
30	0	0	0	0	0	0	6,530	6,530
36	0	0	0	0	0	0	1,200	1,200
Total	64,200	56,920	58,980	70,770	61,450	29,670	25,080	367,070

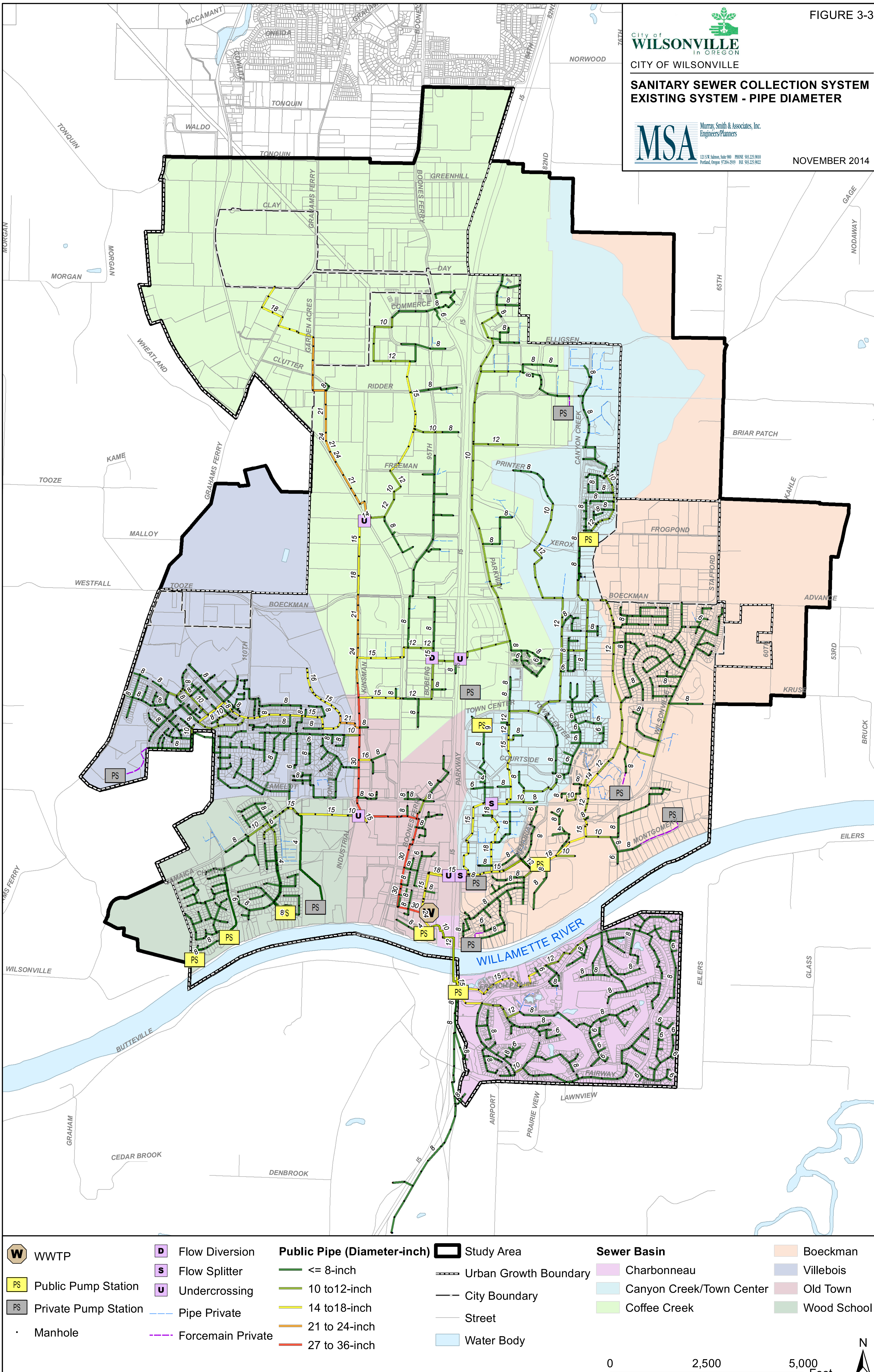

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FIGURE 3-4

CITY OF WILSONVILLE

SANITARY SEWER COLLECTION SYSTEM
EXISTING SYSTEM - PIPE AGE

NOVEMBER 2014

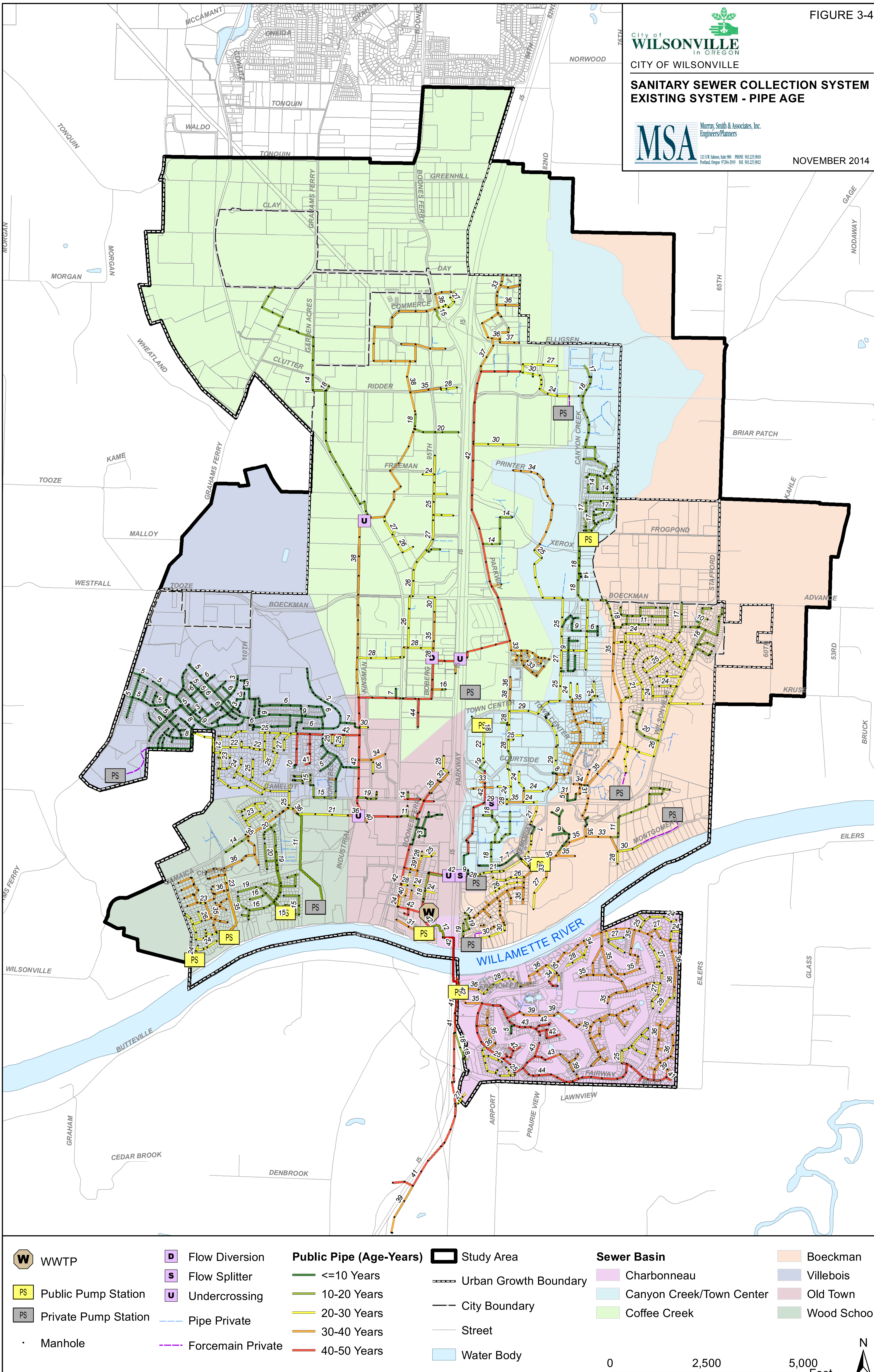


FIGURE 3-5

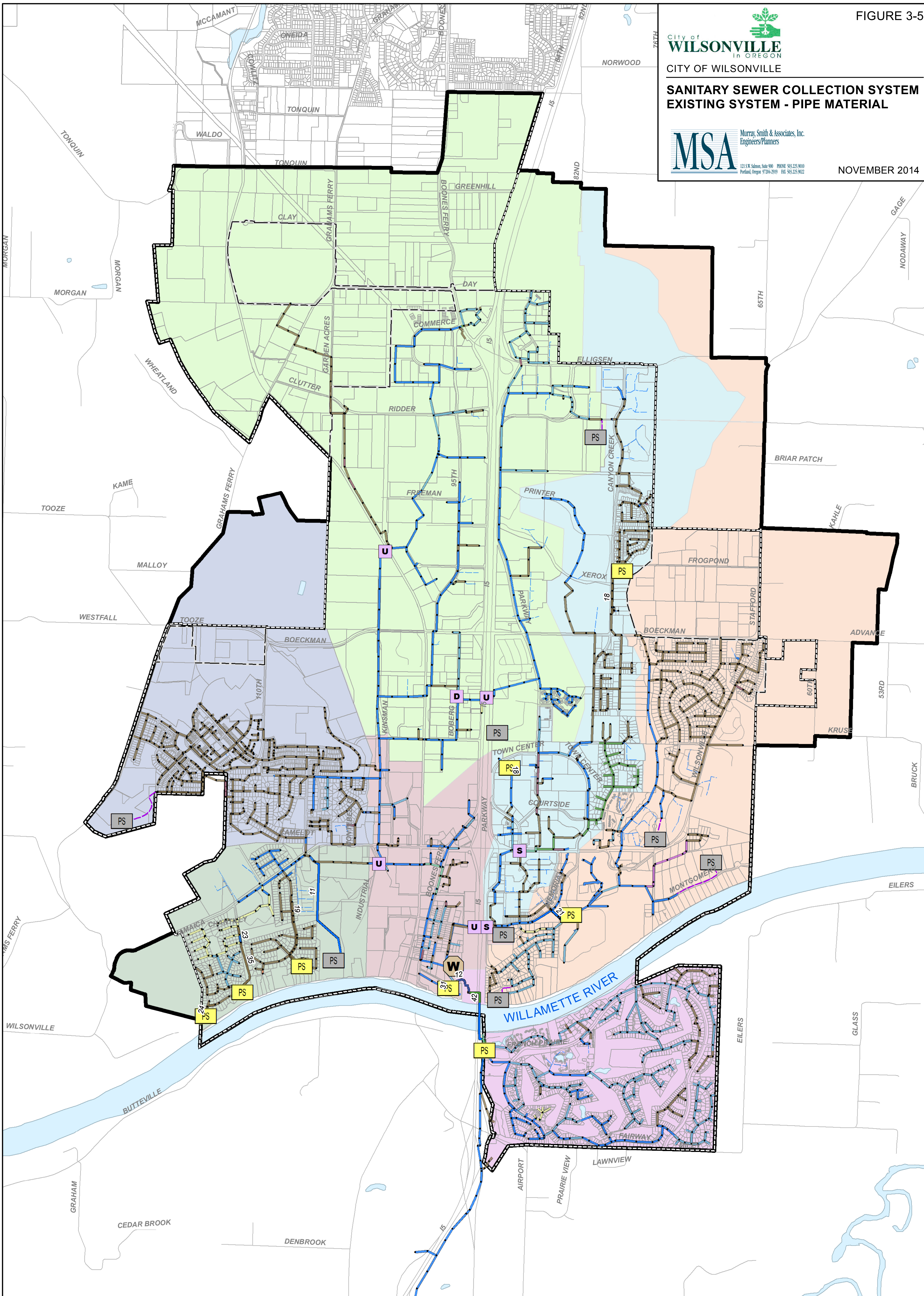
City of WILSONVILLE in OREGON

CITY OF WILSONVILLE

SANITARY SEWER COLLECTION SYSTEM
EXISTING SYSTEM - PIPE MATERIAL

MSA Murray, Smith & Associates, Inc. Engineers/Planners

NOVEMBER 2014



W	WWTP	D	Flow Diversion	**Public Pipe (Material)**		Ductile Iron			Study Area
PS	Public Pump Station	S	Flow Splitter		Asbestos Cement	HDPE			Urban Growth Boundary
PS	Private Pump Station	U	Undercrossing		Steel (C90)	PVC			City Boundary
·	Manhole		Pipe Private		Cast Iron	Reinforced Concrete			Street
			Forcemain Private		Concrete	Unknown			Water Body
					Corrugated Steel				

0 2,500 5,000 Feet

N

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Table 3-3 | Gravity Pipe

Material	Length by Age and Material (feet)					Total Length (feet)
	<= 10 Years	10-20 Years	20-30 Years	30-40 Years	40-50 Years	
Asbestos Cement	--	--	--	7,570	--	7,570
Steel (C90)	--	1,840	--	--	--	1,840
Cast Iron	--	90	--	--	--	90
Concrete	--	--	11,670	47,570	9,710	68,950
Corrugated Steel	--	--	650	6,360	890	7,900
Ductile Iron	--	1,130	2,280	560	--	3,970
HDPE	110	--	--	--	--	110
PVC	50,200	56,130	59,090	1,740	110	167,270
Reinforced Concrete	810	390	740	--	430	2,370
Unknown	2,150	4,260	23,690	36,670	40,230	107,000
Total	53,270	63,840	98,120	100,470	51,370	367,070

Table 3-4 | Gravity Interceptors

Interceptor	Length by Diameter (feet)									Total Length (feet)
	10 in.	12 in.	14-16 in.	18 in.	21 in.	24 in.	27 in.	30 in.	36 in.	
Boeckman Upper NE	1,000	1,390	--	--	--	--	--	--	--	2,390
Boeckman Upper NW	--	3,890	--	--	--	--	--	--	--	3,890
Boeckman Main	--	1,620	1,210	1,400	--	--	--	--	--	4,230
Boeckman Lower	--	--	2,180	2,210	--	210	--	--	--	4,600
Canyon Creek Upper NE	800	3,800	--	--	--	--	--	--	--	4,600
Canyon Creek Upper NW	1,110	3,510	--	--	--	--	--	--	--	4,620
Canyon Creek Main	--	3,420	2,310	--	--	--	--	--	--	5,730
Canyon Creek Lower	--	--	2,450	1,950	--	--	--	--	--	4,400
Charbonneau Upper North	--	1,710	2,630	--	--	--	--	--	--	4,340
Charbonneau Upper South	--	1,210	740	--	--	--	--	--	--	1,950
Charbonneau Lower	--	--	--	320	--	130	--	--	--	450
Parkway Upper	8,160	3,680	--	--	--	--	--	--	--	11,840
Parkway Lower	--	2,550	2,860	--	--	--	--	--	--	5,410
Coffee Creek Upper NE	1,120	3,180	3,070	--	--	--	--	--	--	7,370
Coffee Creek Upper NW	--	--	20	2,410	4,950	510	--	--	--	7,890
Coffee Creek Upper	--	--	1,180	990	1,030	1,270	360	--	--	4,830
Coffee Creek Main	--	--	--	--	--	--	--	3,240	--	3,240
Coffee Creek Lower	--	--	--	--	--	--	--	3,290	1,200	4,490
Villebois North	--	--	1,600	--	170	--	--	--	--	1,770
Villebois	--	--	4,350	--	600	--	--	--	--	4,950
Wood School	1,600	--	1,670	--	--	--	--	--	--	3,270
Total	13,790	29,960	26,270	9,280	6,750	2,120	360	6,530	1,200	96,260

INTERTIES

Presently there are no piping interties between the City's wastewater collection system and any adjacent local agency.

PUMP STATIONS AND FORCE MAINS

The City owns and operates 8 public pump stations (lift stations) of various sizes. In addition to these public pump stations, there are several privately-owned pump stations within the City maintained by their respective owners. Figure 3-2 shows the pump station locations throughout the system. Detailed information regarding these facilities is also summarized in Table 3-5, which indicates information related to each pumping system and associated force mains.

The City upgraded the telemetry and control systems for all of their pump stations in 2009, switching from dial-up telephone communication systems to radio. This enabled the City to utilize supervisory control and data acquisition (SCADA) software to monitor each facility remotely from a central location at the WWTP.

Operation and maintenance of these pump stations has been contracted to CH2M HILL, parallel to their operation of the WWTP. Because this CSMP is structured to document City-owned and operated collection system infrastructures, further reference to these privately owned facilities is omitted; however, their locations are shown in Figure 3-2. A summary of the City's larger and more significant pump stations are provided below.

Memorial Park Pump Station

The Memorial Park Pump Station is the City's largest by volume, conveying wastewater at 900 gpm and over 100 feet in elevation gain. The pump station is located within Memorial Park immediately north of the sports fields. It is situated at the downstream end of the Boeckman Creek Interceptor main branch within the flood plain of Boeckman Creek. The location places the pump station at risk during conditions of heavy rain and flooding.

Canyon Creek Pump Station

The Canyon Creek Pump Station is the third largest in the City by volume, and collects wastewater from the Canyon Creek Interceptor upper northeast branch. The pump station is located near the intersection of Canyon Creek Road and SW Thornton Drive and conveys 600 gpm over an elevation gain of 60 feet before discharging into the Canyon Creek Interceptor main branch.

Charbonneau Pump Station

The Charbonneau Pump Station is the City's second largest, and collects wastewater from the Charbonneau District. The pump station is located in the northwest corner of the Charbonneau District adjacent to the Willamette River. The Charbonneau pump station conveys wastewater at a rate of 750 gallons per minute (gpm), elevating 65 feet to cross over the river. The force main is affixed to the underside of the Interstate 5 bridge structure (Boone Bridge), and discharges into the Charbonneau Interceptor lower branch.

WASTEWATER TREATMENT FACILITY IMPROVEMENTS OVERVIEW

The City's WWTP, built in 1971, discharges treated effluent from the City into the Willamette River. The plant experienced updates in the late 70s, 80s, and 90s. Between 2004 and 2009, the City evaluated the most efficient and cost-effective method of financing and constructing the needed upgrades, and was able to take advantage of historically low interest rates to finance plant upgrades with $38 million in 20-year bonds.
The City then awarded a Design-Build-Operate (DBO) project delivery contract to CH2M HILL, who completed Phase I plant upgrades in 2014.

Phase I improvements increased flow capacity from 2 mgd to 4 mgd and decreased odors from the plant. Another key improvement enabled the WWTP to produce solid by-product, which can be applied as fertilizer. Previously, the plant produced liquid by-product, which was expensive to store and dispose of in the winter wet season.

WWTP Phase II improvements that will expand the system's capacity to 7 mgd are anticipated for 2020. CH2M HILL will operate the WWTP and 8 public pump stations within the City through 2026. Detailed information related to the WWTP's capacity, treatment process and performance can be found in the Wastewater Facility Plan (2002).

WASTEWATER RECLAMATION

Although the City does not reclaim wastewater for secondary uses such as irrigation or industrial cooling, the WWTP's recently completed upgrades may be incorporated into the City's service portfolio for such uses in the future.

Table 3-5 | City of Wilsonville, Wastewater Pump Station Summary													
Pump Station	Address	Sewer Basin	Year Installed/ Refurbished	Pump Quantity	Pump Type	Pump Manufacturer	Horse Power (hp)	Firm Capacity (gpm)	Total Dynamic Head (TDH) (ft)	Force Main Diameter (inches)	Force Main Length (ft)	Force Main Material	Back-Up Power
Canyon Creek	27370 SW Canyon Creek North	Canyon Creek / Town Center	1994	2	Self-priming	Gorman-Rupp	25	600	60	8	1,460	PVC	Fixed natural gas powered driving pump No. 2 only. 12 V controls battery powered.
Charbonneau	8786 SW Illahee Court	Charbonneau	1996	2	Self-priming	Gorman-Rupp	15	750	65	10 & 12	3,600	DI & HDPE	Fixed natural gas powered driving pump No. 2 only. 12 V controls battery powered.
Corral Creek	31287 SW Willamette Way W	Wood School	1990	2	Submersible	Meyers	5	160	40	4	520	PVC	Portable gas generator.
Memorial Park	7990 SW Memorial Drive	Boeckman	1995	2	Self-priming	Gorman-Rupp	100	900[1]	101	12	1,070	DI	Fixed natural gas powered driving pump No. 2 only. 12 V controls battery powered.
Morey's Landing	10700 SW Edgewood Court	Wood School	1997	2	Self-priming	Gorman-Rupp	15	260	79	4 & 6	2,180	PVC	Fixed natural gas powered driving pump No. 2 only. 12 V controls battery powered.
River Village	9310 SW Tauchman Street	Old Town	1984	2	Submersible	Meyers	7	250	32	4	240	PVC	Portable gas generator.
Rivergreen	11178 SW Belknap Court	Wood School	1991	2	Submersible	Meyers	15	285	91	6	1,280	PVC	Portable diesel generator.
Parkway/ Town Center	29070 SW Town Center Loop W	Canyon Creek / Town Center	1996	2	Self-primed suction lift	Gorman-Rupp	5	220	20	6	120	DI	Portable gas generator.

Notes:
1 – The current capacity of the Memorial Park Pump Station is 900 gpm. This facility can be reconfigured to provide an expanded capacity of 1,680 gpm

SECTION 4 | REGULATIONS AND POLICIES

INTRODUCTION

This collection system master plan (CSMP) has been created in compliance with following federal, state, and local requirements.

FEDERAL STATUES, REGULATIONS AND PERMITS

NPDES Permit

The Clean Water Act (CWA) is the principal federal law in the United States governing water pollution and provides the basis for the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) permit program, which regulates discharge pollutants from point sources to waters of the United States. The CWA can regulate pollutants through technology and water quality based effluent limits. Other regulations that can also apply to the NPDES program include Safe Drinking Water Act, Endangered Species Act, National Environmental Policy Act, National Historic Preservation Act, Coastal Zone Management Act, Wild and Scenic Rivers Act, Fish and Wildlife Coordination Act, and Essential Fish Habitat Provisions.

The Oregon Department of Environmental Quality (DEQ) administers the state's NPDES permit program on behalf of the federal government. This permit establishes maximum pollutant concentrations and loads allowed in the effluent discharge stream. The City of Wilsonville's (City's) Wastewater Treatment Plant (WWTP) is authorized by NPDES Permit OR-101888 to discharge treated wastewater into the Willamette River. The current 3-year permit cycle runs to December 31, 2014.

National Pretreatment Program

The National Pretreatment Program is charged with controlling toxic, conventional, and non-conventional pollutants from non-domestic sources that discharge into sewer systems, as described in CWA Section 307(a). This program requires all large, publically owned treatment works (POTW) that have a designed treatment capacity of more than five (5) mgd to establish local pretreatment programs.

Local programs must enforce all national pretreatment standards and requirements, in addition to any more stringent local requirements necessary to protect site-specific conditions at the POTW. Because POTWs are generally not designed to treat most toxic or non-conventional pollutants present in industrial waste, the National Pretreatment Program protects the POTW and the environment from adverse impacts that may occur when hazardous or toxic wastes are discharged into a sanitary sewer system. This is achieved mainly by regulating nondomestic (industrial) users of POTWs that discharge toxic wastes or unusually strong conventional wastes.

Wilsonville conducts an industrial pretreatment program though its' Public Works Department. The primary objective of the program is to prevent harmful discharges into the wastewater collection system that could degrade the quality of municipal digested biosolids, negatively affect the sewer system, or pass through the treatment process into the Willamette River. The program also strives to improve opportunities to reclaim wastewater and biosolids.

OREGON STATUTES, REGULATIONS AND PERMITS

Oregon Administrative Rule, Division 660

Oregon requires its cities and counties to adopt pubic facility plans for any urban growth boundary (UGB) areas with a population greater than 2,500. A public facility plan (PFP) helps assure that development within the UGB is guided and supported by the types and levels of urban facilities and services appropriate for the needs and requirements of the areas to be served, and that those facilities and services are provided in a timely, orderly and efficient arrangement, as required by Goal 11 and its implementing administrative rule at Oregon Administrative Rule (OAR) 660-011. This CSMP has been developed in conformance with this rule and will act as a supporting document for the City's Comprehensive Plan.

Oregon Administrative Rule, Division 340

This rule authorizes the actions of the Oregon DEQ. Total Maximum Daily Loads (TMDLs) are established for the Willamette River under this rule, which in turn prohibits such activities as discharging waste from industrial and commercial activities without a permit. This planning document provides supporting information for the City to renew its NPDES permit with the DEQ.

Oregon Revised Statute, Division 224

This statute governs the City's wastewater system management. The operational aspects of the system are defined herein, including the authority of the City to charge for provision or service and obtain debt obligations for construction of sewer systems.

Oregon Revised Statute, Division 223

This statute allows the City to recover the costs of a new development's share of the system capacity by collecting system development charges (SDCs). Under this statute, new developments must pay a proportional share of expenses to meet the increased demands that they place on the system. SDC fees can be imposed to offset the expense of any system accommodations made necessary by the new development.

LOCAL SEWER ORDINANCES, AGREEMENTS AND RELATED PLANNING POLICIES

METRO 2040 Regional Framework Plan

The City's planning programs are required to support METRO's (formerly Metropolitan Service District) 2040 Regional Framework Plan, a document intended to direct and control the region's urban growth and development. This plan was adopted by METRO council in

1995. This CSMP aids the City in meeting METRO's requirements for infrastructure planning, necessary before an area can be added to the official UGB.

Washington and Clackamas Counties

Neither Washington nor Clackamas counties have any specific regulation or rule that would apply towards the wastewater collection system within the City.

City of Wilsonville, Comprehensive Plan (July 2013), Ordinance No. 517

The Wilsonville Comprehensive Plan is an official statement of the goals, policies, implementation measures and physical plans for the City's development. A completely revised plan was adopted by City Council Ordinance No. 517 on October 16, 2000. It was again updated in July 2013 to include a number of amending ordinances, summarized below.

City of Wilsonville, Wastewater Collection System Master Plan (July 2001), Ordinance No. 530

This document, prepared by HDR, serves as an important starting point for development of this new CSMP, as it summarizes all of the previous wastewater planning efforts to date. The report contains the current Capital Improvement Program (CIP) for the collection system and details the analysis used in developing recommended improvements. This plan has served as a primary support document for the City to renew its NPDES permit from Oregon DEQ.

City of Wilsonville, Wastewater Facility Plan (November 2002), Ordinance No. 571

The Wastewater Facility Plan provides another important supporting document towards issuance of the City's NPDES permit. This report, prepared by HDR, updates the previous 1995 Facility Plan and recommends expanding existing treatment systems and using new treatment technologies to meet the City's wastewater needs. This document was reviewed to evaluate whether the modeled wastewater collection system flows were within the ranges anticipated for treatment and disposal by the WWTP.

City of Wilsonville, Coffee Creek Master Plan (October 2007), Ordinance No. 637

The Coffee Creek Master Plan was written to establish the infrastructure framework necessary to support future land uses within the associated planning area. Wastewater unit flow assumptions made during the planning for this area were reviewed for conformance with the current master planning effort. In addition, locations of planned sewer lines identified in the Coffee Creek Master Plan were used for loading into the collection system model.

City of Wilsonville, Stormwater Master Plan (March 2012), Ordinance No. 700

The City's stormwater master plan was consulted to evaluate potential efficiencies that could be realized for the wastewater CIP recommendations provided in later sections of this report. A key finding of this document was the trend towards managing stormwater with low-impact development (LID) techniques. LID practices promote disposal of stormwater runoff through infiltration, which may increase seepage into the wastewater collection system. Infiltration of stormwater typically increases the ground water table adjacent to the LID facility. Sewer collection piping within such an elevated ground water table would experience increased seepage through condition based problems such as tree root intrusion or deteriorated joints.

City of Wilsonville, Water System Master Plan (September 2012), Ordinance No. 707

The Water System Master Plan (WSMP) identifies water demands and system capital improvement projects for the 20-year planning horizon. Since the water system provides the primary source of wastewater during dry weather conditions, the WSMP study area and demands were coordinated with loading and planning assumptions for this CSMP.

City of Wilsonville, Transportation System Plan (June 2013), Ordinance No. 718

Sanitary sewers are often constructed in street rights of way within the City. The Transportation System Plan (TSP) was consulted to evaluate potential efficiencies that could be realized for CIP recommendations provided in later sections of this report.

City of Wilsonville, Villebois Village Master Plan (October 2013), Ordinance No. 724

This 480-acre planned development on the west side of the City represents a recent comprehensive effort to develop a land use program, parks and open space, utilities, and transportation circulation into a cohesive community. The document was reviewed for consistency with the CSMP loading assumptions for the Villebois area.

City of Wilsonville, Frog Pond Area Concept Plan (Under Development)

The City is currently planning for the development of the Frog Pond UGB area and urban reserve area (URA) adjacent to Advance Road. Concept planning is underway for these development areas to address density and mix of uses and housing types; location of schools, parks and natural areas; water quality and ecosystem protection; multimodal transportation; public facilities location and service providers; and a financing plan. Coordination was made during development of this CSMP regarding infrastructure needs for the Frog Pond area and conformance with the collection system analysis.

City of Wilsonville, Basalt Creek Concept Plan (Under Development)

The City is also planning for the development of the Basalt Creek UGB area on the north side of the City. Concept planning is in the beginning stages for these development areas to address density and mix of uses and housing types; location of schools, parks and natural areas; water quality and ecosystem protection; multimodal transportation; public facilities location and service providers; and a financing plan.

City of Wilsonville, Municipal Code

Service area policies of the sewer system are defined in Chapter 3 of the Wilsonville Municipal Code. This includes connection charges and monthly user fees, provisions for use of the sewer system, prohibited discharges to public facilities, requirements for pretreatment, general standards for building sewers, general standards for public sewer construction, and requirements for compliance with the International Plumbing Code.

Chapter 4 of the City's Municipal Code is typically referred to as the "Planning and Land Use Ordinance," but is also known as the Development Code or Zoning Code. It is enacted to promote the general public welfare by ensuring procedural due process in the administration and enforcement of the City's Comprehensive Plan, zoning, design review, land division, and development standards.

City of Wilsonville, Public Works Standards

The Public Works Standards (PWS) have been developed to set forth uniform material and workmanship criteria applicable to infrastructure under the City's jurisdiction. They also streamline the administration and construction of public facilities in the City and help minimize maintenance for each facility.

Section 4 of the PWS pertains specifically to the sanitary sewer design and construction standards applicable within the City. These standards outline the City's requirements for: engineering; design; material, technical and construction specifications; and testing procedures for sanitary sewers. A subsection has also been dedicated towards Wastewater Pump Station Design Standards.

These pump station standards are applicable to construction, installation, or modification of any public wastewater pumping facility requiring a City of Wilsonville Public Works Permit. These standards were created pursuant to the City's Development Code Section 4.262.04 for Sanitary Sewers, and they outline the general provisions, requirements and documentation necessary to install one of these facilities.

The City typically reviews all collection system related documentation for their system, however for pump stations the PWS standards indicate that Oregon DEQ remains the final reviewing authority for all pump station documentation. All plans and specifications shall be reviewed and approved by this agency under Oregon Administrative Rule 340, Division 52. To that extent, all documentation shall follow the guidelines and criteria set forth in the *Oregon Standards for Design and Construction of Wastewater Pump Stations*, Oregon Department of Environmental Quality, May 2001 (DEQ Standards).

SECTION 5 | POPULATION & FLOW PROJECTIONS

INTRODUCTION

This section of the Wastewater Collection System Master Plan (CSMP) documents existing wastewater flows and future flow projections based on designated land use. The flow projections consider existing and future customers within the project study area and highlight potential growth within the urban growth boundary (UGB) and urban reserve area (URA). All currently unsewered parcels were assumed to be sewered for build-out conditions. To develop anticipated wastewater flows, the following information was reviewed:

- Population projections
- Current and future service area boundaries
- Delineation of the major sewer basins
- City Comprehensive Plan for location based zoning
- METRO land use data
- Water production records
- Sewer flow monitoring data at multiple locations in the system
- Wastewater Treatment Plant (WWTP) flow records

This section of the CSMP focuses on definitions, flow characterization, per capita wastewater usage, unit flow factor development, and flow projection summaries. A computer model was developed to generate existing and future flows and evaluate system capacity. Specific discussion of model development, calibration based on flow monitoring data, and application of the flow methodology to evaluate the capacity of the collection system are provided in Section 6, "System Analysis."

HISTORIC AND FUTURE POPULATION DATA

The population projections for the CSMP are consistent with projections for the Wilsonville Water System Master Plan (WSMP), which was adopted September 6, 2012 by City Ordinance 707. Since the water system is the source of wastewater during dry weather conditions, basing the collection system analysis around the WSMP assumptions will align the capacity of both systems.

The WSMP analysis relied upon three sources of historical population data, including US Census Bureau data, Portland State University (PSU) certified population estimates, and estimations based upon applications for City building permits.

According to US census data, the number of people per household increased from 2.35 people per occupied household in 2000 to 2.48 people per occupied household in 2010. The 2.48 people per household assumption from 2010 was maintained for the 20-year population forecast for the CSMP.

In projecting future residential growth and associated water demand, the WSMP relied upon historical populations and population projections documented in the City's following publications:

- 2002 Water Master Plan
- 2004 Water Management and Conservation Plan
- 2006 Transit Master Plan
- 2007 Parks Master Plan
- 2008 20-Year Look
- 2009 Transportation Plan

These previous publications assumed annual residential growth rates between 2.4% and 3.2%, with four of the documents using approximately 2.9%. Based on this information, the City elected to analyze the water system assuming an annual residential growth rate of 2.9% for both population and the number of households. This value, along with the land use and densities outlined in the WSMP anticipate that build-out conditions may be reached in the year 2045 with a population for the study area of 52,400 residents. The historic population data and population projections are presented in Table 5-1 and Figure 5-1 below.

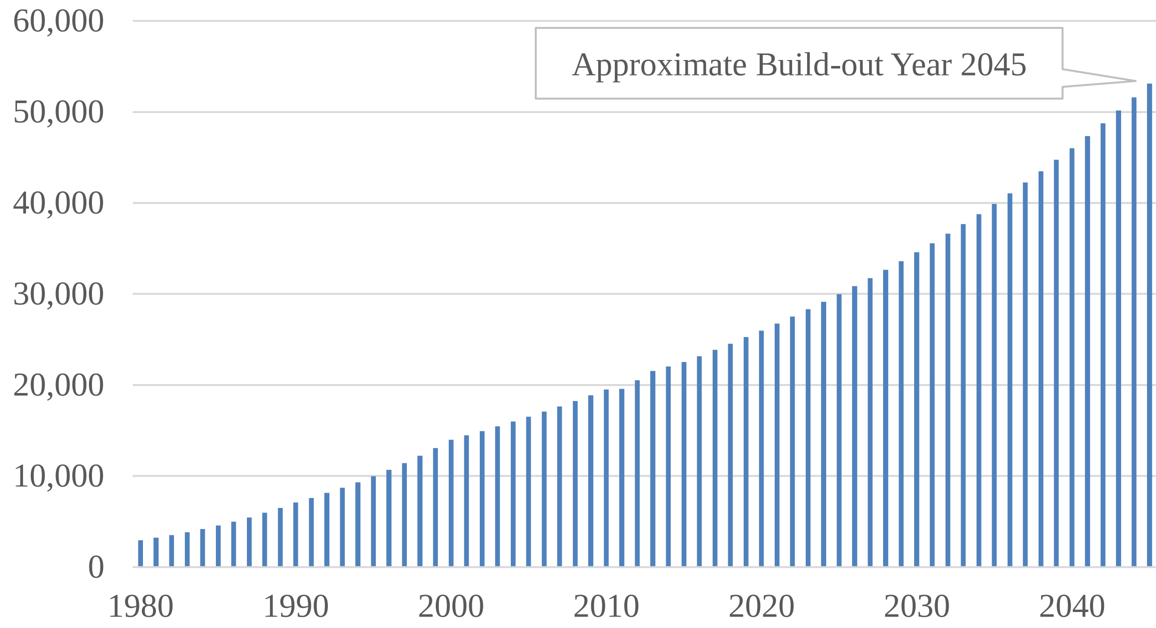
Table 5-1 | Wilsonville Population Data

Year	U.S. Census Count[1]	PSU Research Center Projections[2]	Water System Master Plan Projections[3]	Average Annual Growth Rate
Build-Out[4]	-	-	52,400	2.9%
2030	-	-	34,585	2.9%
2025	-	-	29,979	2.9%
2020	-	-	25,986	2.9%
2015	-	-	22,525	2.2%
2013	-	21,550	-	5.0%
2012	-	20,515	-	4.9%
2011	-	19,565	-	0.3%
2010	19,509	-	-	3.4%
2000	13,991	-	-	7.0%
1990	7,106	-	-	9.2%
1980	2,950			-

Notes:

1. United States Department of Commerce, Bureau of the Census.
2. Portland State University, College of Urban & Public Affairs, Population Research Center (April 15, 2014).
3. Water System Master Plan, City of Wilsonville (Sept. 2012).
4. Build-out is anticipated to occur between 2044 and 2045 based upon the buildable lands within study area and average annual growth of the population at a rate of 2.9%

Figure 5-1 | Wilsonville Historic and Projected Population



WASTEWATER FLOW DESCRIPTION

Flow Components

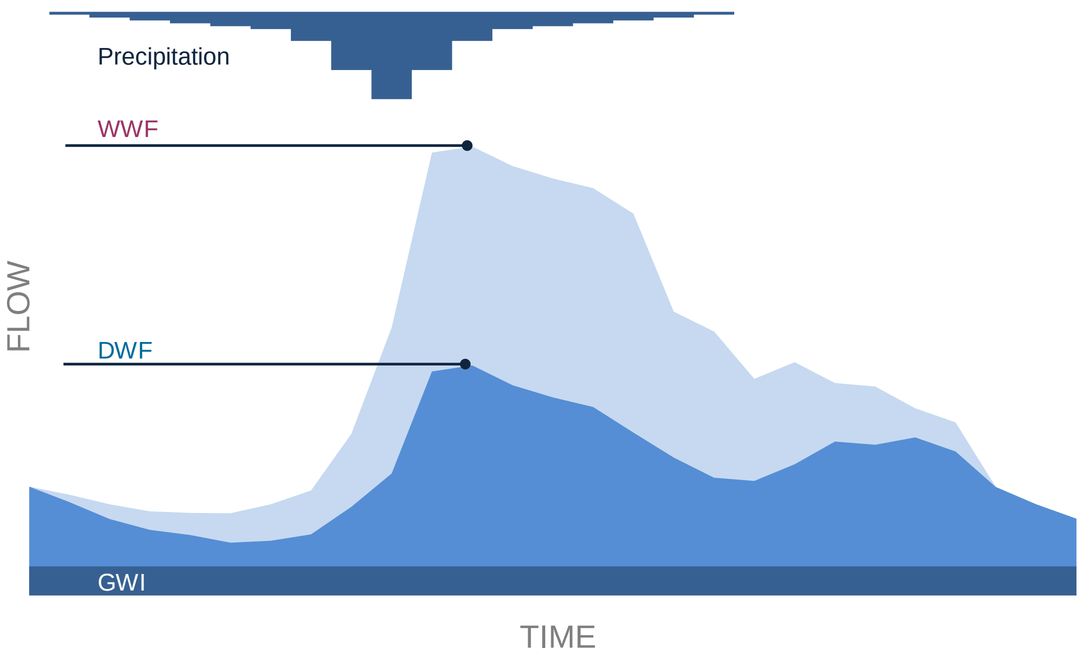
The major components of the wastewater flow are defined below. Figure 5-2 shows a generic schematic of the wastewater flow components.

1. ***Dry Weather Flow (DWF)*** is wastewater from residential, commercial, institutional (e.g., schools, churches, hospitals) and industrial sources. The dry weather wastewater flow is a function of the population and land use, and varies throughout the day in response to personal habits and business operations.

2. ***Groundwater Infiltration (GWI)*** is defined as groundwater entering the collection system unrelated to a specific rain event. GWI occurs when groundwater is at or above the sewer pipe invert, and infiltrates through defective pipes, pipe joints and manhole walls. This component of the dry weather flow is typically seasonal.

3. ***Wet Weather Flow (WWF)***, also known as *rainfall derived infiltration and inflow* (RDII), is stormwater that enters the collection system during or immediately following a rain event. Stormwater inflow reaches the collection system by direct connections such as roof downspouts connected to sanitary sewers, yard and area drains, holes in manhole covers, or cross-connections with storm drains or catch basins. Rainfall-dependent infiltration includes flow that enters defective pipes, pipe joints and manhole walls after percolating through the soil.

Figure 5-2 | Generic Schematic of Wastewater Flow Components



Flow Methodology

Existing system flows were developed from flow monitoring data. Future flow projections were based on unit flow factors derived from water consumption data and land use data. A general discussion of the flow methodology is provided below.

1. ***Existing DWF*** – The existing average DWF, often referred to as dry weather loading, was generated from localized flow monitoring data and distributed to the collection system at the parcel level based on metered winter-time water consumption. The flow monitoring data was also used to develop a "diurnal pattern" to describe flow variability throughout the day at hourly increments for each flow meter basin. The peak DWF was generated by multiplying the diurnal pattern by the average DWF. GWI is included in the existing DWF based on flow monitoring data.

2. ***Existing WWF*** – The existing peak WWF relied on localized flow monitoring data to extract peak RDII rates and unit hydrograph parameters during an actual storm event. These parameters were extrapolated to a 10-year design storm event and applied to existing sewersheds (wet weather areas of impact represented by placing buffer areas around all existing pipelines).

3. ***Future DWF*** – The future DWF projections included evaluation of historical water consumption data for use in generating per capita (residential) and per acre (commercial and industrial) unit flow factors by City land classification (zoning). The unit flow factors were then applied to net developable acres of vacant parcels to forecast future average DWF. The peak future DWF was generated by multiplying a

representative existing diurnal pattern by the average future DWF. Future GWI is assumed to be included in the DWF component of the flow.

4. ***Future WWF*** - The future WWF projections utilized representative existing peak RDII rates and unit hydrograph parameters. These parameters were extrapolated to a 10-year design storm event and applied to future sewersheds (wet weather areas of impact represented by percentage of net acreage).

EXISTING DRY WEATHER FLOW CHARACTERIZATION

The City's collection system conveys the wastewater flows of both "domestic" and "industrial" dischargers. Domestic wastewater includes residences, retail, commercial enterprises, and institutional facilities (e.g., schools). Industrial dischargers typically include larger and more significant flows generated by manufacturing, non-retail commercial facilities, and other large facilities such as the prison.

Water Consumption

Historic water consumption data recorded from the City's water meters during winter months are presented in Table 5-2. Unit wastewater loads for residential, commercial, and industrial land uses are estimated using the water meter data divided by the net developed acreage.

Table 5-2 | Water Consumption and Acres By Land Use

Land Use	Water Demand (million gallons per day, mgd)	Acres	Average Unit Load (gallons-per-acre-per-day, gpad)
Residential	1.2	1,300	900
Commercial	0.3	300	900
Industrial	0.3	700	500

Historic Flow Trends

Historical average daily DWF information recorded at the WWTP is provided in Figure 5-3. This data reflects influent readings from the beginning of July through the end of September, and illustrates that flows on average have been trending lower since 2005 in spite of a growing population base. This may likely be attributed to water conservation efforts.

Large wastewater dischargers include flows generated by local industries or atypical developments such as the Coffee Creek Correction Facility (CCCF). There are a handful of large dischargers within the City, which have been summarized in Table 5-3.

Figure 5-3 | Historic Dry Weather Flow Trends at WWTP

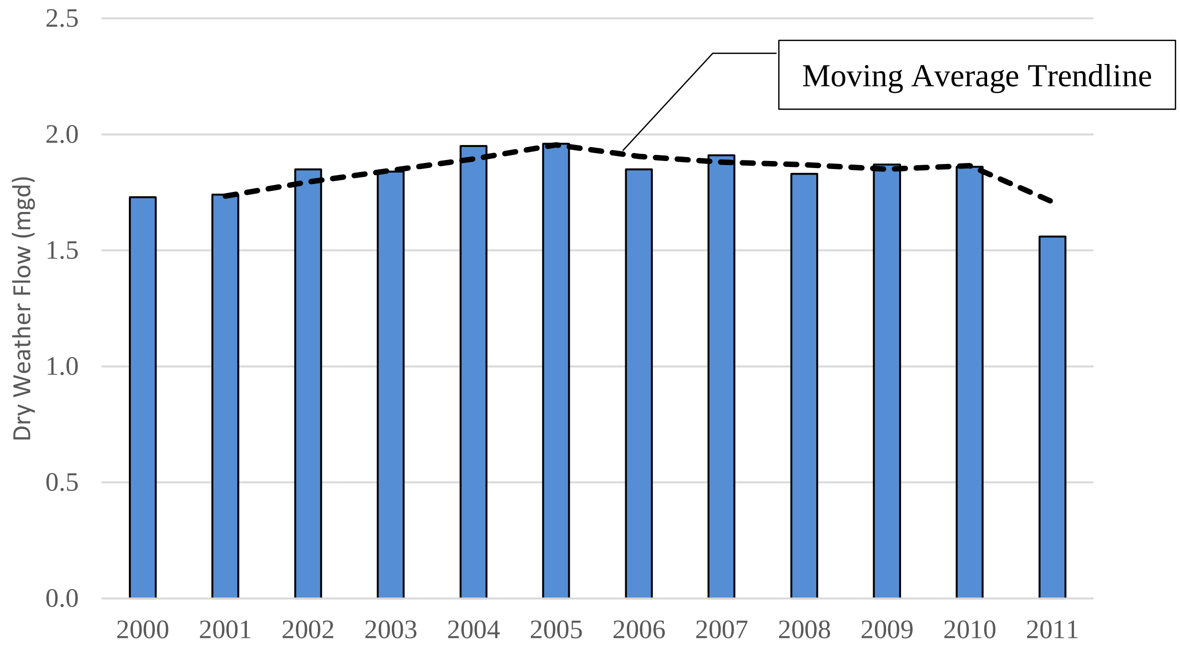


Table 5-3 | Large Dischargers					
Large Discharger	Discharge Manhole	Recorded Flows (gpm) Summer 2012	Recorded Flows (gpm) September 2012	Average Daily Discharge (mgd)	Average Annual Discharge (million gallons, mg)
CCCF	SMH2142	95.0	90.5	0.134	48.7
Coca-Cola	SMH4223	27.0	29.2	0.040	14.8
Flir	SMH1713	0.3	0.2	0.000	0.1
Fujimi	SMH2114	13.0	19.6	0.023	8.6
Leadtec	SMH2736	1.0	0.6	0.001	0.4
Xerox 1	SMH1705	3.5	3.4	0.005	1.8
Xerox 2	SMH1723	3.5	3.4	0.005	1.8
	Total	143.3	146.9	0.209	76.3

Per Capita Wastewater Usage

Based on historic dry weather flow and population data between 2005 and 2010, an average "domestic" per capita wastewater usage between 70 and 80 gallons-per-capita-per-day (gpcpd) was calculated. Strictly residential per capita wastewater usage varied between 60 and 67 gpcpd. The City's per capita wastewater usage is similar to values reported by other wastewater collection utilities in the region as shown in Table 5-4.

Table 5-4 | Per Capita Wastewater Flow in Similar Municipalities		
City	Per Capita Wastewater Flow Contribution (gpcpd)	2010 U.S. Census Population
Lake Oswego	79	36,619
Milwaukie	76	20,291
Newberg	68 - 91	22,068
Oregon City	80	31,859
Troutdale	70	15,962

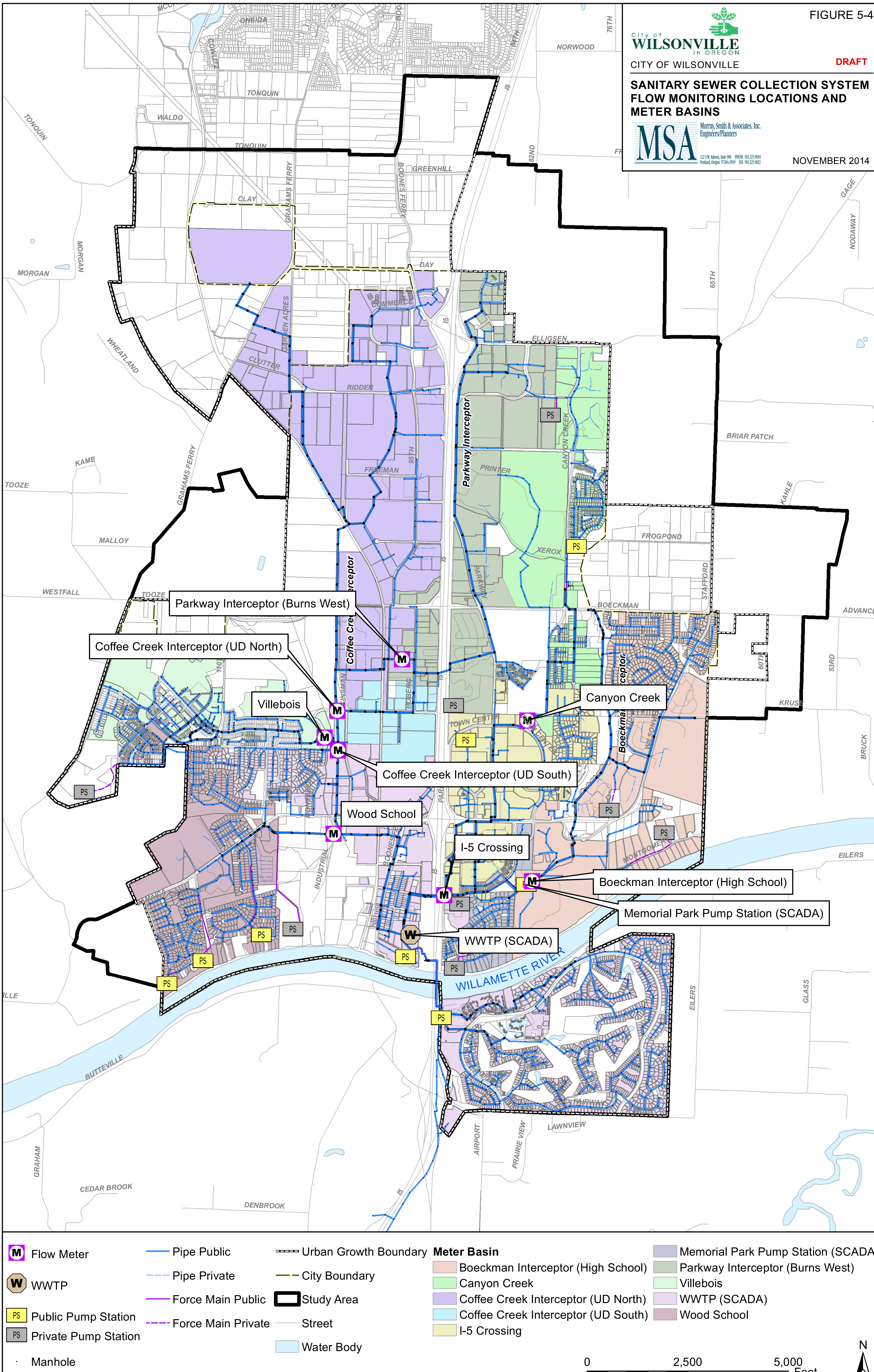
Existing Dry Weather Flow Summary

The City has performed gravity flow monitoring on the major interceptors since 2006. Data from 2011 and 2012 at eight Telog meter sites and SCADA (supervisory control and data acquisition) data at the WWTP and Memorial Park Pump Station were used to develop existing system flow rates. Timeseries and flow vs depth plots were reviewed for each monitoring location to identify time periods of reasonable data quality as documented in the technical memorandum *"Sewer Flow Monitoring Data Analysis [December 2013]."*

The flow monitoring basin boundaries (meter basin) and monitoring sites are shown in Figure 5-4. Within each meter basin, the daily average loads from the flow monitors were distributed to parcels based on metered winter-time water consumption. Dry weather flows and peaking factors for the existing system are summarized by flow monitoring location in Table 5-5 and by sewer basin in Table 5-6. The values were developed for the dry weather time period between September and November 2012 to account for contributions from new development.

Table 5-5 | Existing Dry Weather Flow Summary by Flow Monitoring Location			
Flow Monitor Location	Average DWF (mgd)	Peaking Factor	Peak DWF (mgd)
Boeckman Interceptor (High School)	0.27	1.7	0.46
Memorial Park Pump Station (SCADA)	0.26	1.7	0.44
Canyon Creek	0.05	2.3	0.12
Parkway Interceptor (Burns West)	0.07	1.8	0.12
I-5 Crossing	0.53	1.9	1.00
Coffee Creek Interceptor (UD North)	0.31	1.8	0.56
Coffee Creek Interceptor (UD South)	0.59	1.4	0.83
Villebois	0.08	1.8	0.14
Wood School	0.10	2.1	0.21
WWTP (SCADA)	1.60	1.7	2.73

Table 5-6 | Existing Dry Weather Flow Summary by Basin		
Basin	**Average DWF (mgd)**	**Peak DWF (mgd)**
Charbonneau	0.22	0.34
Boeckman	0.31	0.52
Canyon Creek/Town Center	0.22	0.44
Coffee Creek	0.48	0.80
Old Town	0.11	0.16
Villebois	0.18	0.31
Wood School	0.08	0.16
Total	1.60	2.73



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EXISTING WET WEATHER FLOW CHARACTERIZATION

The wet weather flow (WWF) component of the wastewater flow is generated by rainfall derived infiltration and inflow (RDII). Flow monitoring data and SCADA data were examined during large storm events between 2006 and 2012. Two of the largest events occurred in 2012, on January 18th-19th, and November 19th. The Aurora State Airport data estimated cumulative 24 hour depths of 2.05 and 2.22 inches for the January and November events respectively.

In order to estimate the WWF generated in the collection system in response to these two events, estimates were made of the RDII components of the peak flow measured at each flow monitoring location. This was done by first estimating and subtracting out the portion of the total peak flow attributable to DWF by using monitor data from dry time periods. The RDII component was assumed to be the difference between the total measured peak flow and the DWF estimate. Table 5-7 shows the peak flow measured at each monitor location for each event, as well as the estimated DWF and RDII flow components. Higher flow rates were measured for the January event likely caused by snow melt, soil saturation, and high groundwater.

Table 5-7 | Estimated Dry Weather Flow and RDII from Flow Monitoring Data (2012)

Flow Monitor Location	Dry Flow (mgd)		RDII (mgd)		Total Flow (mgd)	
	Jan	Nov	Jan	Nov	Jan	Nov
Boeckman Interceptor (High School)	0.37	0.28	0.60	0.58	0.97	0.87
Memorial Park Pump Station	0.33	0.27	1.98	0.66	2.31	0.93
Canyon Creek	no data	0.09	no data	0.20	no data	0.29
Parkway (Burns West)	0.09	0.10	0.79	0.54	0.89	0.64
I-5 Crossing	no data	0.52	no data	1.35	no data	1.87
Coffee Creek (UD North)	0.26	0.18	4.01	1.61	4.28	1.79
Coffee Creek (UD South)/Villebois	no data	0.56	no data	1.98	no data	2.53
Wood School	0.11	0.13	0.68	0.31	0.78	0.44
WWTP	2.24	1.85	5.52	4.20	7.76	6.05

Design Storm

Based on the November 2010, *"Internal Management Directive Sanitary Sewer Overflows (SSOs)" document from the Oregon Department of Environmental Quality (DEQ) and Oregon Administrative Rules Chapter 340-Division 041(OAR 340-041-0009)*, all SSOs are prohibited. However, DEQ may withhold enforcement action for those SSOs that occur from larger storm events; e.g. a winter storm that corresponds to a 1 in 5-year, 24-hour duration storm and a summer storm that corresponds to a 1 in 10-year, 24-hour duration. The City has elected to apply the 1 in 10-year, 24-hour duration storm to the system analysis to reduce the risk of SSOs occurring as a result of high flows. The City's Public Works Construction Standards list the 5-year and 10-year 24-hour storm depths as 3.1 and 3.45-inches respectively, as referenced in the *"NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States -Oregon "NOAA, 1973]"*.

Rainfall Derived Inflow and Infiltration (RDII)

WWF can be calculated within contributing sewer basin areas in order to estimate flow per acre values, typically referred to as RDII rates. These RDII rates can vary significantly across the system, due to factors such as sewer basin development, land use differences, soil type, and system condition (pipe and manhole). The RDII rates were estimated for each flow monitoring location during the available storm events and then extrapolated to the 10-year design storm. RDII projection can be conservative when extrapolating from a small storm to a larger design storm. To minimize flow extrapolation error and limit flow projection conservancy, the largest monitored rainfall event (January 2012) was given the highest priority when developing the RDII rates. Key considerations regarding development of the RDII rates for each metered basin are presented below.

- *Boeckman Interceptor (High School)* - The January event was used to estimate RDII.
- *Memorial Park Pump Station (SCADA)* - The RDII rate was selected between the January and November responses, such that the flow per area value was consistent with the values developed from the upstream High School flow meter.
- *Canyon Creek* - Data was unavailable for the January event. The November RDII rate was increased to provide a flow per area value consistent with other values on the east side of the City.
- *Parkway (Burns West)* - The January event was used to estimate RDII.
- *I-5 Crossing* - Data was unavailable for the January event. The November RDII rate was increased to provide a flow per area value consistent with other values on the east side of the City.
- *Coffee Creek (United Disposal North)* - Due to concerns about the quality of the data for the January event, the November event was used to estimate RDII. Then, the November RDII rate was increased to provide a flow per area value consistent with other values on the west side of the City.
- *Coffee Creek (United Disposal South)* - Data was unavailable for the January event. The November RDII rate was increased to provide a flow per area value consistent with other values on the west side of the City.
- *Villebois* - Due to a lack of available flow data, the RDII rate applied for this basin was chosen to provide the same flow per acre value as the RDII associated with the downstream Coffee Creek (United Disposal South) flow meter.
- *Wood School* - The January event was used to estimate RDII.
- *WWTP (SCADA)* - The January event was used to estimate RDII.

The 2012 RDII rates were extrapolated to the 10-year, 24-hour duration design storms. The calculated peak RDII rates vary by sub-basin between 1,500 gpad and 2,500 gpad as summarized in Table 5-8. These rates are consistent with new system design standards for many utilities in Oregon where design RDII rates typically range from 1,000 to 2,500 gpad.

Table 5-8| RDII Peak Rates and Extrapolation			
Flow Monitor Location	Estimated Peak RDII Rate Nov/Jan 2012 (gpad)	Peak RDII Rate 5-year Design Storm (gpad)	Peak RDII Rate 10-year Design Storm (gpad)
Parkway Interceptor (Burns West)	1,500	2,200	2,500
Canyon Creek	1,000	1,400	1,600
Boeckman Interceptor (High School)	1,100	1,600	1,800
I-5 Crossing	1,100	1,600	1,800
Memorial Park Pump Station	1,100	1,600	1,800
Coffee Creek Interceptor (UD North)	1,100	1,700	1,900
Coffee Creek Interceptor (UD South)	1,100	1,600	1,800
Villebois	900	1,300	1,500
Wood School	1,200	1,700	1,900
WWTP[1]	1,100	1,600	1,800

Note 1. A meter on SW Evergreen Avenue indicated an RDII rate of 3,500 gpad for the small contributing upstream service area. This area is located in the WWTP meter basin. This meter was later moved to the Villebois Interceptor.

Existing Dry + Wet Weather Flow Summary

WWF and total flow estimates for the existing system are summarized by sewer basin in Table 5-9 as developed from the flow monitoring data and extrapolation to the 10-year design storm event.

Table 5-9 | Existing Dry and Wet Weather Flow Summary by Basin					
Basin	Average DWF (mgd)	Peak DWF (mgd)	Peak WWF (mgd)	Peak DWF + WWF (mgd)[1,2]	Dry + Wet Peaking Factor[3]
Charbonneau	0.22	0.34	0.45	0.78	3.5
Boeckman	0.31	0.52	0.84	1.37	4.4
Canyon Creek/ Town Center	0.22	0.44	0.82	1.26	5.6
Coffee Creek	0.48	0.80	2.12	2.92	6.1
Old Town	0.11	0.16	0.34	0.50	4.7
Villebois	0.18	0.31	0.31	0.62	3.3
Wood School	0.08	0.16	0.41	0.57	7.5
Total	1.60	2.73	5.28	8.01	5.0

Note 1. Flow estimates developed for upstream entry points to trunk sewer. Flow at the WWTP will be approximately 10% less as a result of travel time, flow attenuation, and system storage.
Note 2. WWF assumes 10-year design storm.
Note 3. Dry + Wet Peaking Factor = (Peak DWF + Peak WWF)/Average DWF.

FLOW PROJECTIONS

Dry Weather Flow Projection

DWF projections for build-out conditions (approximately 2045) assumed full development of the current UGB and development of specific areas of the URA as shown in Figure 5-5. Three scenarios were developed for future areas assuming high, medium, and low densities for City residential land use/zoning classifications. Additionally, a range of unit loading factors were applied to future commercial and industrial areas based on equivalent dwelling units and the existing water consumption analysis. The medium growth scenario represents the average development potential. The low and high density scenarios were developed to characterize system sensitivity to lower or higher peak flows. The range of flow rates generated by the sensitivity analysis were applied to the collection system to evaluate improvement trends as further described in Section 6, "System Analysis." When applied to capital improvement planning, the sensitivity analysis provides the City with confidence in the capacity related design criteria, an understanding of the flexibility of the collection system to serve a lesser or greater future population, and critical information for improvement prioritization.

Assumptions related to the build-out dry weather flow projections are provided below.

- An average 65% net acreage factor was applied to the gross acreage of each undeveloped or unserved parcel. The net acreage factor accounts for undevelopable areas such as wetlands, right of way, etc. METRO designated "open areas" were excluded from the gross and net acreages.

- Unit loading factors by City land classification/zoning are presented in Table 5-10 and were applied to net acres of presently undeveloped or unserved parcels within the UGB and URA to develop build-out average flows.

- Residential unit loading factors were based on projected densities by land use and a per household wastewater usage of 166 gallons per day (gpd) based on 67 gallons per capita wastewater usage and City projected household size of 2.48 people per unit.

- Land use classifications for undeveloped parcels of Exclusive Farm or Forest Use (EFU, AF-10, AF-5), Future Development (FD-20), Agricultural Holdings (RAH), and Rural Residential (RRFF5) assume land use re-classification with equivalent dwelling unit (EDU) densities varying for high (15 units/acre), medium (10 units/acre), and low (6 units/acre) flow scenarios.

- Commercial and industrial flow factors were varied for high, medium, and low flow scenarios based on typical values based on the City's winter-time water consumption data. Commercial unit loading factors range from 500 to 1,000 gpad. Industrial unit loading factors range from 350 to 1,000 gpad.

- Based on review of the existing flow monitoring data, the peaking factor from the Canyon Creek flow meter was assigned to presently undeveloped or unserved parcels. The Canyon Creek meter is located in the upper sub-basins and the pattern is less affected by travel time (flow attenuation) as demonstrated by a conservative peaking factor of approximately two.

Table 5-10 | Build-out Unit Loading Assumptions

City Zoning	Description	High Density: Equivalent Dwelling Units Per Acre	High Density: Unit Load (gpad)	Medium Density: Equivalent Dwelling Units Per Acre	Medium Density: Unit Load (gpad)	Low Density: Equivalent Dwelling Units Per Acre	Low Density: Unit Load (gpad)
Commercial							
PDC, PDCTC	Planned Development Commercial, Planned Development Town Center	-	1,000	-	750	-	500
PF, PFC	Public Facility, Public Facility Corrections	-	1,000	-	750	-	500
Industrial							
PDI	Planned Development Industrial	-	1,000	-	500	-	350
RI	Rural Industrial	-	1,000	-	500	-	350
Residential and Mixed-Use							
PDR-1	Single Family ~1 acre lot	1	166	1	166	1	166
PDR-2	Single Family ~10,000 sq.ft. lot	3	498	3	498	3	498
PDR-3	Single Family ~7,000 sq.ft. lot	5	831	5	831	5	831
PDR-3	Single Family ~5,000 sq.ft. lot	7	1,163	7	1,163	7	1,163
PDR-4	Single Family ~3,500 sq.ft. lot	10	1,662	10	1,662	10	1,662
PDR-5	Multi-family Medium Density	12	2,044	12	2,044	12	2,044
PDR-6	Multi-family High Density	18	2,958	18	2,958	18	2,958
PDR-5, Village	Mixed Use	11	1,861	11	1,861	11	1,861
Variable Density (Re-Zoning)							
EFU, AF-10, AF-5, RAH, FD-20, RRFF5	Exclusive Farm or Forest Use, Future Development, Agricultural Holdings, Rural Residential	15	2,492	10	1,662	6	997

Note: Unit loads for land use classifications with equivalent dwellings units are calculated assuming 67 gpcd and 2.48 people per unit.

DWF average and peak flow estimates for future development are categorized by UGB and URA planning areas, and summarized by sewer basin in Tables 5-11 and 5-12. A more detailed summary of the high density scenario average flow estimates and applicable net acreage by zoning classification is presented in Table 5-13.

DWF produced by the high density scenario most closely align with water demands from the City's Water Master Plan. Based on the high density scenario, the average daily dry weather flow for the build-out system is approximately 6.7 mgd including ground water infiltration (GWI) and approximately 5.5 mgd excluding GWI. The estimated peak water usage at build-out for the minimum month (excludes Sherwood) from the Water Master Plan is 5.9 mgd. The corresponding dry weather average flows for the medium and low densities scenarios are 5.1 mgd (4.2 mgd without GWI) and 4.0 mgd (3.3 mgd without GWI) respectively.

Table 5-11 | Future Build-out Dry Weather Loading Estimates (Daily Average, mgd)

Basin	Future Development UGB			Future Development URA		
	High	Medium	Low	High	Medium	Low
Charbonneau	0.00	0.00	0.00	0.00	0.00	0.00
Boeckman	0.50	0.36	0.25	0.79	0.53	0.32
Canyon Creek/Town Center	0.19	0.16	0.14	0.43	0.28	0.17
Coffee Creek	1.67	1.14	0.74	0.20	0.13	0.08
Old Town	0.17	0.11	0.07	0.00	0.00	0.00
Villebois	0.50	0.39	0.30	0.33	0.22	0.13
Wood School	0.16	0.13	0.11	0.11	0.07	0.04
Total	3.20	2.30	1.62	1.86	1.24	0.74

Table 5-12 | Future Build-out Dry Weather Peak Flow Estimates (mgd)

Basin	Future Development UGB			Future Development URA		
	High	Medium	Low	High	Medium	Low
Charbonneau	0.00	0.00	0.00	0.00	0.00	0.00
Boeckman	1.15	0.83	0.57	1.82	1.21	0.73
Canyon Creek/Town Center	0.43	0.36	0.31	0.98	0.65	0.39
Coffee Creek	3.78	2.59	1.67	0.46	0.31	0.19
Old Town	0.35	0.23	0.15	0.00	0.00	0.00
Villebois	1.11	0.88	0.69	0.76	0.51	0.30
Wood School	0.38	0.30	0.25	0.25	0.17	0.10
Total	7.20	5.19	3.64	4.27	2.85	1.71

Table 5-13 | Future Development Net Acreage and Dry Weather Loading by Land Use																		
City Zoning	Land Use Description	High Density Unit Loading (gpad)	Net Acreage by Basin								Average Dry Weather Flow by Basin (gpm)							
			Charbonneau	Boeckman	Canyon Creek/ Town Center	Coffee Creek	Old Town	Villebois	Wood School	Total	Charbonneau	Boeckman	Canyon Creek/ Town Center	Coffee Creek	Old Town	Villebois	Wood School	Total
Commercial																		
PDC, PDCTC	Planned Development Commercial, Planned Development Town Center	1,000	0	0	3	46	8	0	1	58	0	0	2	32	6	0	1	41
PF, PFC	Public Facility, Public Facility Corrections	1,000	0	1	0	25	0	49	0	76	0	1	0	18	0	36	0	55
Industrial																		
PDI	Planned Development Industrial	1,000	0	0	15	88	22	0	17	143	0	0	11	67	17	0	12	107
RI	Rural Industrial	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential and Mixed-Use																		
PDR-1	Single Family ~1 acre lot	166	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PDR-2	Single Family ~10,000 sq.ft. lot	498	0	6	1	0	0	6	1	14	0	2	0	0	0	2	0	5
PDR-3	Single Family ~7,000 sq.ft. lot	831	1	5	4	0	0	0	7	16	1	3	2	0	0	0	4	10
PDR-3	Single Family ~5,000 sq.ft. lot	1,163	0	23	13	25	2	0	3	66	0	19	10	20	2	0	3	54
PDR-4	Single Family ~3,500 sq.ft. lot	1,662	0	3	0	1	4	2	32	42	0	4	0	1	4	2	37	49
PDR-5	Multi-family Medium Density	2,044	0	20	22	39	0	1	5	87	0	29	31	56	0	2	8	125
PDR-6	Multi-family High Density	2,958	0	0	5	0	0	0	0	5	0	0	10	0	0	0	0	10
PDR-5, Village	Mixed Use	1,861	0	0	12	0	0	84	0	96	0	0	20	0	0	110	0	130
Variable Density (Re-Zoning)																		
EFU, AF-10, AF-5 RAH, FD-20 RRFF5	Exclusive Farm or Forest Use, Agricultural Holdings, Future Development, Rural Residential	2,492	0	485	197	632	48	240	71	1,674	0	840	342	1,109	87	423	124	2,924
Total			1	544	272	857	83	383	137	2,278	1	898	428	1,302	116	575	189	3,509

Wet Weather Flow Projection

WWF projections for build-out conditions also assumed full development of the UGB and development of specific areas of the URA as shown in Figure 5-2. Based on the existing system RDII analysis and the extrapolation to the 10-year design storm, the peak RDII rate averaged across the entire system is 1,800 gpad. The 1,800 gpad RDII rate was applied to future development net acres to project future WWF.

WWF peak flow estimates for future development are categorized by UGB and URA planning areas, and summarized by sewer basin in Tables 5-14.

Table 5-14 | Future Build-out Wet Weather Peak Flow Estimates (mgd)

Basin	Future Development UGB	Future Development URA
Charbonneau	0.00	0.00
Boeckman	0.40	0.57
Canyon Creek/Town Center	0.16	0.31
Coffee Creek	1.39	0.15
Old Town	0.10	0.00
Villebois	0.42	0.24
Wood School	0.16	0.08
Total[1]	2.64	1.34

Note 1. Flow estimates developed for upstream entry points to trunk sewer. Flow at the WWTP will be approximately 10% less as a result of travel time, flow attenuation, and system storage.

Future Dry + Wet Weather Flow Projection Summary

The total peak wastewater flow is calculated as the superposition of the maximum dry weather contribution with the RDII flow derived from the 10-year design storm event. The summary of total peak wastewater flow is summarized by basin in Table 5-15.

Table 5-15 | Future Total Peak Flow Estimates (mgd)								
Basin	Existing DWF	Existing WWF	Future UGB DWF[2]	Future UGB WWF	Future URA DWF[2]	Future URA WWF	Total UGB[2]	Total UGB+URA[2]
Charbonneau	0.34	0.45	0.00	0.00	0.00	0.00	0.78	0.78
Boeckman	0.52	0.84	1.15	0.40	1.82	0.57	2.92	5.31
Canyon Creek/Town Center	0.44	0.82	0.43	0.16	0.98	0.31	1.85	3.14
Coffee Creek	0.80	2.12	3.78	1.39	0.46	0.15	8.09	8.70
Old Town	0.16	0.34	0.35	0.10	0.00	0.00	0.94	0.94
Villebois	0.31	0.31	1.11	0.42	0.76	0.24	2.15	3.15
Wood School	0.16	0.41	0.38	0.16	0.25	0.08	1.11	1.43
Total[1]	2.73	5.28	7.20	2.64	4.27	1.34	17.85	23.46

Note 1. Flow estimates developed for upstream entry points to trunk sewer. Flow at the WWTP will be approximately 10% less as a result of travel time, flow attenuation, and system storage.
Note 2. Flow estimate based on high density scenario applied to future development.

FIGURE 5-5

City of WILSONVILLE in OREGON

CITY OF WILSONVILLE

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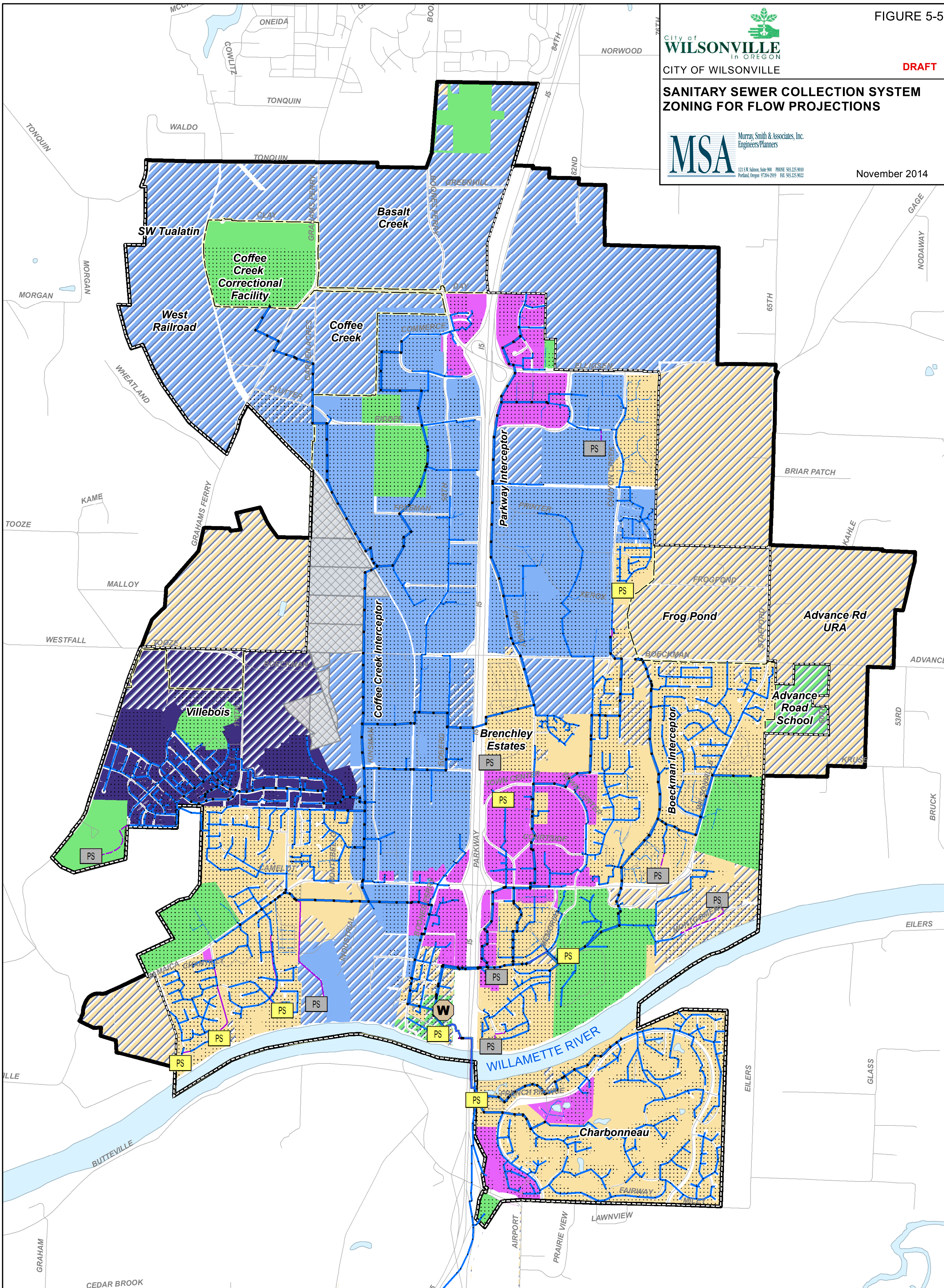
SANITARY SEWER COLLECTION SYSTEM ZONING FOR FLOW PROJECTIONS

MSA Murray, Smith & Associates, Inc. Engineers/Planners

November 2014



W WWTP

PS Public Pump Station

PS Private Pump Station

Manhole

Pipe Public

Pipe Private

Force Main Public

Force Main Private

Street

Water Body

Urban Growth Boundary

City Boundary

Study Area

Metro Open Space

Developed UGB

Re-Zone Potential, Variable Loading*

Zoning

- Residential
- Industrial
- Commercial
- Public
- Village

*Area of re-zoning potential. Projected zoning classification shown. Lands have existing zoning classification of future development, agricultural holding, exclusive farm use, and rural residential. Varied loading factors applied for sensitivity analysis.

0 2,500 5,000 Feet

N

SECTION 6 | SYSTEM ANALYSIS

INTRODUCTION

This section of the Wastewater Collection System Master Plan (CSMP) outlines the system capacity analysis and hydraulic model assumptions. To evaluate system capacity, design criteria were established for maximum allowable flow depth during dry and wet weather conditions, maximum velocity, and pump station capacity. A hydraulic model was developed and calibrated to evaluate the response of the system against the design criteria for existing and future flows. The hydraulic model was further used as a tool to evaluate and recommend system improvements. This section documents the model development, design criteria assumptions, application of future loads, existing and future system capacity analyses, and capital improvement analysis.

Additionally, this section of the CSMP provides a summary of the infrastructure condition for gravity pipelines, diversion structures, flow splitter structures, pump stations, and force mains. The condition assessment is based on interviews with City staff and provides condition-based improvement recommendations.

All improvements are evaluated at the master planning level of accuracy which allows for determination of budget level cost estimates for the purpose of determining system development charges (SDCs) and rates (user fees) to support the Capital Improvement Program (CIP) as presented in Section 7, "Capital Improvement Program." Prior to implementation, each improvement project will require standard design phases to identify construction details and refine infrastructure sizing.

MODEL DEVELOPMENT

To evaluate the existing and future capacity of the system, a collection system hydraulic model was developed in INFOSWMM (a proprietary software program by Innovyze) which utilizes the industry-standard SWMM 5 hydraulic engine developed by the Environmental Protection Agency (EPA). The City's GIS data was used to create the model network. All pipelines 10-inches and larger were incorporated into the model network. Information required to perform the hydraulic calculations in a network model include pipeline diameter, pipeline length, pipeline slope (based on pipeline inverts), manhole invert elevations, and manhole rim elevations. The Charbonneau and Memorial Park pump stations were also incorporated into the hydraulic model based on data provided by the City, including the number of pumps, wet well dimensions, pump curves, and control set points.

MODEL CALIBRATION

Model calibration generally consists of inputting and adjusting model parameters such that model and field data match within a reasonable tolerance. At the conclusion of each calibration iteration, field data are compared with the modeled data to determine the model's level of accuracy. Once the desired level of accuracy has been achieved, the calibration is complete.

In collection system modeling, the calibration level of accuracy is both qualitative and quantitative. Flow rates measured at each flow monitoring site are visually compared to model flow rates for an extended period of time. A dry weather period including both weekdays and weekend days and a wet weather period are selected for model calibration. The dry weather flows are calibrated first with adjustments to the model loading and diurnal patterns until field and model flows match. The wet weather flows are calibrated second with adjustments to wet weather hydrographs, rainfall derived infiltration and inflow (RDII) parameters, and sewershed areas (wet weather impact areas) until field and model flows match during a significant rain event. Actual precipitation gage data is used in the model during the wet weather calibration. “Good,” “moderate,” and “poor” calibration result categories occur when field and model peak flows match within 10-percent, 20-percent, and greater than 20-percent respectively.

The City has performed gravity flow monitoring in place since 2006. The current flow monitoring basin boundaries (metersheds) and meter sites are shown in Figure 6-1. The largest rain event of the flow monitoring period occurred between January 16 and January 22, 2012. The dry weather period selected for calibration occurred in September to November 2012. The modeling parameters that impact the dry weather and wet weather calibration are described below:

Existing System Dry Weather Loading

The existing system dry weather flow component of the model consists of a daily average load and a normalized diurnal pattern which informs the model how to adjust the average flow throughout the day. Daily average flows and diurnal patterns for each meter basin were calculated for weekdays (Monday-Friday) and weekend days (Saturday-Sunday) separately.

Within each meter basin, the calculated daily average loads from the flow monitors were distributed to model nodes based on winter-time water usage as defined by the City’s billing records and developed for the City’s Water Master Plan (2011). Each metered address was spatially located using the available parcel database. The flow loading was assigned to model nodes (manholes) using delineated service area boundaries (see Figure 6-1).

Existing System Wet Weather Loading

The wet weather flow component of the model consists of a storm event, sewershed acreage (wet weather area of impact), and RDII unit hydrograph. The sewersheds are defined by placing a 50-foot buffer around all system pipes. During the model calibration, actual precipitation data is modeled. Precipitation from the rain event falls on the sewershed acreage creating a volume of water. The sewershed areas are assigned to model nodes using delineated service area boundaries (see Figure 6-1).

The RDII unit hydrograph defines the amount of runoff (percentage of the volume created from the sewershed and rain depth) which enters the system and the travel time. The RDII unit hydrograph is a composite of three component hydrographs representing initial, intermediate, and long-term system response. Each of the three hydrographs is defined by three parameters which are adjusted during model calibration until field and model flows match within the desired level of accuracy (~10%). The RDII unit hydrograph parameters are described below and shown in Figure 6-2.

Unit Hydrograph Parameter 1 - R1, **R2**, **R3 -** Response ratios for the short-term, intermediate-term, and long-term UH responses, respectively.

Unit Hydrograph Parameter 2 - T1, **T2**, **T3** - Time to peak for the short-term, intermediate-term, and long-term UH responses, respectively.

Unit Hydrograph Parameter 3 - K1, **K2**, **K3 -** Recession limb ratios for short-term, intermediate-term, and long-term UH responses, respectively.

Figure 6-2 | EPASWMM Unit Hydrograph

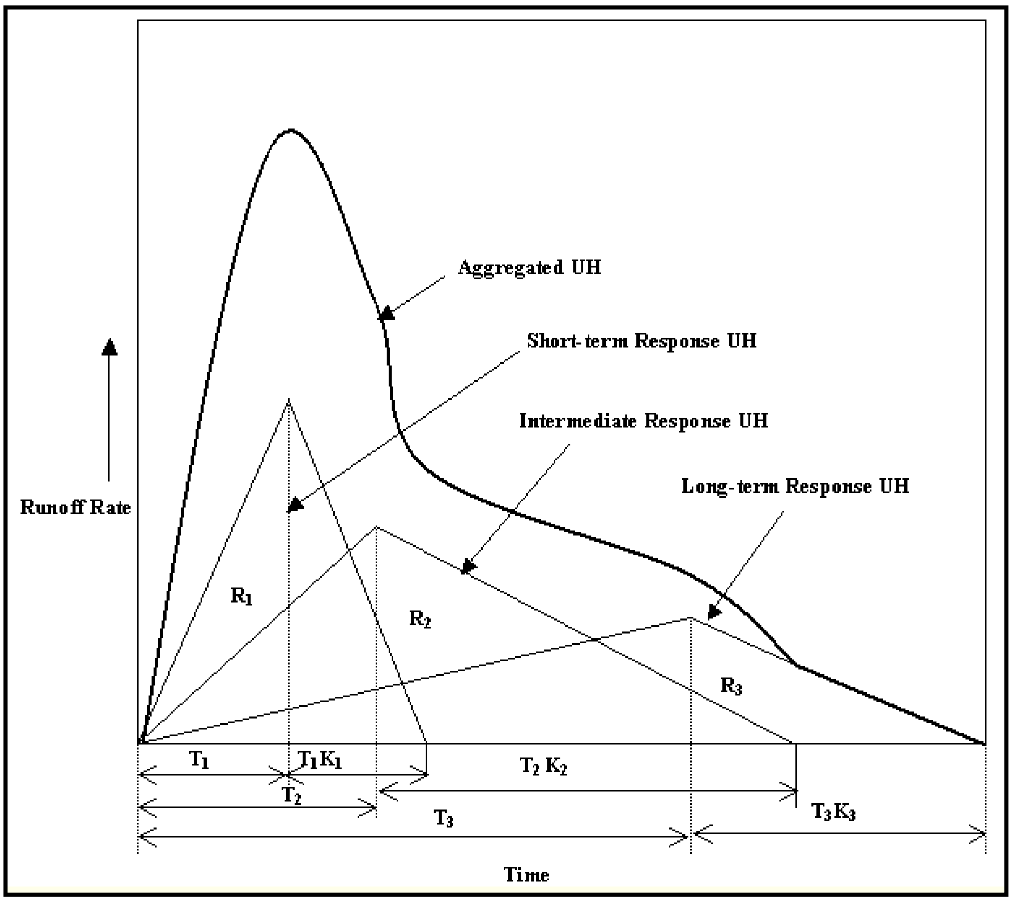


FIGURE 6-1

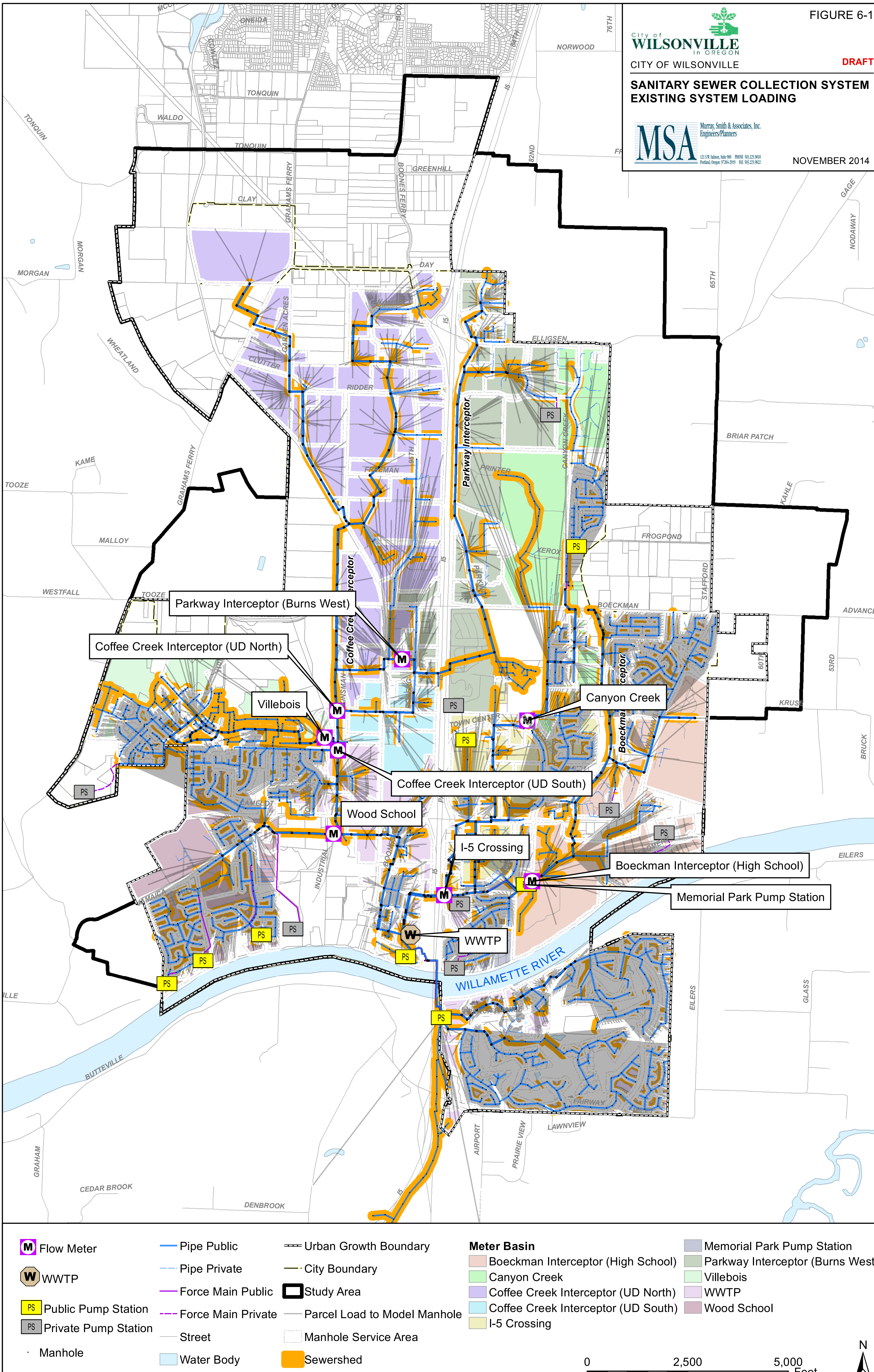
CITY OF WILSONVILLE

DRAFT

SANITARY SEWER COLLECTION SYSTEM EXISTING SYSTEM LOADING

Murray, Smith & Associates, Inc. Engineers/Planners

NOVEMBER 2014



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Dry Weather Calibration Results

The dry weather calibration results, including the diurnal pattern peaking factors and the quality of calibration at each meter, are presented in Table 6-1. Accurate dry weather metering data was available at ten meter locations. Plots comparing field and model flows are presented in Appendix A for each flow meter location. The model was calibrated in each meter basin by adjusting diurnal patterns and average loading with the overall goal of matching flow data at the wastewater treatment plant (WWTP). Visual comparisons of the field and model dry weather flows show a reasonable model calibration with most meters providing "good" calibration results. Several meters including the Memorial Park and I-5 Crossing meters are impacted by pump station operation. The model tends to dampen flow spikes caused by the pump station turning on and off. Additionally, the dry weather model predicts less conservative flow than the meter on the Boeckman Interceptor. Efforts to address model conservancy were focused on the wet weather calibration since the peak flow rates caused by RDII are the primary source for system deficiencies.

Table 6-1 | Dry Weather Calibration Results

Flow Meter	Diurnal Pattern Peaking Factor	Calibration Quality	Comment
Parkway Interceptor (Burns West)	1.8	Good	
Canyon Creek	2.3	Good	
Boeckman Interceptor (High School)	1.7	Moderate	Additional conservancy added to wet weather model.
I-5 Crossing	1.9	Moderate	Impacted by Memorial Park Pump Station operation.
Memorial Park Pump Station	1.7	Moderate	Impacted by Memorial Park Pump Station operation.
Coffee Creek Interceptor (UD North)	1.8	Good	
Coffee Creek Interceptor (UD South)	1.4	Good	
Villebois	1.8	Good	
Wood School	2.1	Good	
WWTP	1.5	Good	

Calibration Storm Selection

The RDII unit hydrograph parameters are storm dependent. Typically, calibration priority is given to the storm that most closely resembles the theoretical design storm to minimize extrapolation of wet weather impacts and reduce the level of conservancy in the analysis. The 2012 storm event was given priority for the calibration because it was more severe than other metered storm events. The calibration storm event experienced two peaks over two days with the second peak caused by a combination of rainfall and melting snow.

The rainfall data during the calibration period was collected from the precipitation gauge at the Aurora State Airport located approximately 5 miles from Wilsonville. Wet weather analysis is more accurate where localized precipitation data is available (2 mile proximity). Localized precipitation monitoring is recommended for future flow monitoring. The January 2012 event used for the model calibration impacted the entire Willamette Valley over multiple days and represents the best available data for estimating system wet weather impacts.

Wet Weather Calibration Results

The wet weather calibration results including the existing RDII rate during the January 2012 storm and quality of calibration at each meter are presented in Table 6-2. Accurate metering data for the January 2012 storm was available at seven meter locations. Plots comparing field and model flows are presented in Appendix A for each flow meter location. Visual comparisons of the field and model wet weather flows show a reasonable model calibration with most meters providing “good” calibration results during the 2012 storm event. In the Wood School meter basin, some measured flow spikes were assumed to be metering errors and were ignored during the calibration. The calibration effort focused on matching peak flow response rather than matching total storm volume.

Table 6-2 | Wet Weather Calibration Results

Flow Meter	Peak RDII Rate Jan 2012 (gallons-per-acre-per-day, gpad)	Calibration Quality	Comment
Parkway Interceptor (Burns West)	1,500	Good	
Evergreen[1]	3,500	Good	
Boeckman Interceptor (High School)	1,100	Good	
Memorial Park Pump Station	1,100	Good	
Coffee Creek Interceptor (UD North)	1,100	Good	
Wood School	1,200	Moderate	Some flow meter flow spikes ignored.
WWTP	1,100	Good	

Note 1. A meter on SW Evergreen Avenue indicated an RDII rate of 3,500 gpad for the small contributing upstream service area. This area is located in the WWTP meter basin. This meter was later moved to the Villebois Interceptor.

DESIGN CRITERIA

System Criteria for Deficiencies and Improvements

The City criteria for determining collection system deficiencies and planning improvements are shown in Table 6-3. These standards are consistent with the *"Recommended Standards for Wastewater Facilities [The Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 2004]."* For pipelines, the criteria focus on a maximum water depth of 80% during dry weather conditions and elimination of surcharging above the pipe crown during the design storm event. For pump stations, the criteria focus on pumping peak wet weather flows with the largest pump out of service. Maximum velocity and minimum scouring velocity are considered secondary criteria and are indicative of undersized or over-sized piping respectively. In the case of the minimum scouring velocity violations, the pipelines are flagged for additional maintenance and flushing to prevent solids deposition. Solids deposition can be an issue when pipelines are constructed at less than minimum design slopes or prior to build-out of the upstream service area.

Table 6-3 | Design Criteria

Standard	Category	Criteria	Explanation
Primary	Maximum water depth to diameter ratio during dry weather conditions	0.8	When the depth to diameter ratio exceeds 0.9, the pipe begins to lose gravity capacity due to greater frictional loss associated with a larger wetted pipe perimeter.
	Minimum freeboard during design storm, (clearance from water surface to manhole rim)	Maximum water depth does not exceed crown of pipe	The City standard is conservative in that it does not allow surcharging during the design storm event.
	Pump Station firm capacity[1]	Lift stations have capacity to pump at flows greater than or equal to peak hour flows with largest pump out of service	The firm capacity criteria protects against loss of service during equipment failure and allows for pump cycling for longer equipment life.
	Maximum force main velocity[1]	8 ft/sec	The velocity criteria protects against excessive head loss and allows pumps to operate efficiently.
Secondary	Maximum gravity pipeline velocity	< 15 ft/sec or anchored appropriately for extreme slopes	The maximum velocity criteria protects pipelines from turbulent flow conditions and excessive air entrainment.
	Minimum cleansing/scouring velocity, gravity pipeline[1]	2 ft/sec	Pipe diameters and minimum slopes should be selected to prevent solids deposition.
	Minimum cleansing/scouring velocity of force mains[1]	3.5 ft/sec	Pipe diameters should be selected to prevent solids deposition.
	Minimum design slopes (feet per 100 feet)	8-inch (0.4); 10-inch (0.28); 12-inch (0.22); 15-inch (0.15); 18-inch (0.12); 21-inch (0.10); 24-inch (0.08); 27-inch (0.07); 30-inch (0.06); 36-inch (0.06)	Based on 2014 Public Works Standards. Minimum slope allows for 2 ft/sec scour velocity when flowing full.

Note 1. Oregon DEQ standard.

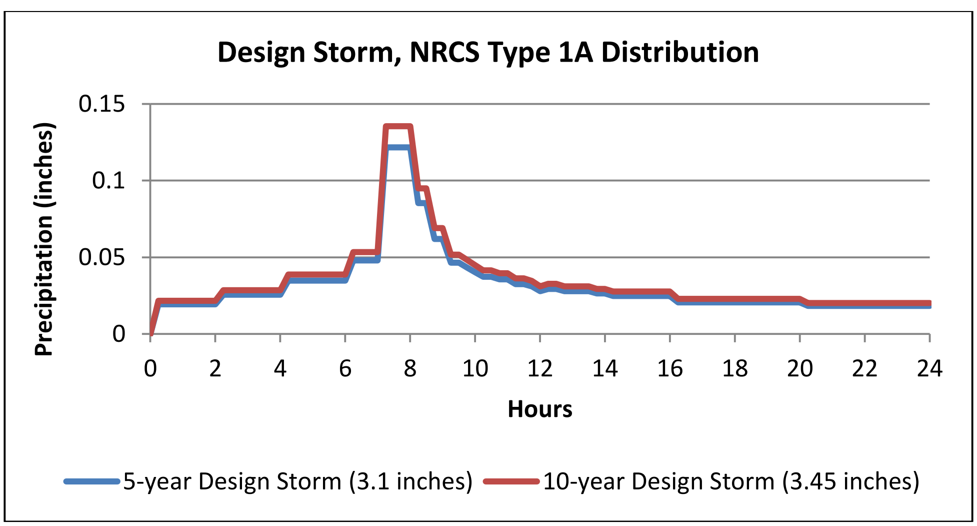
Design Storm

Collection system deficiencies are typically the result of RDII associated with large storm events. The wet weather flow component of the model consists of a storm event, sewershed acreage (wet weather area of impact), and RDII unit hydrograph. The unit hydrograph defines the amount of runoff (percentage of rainfall volume) which enters the system and the travel time. During the model calibration the sewershed acreages and RDII unit hydrographs are established to reflect system response to rainfall based on available flow monitoring data and actual precipitation. During the deficiencies and improvements analysis, a design storm is substituted for the precipitation data allowing for an extrapolation of system response to the critical storm event.

Based on the November 2010, *"Internal Management Directive Sanitary Sewer Overflows (SSOs)" document from the Oregon Department of Environmental Quality (DEQ) and Oregon Administrative Rules Chapter 340-Division 041(OAR 340-041-0009)*, SSOs are prohibited. However, DEQ may withhold enforcement action for those SSOs that occur from larger storm events; e.g. a winter storm that corresponds to a 1 in 5-year, 24-hour duration storm and a summer storm that corresponds to a 1 in 10-year, 24-hour duration. The City has elected to apply the 1 in 10-year, 24-hour duration storm to reduce the risk of SSOs occurring as a result of high flows. The City's Public Works Construction Standards list the 5-year and 10-year 24-hour storm depths as 3.1 and 3.45-inches respectively, as referenced in the *"NOAA Atlas 2, Precipitation-Frequency Atlas of the Western United States -Oregon "NOAA, 1973]"*.

The Natural Resources Conservation Service (NRCS) recommends in the "*Urban Hydrology for Small Watersheds [United States Department of Agriculture, Technical Release 55, 1986]"* publication that a Type 1A hypothetical storm distribution be used to characterize a design storm for the Wilsonville geographical region. The 5-year and 10-year design storms utilizing the NRCS Type 1A hypothetical storm distribution are presented in Figure 6-3.

Figure 6-3 | 5- and 10-year, 24 hour Design Storms, NRCS Type 1A Distribution



Rainfall Derived Inflow and Infiltration

The modeled wet weather flow rates can be associated with contributing sewer basin areas in order to estimate flow per area values. These design RDII rates can vary significantly across the system, due to factors such as sewer basin development, land use differences, soil type, and pipe condition.

Typical RDII criteria for collection systems in Oregon are on the order of 1,000 to 2,500 gallons-per-acre-per-day (gpad). When applying the 10-year design storm to the City's calibrated existing system model, the calculated peak RDII rates vary by sub-basin between less than 1,500 gpad and 2,500 gpad as summarized in Table 6-4. Based on the peak RDII rate averaged across the entire system and measured at the WWTP, the minimum recommended RDII rate for future development is 1,800 gpad. The system averaged value is a reasonably conservative value as future development will include pipeline and manhole construction techniques with the objective of preventing RDII. A more conservative value could result in over-sized pipelines and excessive solids deposition. To achieve this RDII rate within the model, a system-wide composite unit hydrograph (from January 2012 calibration) is applied to future development areas and combined with the 10-year design storm (Public Works Design Standard Storm of 3.45 inches).

Table 6-4 | RDII Peak Rates and Extrapolation

Flow Meter	Peak RDII Rate Jan 2012 (gpad)	Peak RDII Rate 5-year Design Storm (gpad)	Peak RDII Rate 10-year Design Storm (gpad)
Parkway Interceptor (Burns West)	1,500	2,200	2,500
Canyon Creek	1,000	1,400	1,600
Boeckman Interceptor (High School)	1,100	1,600	1,800
I-5 Crossing	1,100	1,600	1,800
Memorial Park Pump Station	1,100	1,600	1,800
Coffee Creek Interceptor (UD North)	1,100	1,700	1,900
Coffee Creek Interceptor (UD South)	1,100	1,600	1,800
Villebois	900	1,300	1,500
Wood School	1,200	1,700	1,900
WWTP[1]	1,100	1,600	1,800

Note 1. A meter on SW Evergreen Avenue indicated an RDII rate of 3,500 gpad during the January 2012 event for the small contributing upstream service area. This area is located in the WWTP meter basin and should be considered for pipeline repair and replacement. This meter was later moved to the Villebois Interceptor.

EXISTING SYSTEM EVALUATION

The City's collection system model was used to identify system hydraulic response to existing dry and wet weather flows based on the design criteria presented in Table 6-3 and the 10-year design storm. Results of the analysis indicate zero hydraulic deficiencies for all existing pipelines and pump stations based on maximum dry and wet flow rates. These results are presented in Figure 6-4 which depict the maximum flow depth to diameter ratio in each pipeline for the peak wet flow scenario. Similar results for the peak dry weather flow scenario are presented in Appendix B, Figure B-1. Additionally, estimated peak flows into each pump station during the design storm were compared to pump station existing firm capacity. The results of the pump station capacity analysis are presented in Table 6-5.

The City's system has been sized to accommodate future growth and as a result, the daily velocities may not exceed 2 feet per second (fps) in the near-term for some locations. Pipeline locations where the 2 fps scouring velocities do not occur during existing dry flow conditions are highlighted in Figure 6-5. To achieve appropriate scouring and prevent solids deposition, these pipelines may require additional maintenance and flushing.

Table 6-5 | Existing Pump Station Capacity

Pump Station	Firm Capacity (gpm)	Peak Flow to Pump Station (gpm)
Canyon Creek	600	360
Charbonneau	750	300
Corral Creek	160	10
Memorial Park	900	900
Morey's Landing	260	140
Parkway/ Town Center	220	60
River Village	250	50
Rivergreen	285	130

FIGURE 6-4

City of WILSONVILLE in OREGON

CITY OF WILSONVILLE

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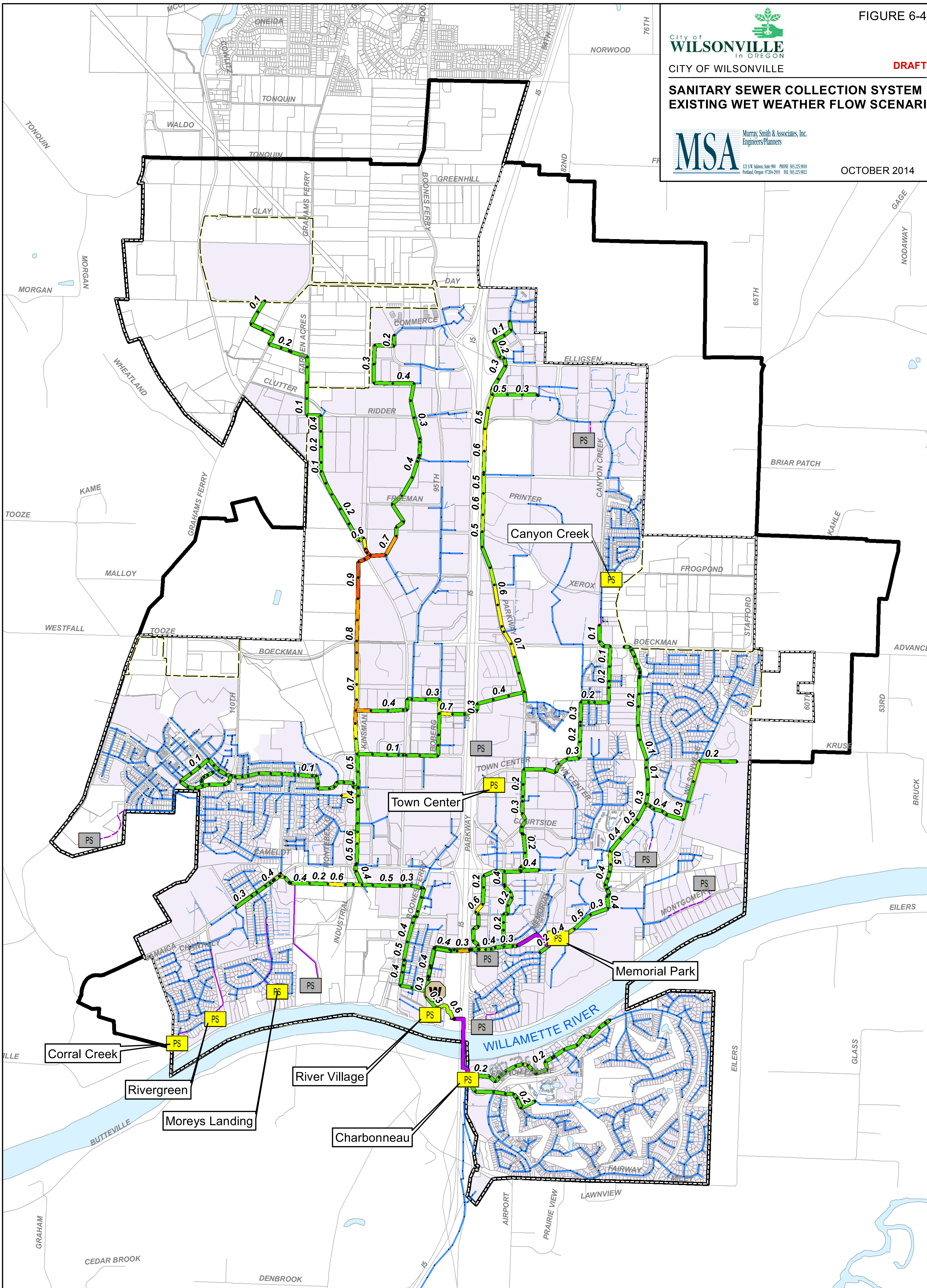
SANITARY SEWER COLLECTION SYSTEM EXISTING WET WEATHER FLOW SCENARIO

MSA Murray, Smith & Associates, Inc. Engineers/Planners

OCTOBER 2014



- W WWTP
- PS Public Pump Station
- PS Private Pump Station
- · Manhole
- Pipe Public
- Pipe Private
- Force Main Public
- Force Main Private
- Street
- Water Body
- Urban Growth Boundary
- City Boundary
- Study Area
- Developed UGB

Wet Weather Results Modeled Trunk line
depth/diameter ratio

- Less than 0.5
- 0.5 - 0.6
- 0.6 - 0.7
- 0.7 - 0.8
- 0.8 - 0.9
- 0.9 - 1.0

0 2,500 5,000 Feet

N

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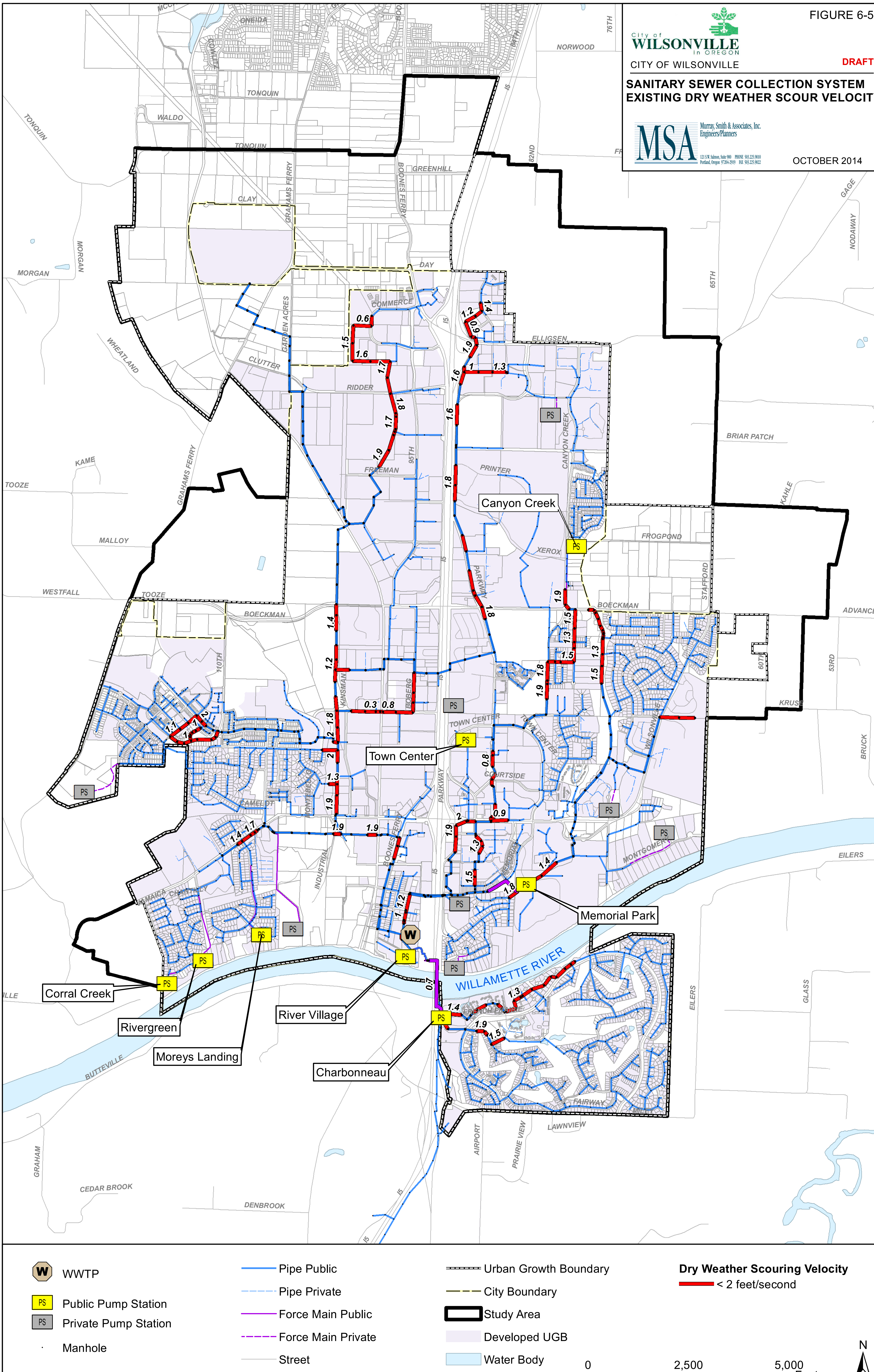
FIGURE 6-5
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
DRAFT
SANITARY SEWER COLLECTION SYSTEM
EXISTING DRY WEATHER SCOUR VELOCITY
MSA Murray, Smith & Associates, Inc. Engineers/Planners
OCTOBER 2014
Canyon Creek
Town Center
Memorial Park
WILLAMETTE RIVER
Corral Creek
Rivergreen
Moreys Landing
River Village
Charbonneau
WWTP
Public Pump Station
Private Pump Station
Manhole
Pipe Public
Pipe Private
Force Main Public
Force Main Private
Street
Urban Growth Boundary
City Boundary
Study Area
Developed UGB
Water Body
Dry Weather Scouring Velocity
< 2 feet/second
0
2,500
5,000
Feet
N
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BUILD-OUT FLOW GENERATION

Flow generation for build-out conditions assumes full development of the net acreage within the UGB and development of specific areas of the URA. Three scenarios were developed and modeled assuming high, medium, and low densities for land use classifications in urban areas. The medium density scenario represents the average development potential. The low and high density scenarios were developed to characterize system sensitivity to lower or higher peak flows. The sensitivity analysis is intended to identify trends in system deficiencies and to assist with improvement prioritization. Assumptions related to the build-out dry weather flow generation for all scenarios are detailed in Section 5, "Population and Flow Projections." Assumptions related to dry weather and wet weather flow loading to the hydraulic model are provided below.

Dry Weather Build-out Loading

- Existing average dry weather loading was applied to parcels identified as presently served. The presently served parcels were developed from water consumption data for the City's Water Master Plan.
- An average 65% net acreage factor was applied to the gross acreage of each undeveloped or unserved parcel. The net acreage factor accounts for undevelopable areas such as wetlands, right of way, etc. METRO designated "open areas" were excluded from the gross and net acreages.
- Unit loading factors by City land classification/zoning, as described in Section 5, "Population and Flow Projections," were applied to net acres of presently undeveloped or unserved parcels within the UGB and URA to develop build-out average loads.
- Residential unit loading factors were based on projected densities and a per household wastewater usage of 166 gallons per day (GPD) based on 67 gallons per capita wastewater usage and City projected household size of 2.48 people per unit.
- Land use classifications for undeveloped parcels of Exclusive Farm or Forest Use (EFU, AF-10, AF-5), Future Development (FD-20), Agricultural Holdings (RAH), and Rural Residential (RRFF5) assume land use re-classification with equivalent dwelling unit (EDU) densities varying for high (15 units/acre), medium (10 units/acre), and low (6 units/acre) flow scenarios.
- Commercial and industrial flow factors were varied for high, medium, and low flow scenarios based on typical values based on the City's winter-time water consumption data. Commercial unit loading factors range from 500 to 1,000 gallons per acre per day (gpad). Industrial unit loading factors range from 350 to 1,000 gpad.
- Diurnal patterns from the model calibration were applied to existing and future average loads to calculate peak dry flow rates at each modeled time step.
- Based on review of the existing system diurnal patterns, the pattern from the Canyon Creek flow meter was assigned to presently undeveloped or unserved parcels. The Canyon Creek meter is located in the upper sub-basins and the pattern is less affected

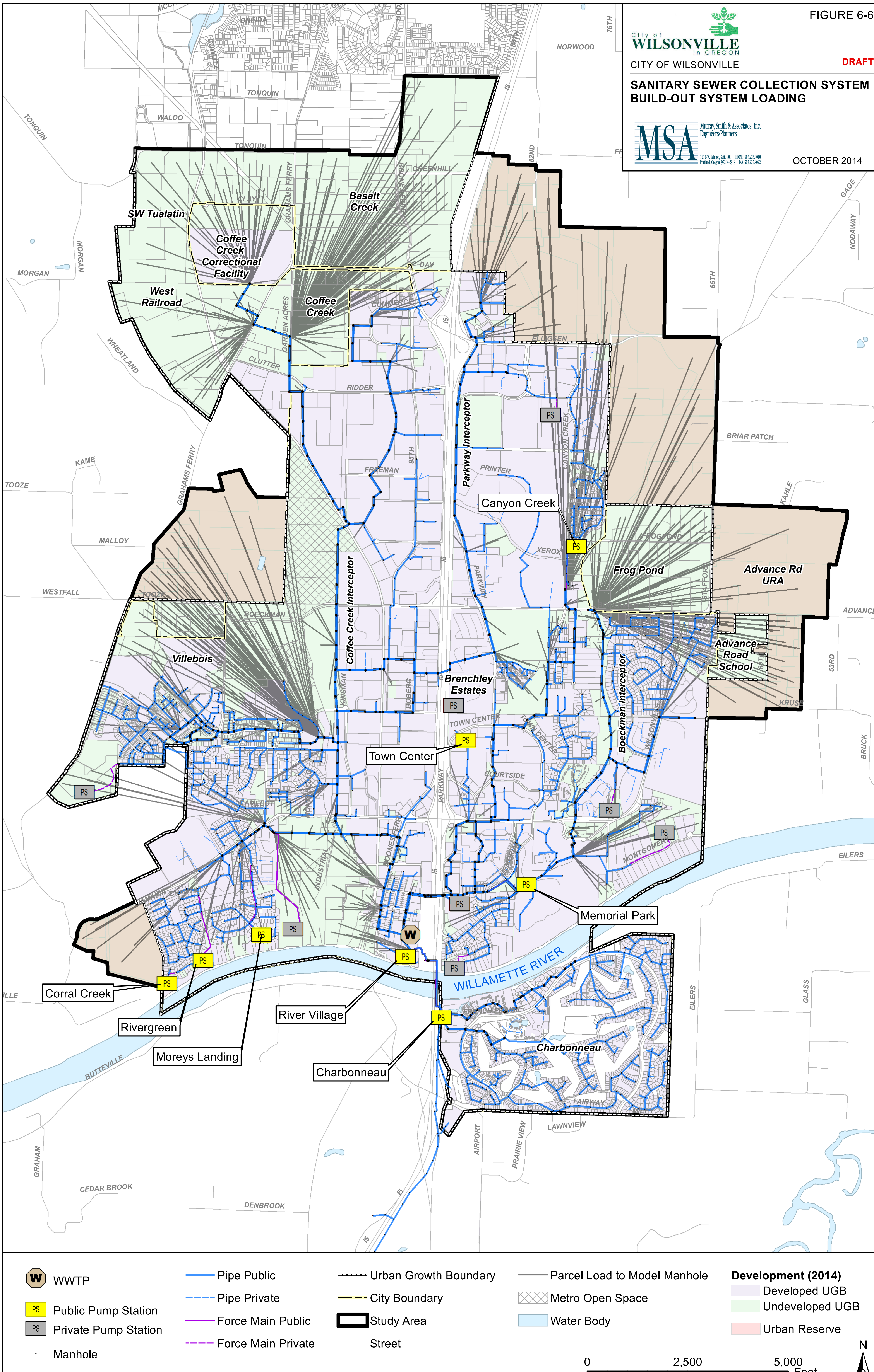
by travel time (flow attenuation) as demonstrated by a conservative peaking factor of approximately two.

Wet Weather Build-out Loading

- Unit hydrographs developed from flow monitoring data for each metered basin during the model calibration were applied to existing sewershed areas to develop wet weather system response from presently served parcels.
- Based on review of the existing system unit hydrographs, one composite unit hydrograph was developed for future growth areas based on average (moderate) system response to RDII. The composite unit hydrograph was applied to future sewershed areas to develop wet weather response from presently undeveloped or unserved parcels.
- Wet weather contributions from future sewersheds were extrapolated by applying a reduction factor to the net acres of presently undeveloped or unserved parcels. The reduction factor is based on the ratio of existing sewershed acreage to presently served net acreage (0.14).
- The 10-year design storm was applied to both the presently served and presently undeveloped or unserved parcels. The combination of the design storm, sewershed extrapolation, and unit hydrograph produces approximately 1,800 gpad of RDII in future development areas.

Build-out Loading Assignment

Build-out loading and sewershed areas were assigned to model junctions (manholes) based on sub-basin delineation, proximity to the manhole, and available 10-foot contour data. The build-out loading assignment is presented in Figure 6-6.



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BUILD-OUT SYSTEM EVALUATION

The City's collection system model was used to identify system hydraulic response to build-out dry and wet weather flows based on the design criteria presented in Table 6-3 and the 10-year design storm. Preliminary scenarios were performed for the high, medium, and low density scenarios. Additionally, a "worst case" scenario was analyzed for build-out within the UGB only for the high density scenario. Improvement results of these scenarios are presented in Appendix B, Figures B-2 through B-5 as outlined below.

- High Density Build-out Scenario – Figure B-2
- Medium Density Build-out Scenario – Figure B-3
- Low Density Build-out Scenario – Figure B-4
- High Density UGB Build-out Only Scenario – Figure B-5

Capacity-related improvement trends were identified for the high, medium, and low density scenarios as listed below.

- Improvements to the Upper Coffee Creek Interceptor, Memorial Park Pump Station, Boberg Diversion Structure, and Memorial Drive Flow Splitter were identified for all scenarios independent of density. These improvements are required for development within the UGB as well as development within the URA. Improvement sizing varied within one pipe size for the range of flow rates.

- Improvements to the Parkway Interceptor, Boeckman Interceptor, and Canyon Creek pump station were identified for all scenarios independent of density for development within the URA. These improvements are not required for development within the UGB. Improvement sizing varied within one pipe size for the range of flow rates. The length of piping requiring improvement is similar for the high and medium density scenarios. The length of piping requiring improvement for the low density scenario is approximately 20% and 35% less than the other scenarios for the Parkway and Boeckman Interceptors respectively.

- Improvements to the Lower Coffee Creek Interceptor were identified only for the high density scenario for development within the URA. This improvement is not required for development within the UGB and is considered low priority for URA development.

The City selected the high density scenario for capital improvement sizing based on the consistency of the improvements identified for all three scenarios and the similar sizing between the high and medium density scenarios. The improvement trends provide critical information to the City to identify improvement priorities. All scenarios were used to establish improvement priorities. Those improvements identified in all scenarios were given highest priority. Those improvements identified in only the high scenario were given the lowest priority. Specific improvement identifiers, lengths, sizes, and priorities are specified in Section 7, "Capital Improvement Program."

Summarized below are the major improvements related to system capacity described from west to east.

Coffee Creek Interceptor

The upper portion of the Coffee Creek Interceptor extends from Barber Street to the P&W Railroad Undercrossing along the future Kinsman Road alignment. This interceptor has capacity for existing customers and development in Coffee Creek. Improvements are required for development in Basalt Creek, Southwest Tualatin, and West Railroad areas within the UGB. The improvement is divided into three projects including:

- *The P&W Railroad Undercrossing* (CIP-01) – The undercrossing currently has limited slope resulting in upstream backwater impacts as flows increase from development. The existing undercrossing has capacity to serve existing customers including the prison, plus 100% of the Coffee Creek development and approximately 13% of Basalt Creek, West Railroad, and SW Tualatin prior to improvement.

- *Coffee Creek Interceptor Phase 1* (CIP-02) – This segment extends between Barber Street and Boeckman Road and aligns with the near-term Kinsman Road construction project. The existing piping has capacity to serve existing customers, plus 100% of the Coffee Creek development. Improvements are required for development of Basalt Creek, West Railroad, and SW Tualatin. The City is currently designing the interceptor improvements. 36-inch and 30-inch pipe sizes are being considered immediately upstream of Barber Blvd. The sizing is controlled by limiting existing pipeline slopes of less than 0.05%. A 30-inch pipeline flows full at a 0.08% slope. A 30-inch pipeline experiences less than 6-inches of surcharging (greater than 4 feet of freeboard) during peak flows at 0.05% existing slope.

- *Coffee Creek Interceptor Phase 2* (CIP-04) - This segments extends between Boeckman Road and the P&W Railroad Undercrossing. The existing piping has capacity to serve existing customers, plus 100% of the Coffee Creek development and approximately 25% of Basalt Creek, West Railroad, and SW Tualatin prior to improvement.

The lower portion of the Coffee Creek Interceptor (phase 3, CIP-10) requires improvement only for the high density scenario serving the URA immediately east of Basalt Creek. This lower section is located on Kinsman Road between Orepac Avenue and Barber Street with one pipeline segment immediately downstream on Orepac Avenue. The improvement is considered a low priority and may not be required if future flows align with the low or medium density scenarios or if the UGB is not expanded to serve the applicable URA east of Basalt Creek.

Parkway Interceptor

The Parkway Interceptor is located east of I-5 between Elligsen Road and Boeckman Road. The interceptor crosses I-5 near the Brenchley Estates subdivision. West of I-5, the interceptor conveys wastewater towards the Boberg Diversion Structure which is located on Boberg Road north of SW Barber Street. This diversion structure routes wastewater through the Parkway Interceptor's lower branch with overflows to a lateral pipeline heading south on Boberg Road. Both the Parkway Interceptor and the overflow pipeline discharge into the Coffee Creek Interceptor at SW Kinsman Road.

- *Parkway Interceptor* (CIP-09) – The interceptor has capacity for existing customers and future development within the UGB. Improvements are required to the upper segments of the interceptor (west of I-5) to accommodate growth in the URA. The Parkway Interceptor has isolated pipe "bellies" that have sagged over time creating sediment deposition and contributed to surcharging (see condition-based improvements discussion later in this section). The condition-based improvements are likely to occur prior to capacity upgrades. At the time of the condition improvements, sizing for build-out should be considered.

- *Boberg Diversion Structure* (CIP-11) – Modifications are required to the existing diversion structure to lower the overflow weir and provide a more efficient flow split between the Parkway Interceptor and the lateral heading south on Boberg Road. This improvement will allow more effective use of available downstream pipeline capacity and avoid upsizing of the lower Parkway Interceptor. The improvement is recommended for all scenarios and is additionally identified as a "condition-based" improvement.

Canyon Creek Pump Station

The Canyon Creek Pump Station is located near the intersection of Canyon Creek Road and SW Thornton Drive. The pump station (CIP-08) requires capacity improvements for all scenarios to accommodate growth in the URA north of the Canyon Creek Interceptor. To accommodate peak flows from the high, medium, and low density scenarios, the pump station firm capacity requirements are 1,100 gpm, 900 gpm, and 800 gpm respectively. The improvement is only required if the UGB is expanded to serve the applicable URA north of Canyon Creek.

Boeckman Interceptor

The upper segments of the Boeckman Interceptor are located on the west side of Boeckman Creek extending from Boeckman Road to the Memorial Park pump station. The interceptor has adequate capacity for existing customers and proposed development in the UGB including Advance Road School and Frog Pond. The interceptor requires improvement for all scenarios to accommodate growth in the Advance Road URA and the URA adjacent to Elligsen Road and 65th Avenue. The improvement is divided into two project phases:

- *Boeckman Interceptor Phase 1* (CIP-05) – This segment extends from Hathaway Park (confluence with High School Interceptor) to Memorial Park Pump Station. Improvement pipe sizes range from 18 to 24-inches.

- *Boeckman Interceptor Phase 2* (CIP-06) – This segment is the upper portion of the interceptor and extends from Boeckman Road to Hathaway Park (confluence with High School Interceptor). The improvement pipe size is 18-inches.

The City has discussed potential Boeckman Creek trail and access road improvements to be constructed in conjunction with the Boeckman Interceptor improvements, but funded independently. Planning and construction of the interceptor may also require an extended timeframe due to specific environmental mitigation associated with adjacent creek and wetland corridors.

Memorial Park Pump Station and Force Main

The Memorial Park Pump Station is located in Memorial Park immediately north of the sports fields. It is situated at the downstream end of the Boeckman Creek Interceptor main branch within the flood plain of Boeckman Creek. The pump station (CIP-03) requires capacity improvements to accommodate growth in the UGB, Advance Road URA, and the URA adjacent to Elligsen Road and 65th Avenue. To accommodate peak flows from the high, medium, and low density scenarios, the pump station firm capacity requirements are 3,800 gpm, 3200 gpm, and 2700 gpm respectively. Based on the high density scenario, the existing pump station has capacity to serve Advance Road School and approximately 40% of Frog Pond development prior to improvement. The pump station requires improvements to serve the remainder of Frog Pond, Advance Road URA, and Elligsen Road URA. The existing force main has capacity to serve Advance Road School, Frog Pond, and Advance Road URA prior to improvement. The force main requires improvement only to serve the Elligsen Road URA. The Memorial Park pump station and force main improvements are additionally identified as a “condition-based” improvement later in this due to its location in the floodplain.

Memorial Drive Flow Splitter Structure

The Memorial Drive flow splitter is located in a manhole near the intersection of SW Parkway Avenue and Memorial Drive, downstream of the Boeckman Creek Interceptor and Memorial Park Pump Station, and east of Interstate 5. Flows are split into an existing 15-inch diameter reinforced concrete pipe and a parallel 18-inch diameter PVC pipe; both run west under Interstate 5 and combine again along Fir Street.

Modifications are required to the flow splitter structure (CIP-12) to provide a more efficient flow split between the 15-inch and 18-inch parallel pipelines at the I-5 undercrossing. Improvements to the pipelines are not anticipated. This improvement will allow more effective use of available pipeline capacity by modifying the flow split. The improvement is recommended for all density scenarios and is additionally identified as a "condition-based" improvement later in this section.

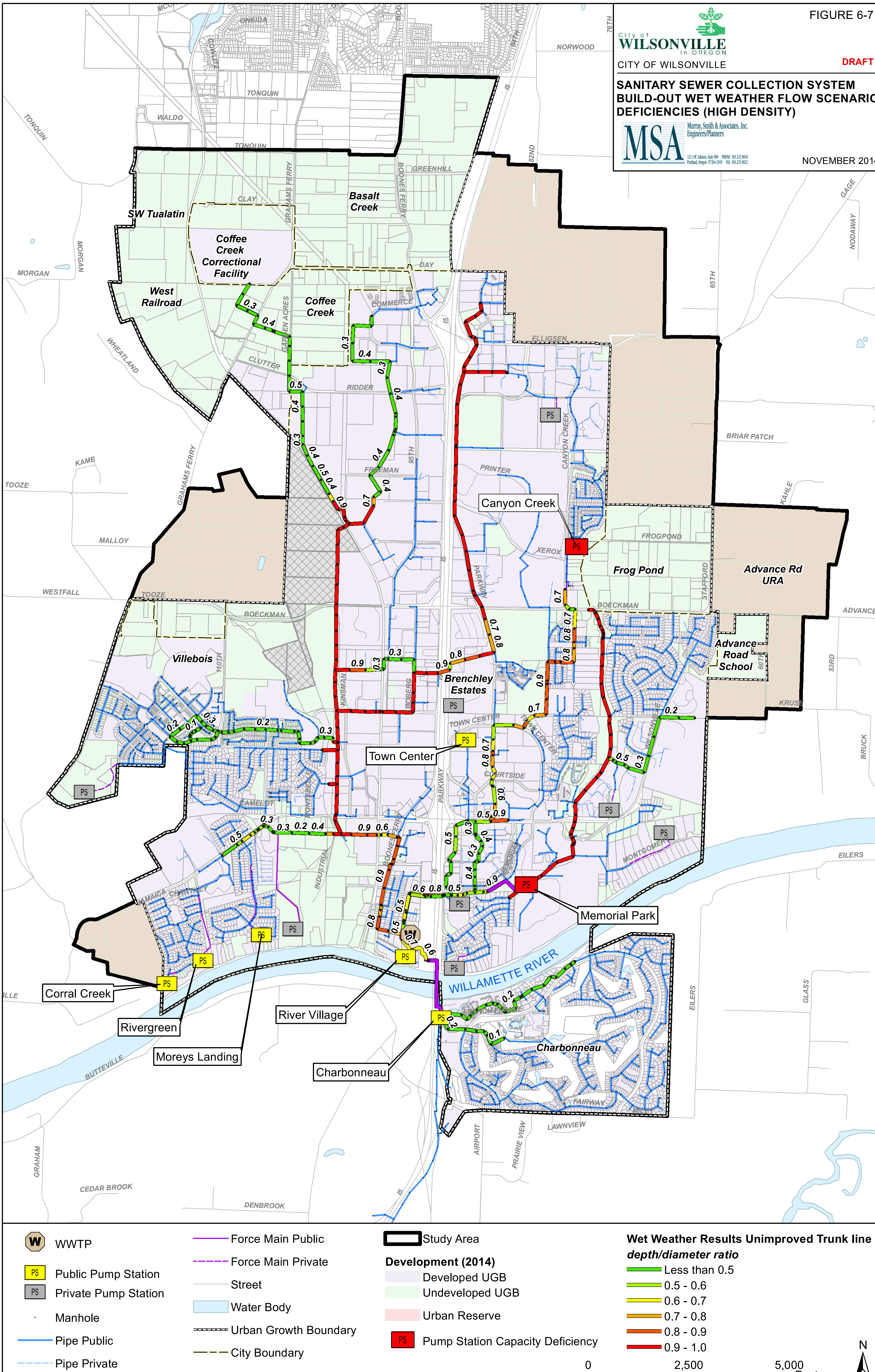
Build-out Deficiencies and Improvement Results

Based on the preliminary results and improvement trends, improvement sizes were finalized for the high density scenario. Results of system deficiencies as a response to the high density build-out flows are presented in Figure 6-7 for the peak wet flow scenario. Similar results are provided for the peak dry flow scenario in Appendix B, Figure B-6. The results depict the maximum flow depth to diameter ratio in each pipeline. Equivalent results showing the elimination of all deficiencies with system improvements are presented in Figures 6-8 and Figure B-7. Additionally, estimated peak build-out flows into each pump station during the design storm were compared to pump station existing firm capacity. The results of the build-out pump station capacity analysis are presented in Table 6-6.

Table 6-6| Future Pump Station Capacity

Pump Station	Firm Capacity (gpm)	Peak Flow to Pump Station (gpm)[1]	Comment
Canyon Creek	600	1100	Capacity improvement required
Charbonneau	750	220	
Corral Creek	160	10	
Memorial Park	900	3800	Capacity improvement required
Morey's Landing	260	160	
Parkway/ Town Center	220	60	
River Village	250	50	
Rivergreen	285	150	

Note 1. Based on High Density Scenario.



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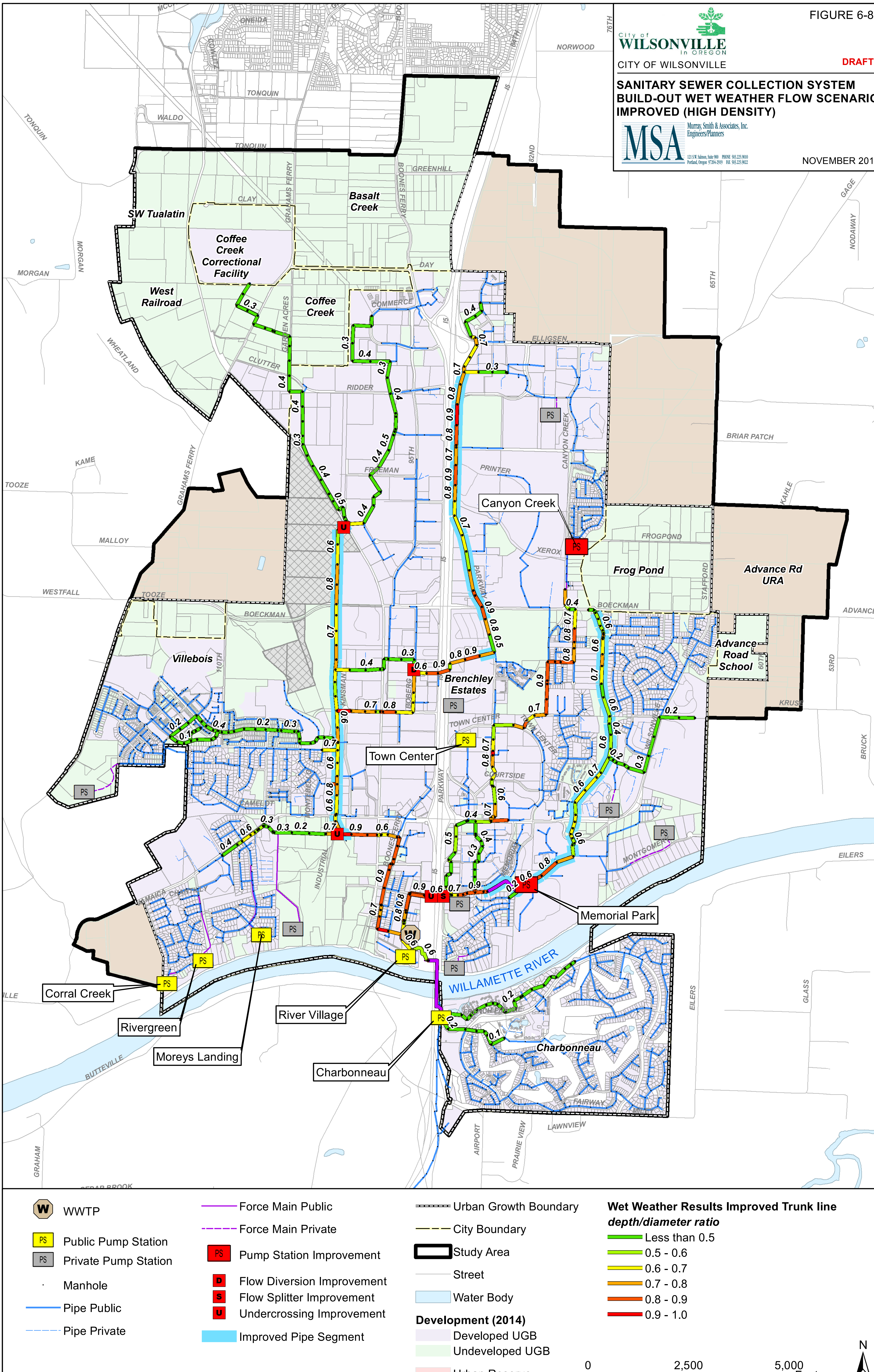

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PIPELINE AND PUMP STATION SERVICE EXTENSIONS

New trunk line extensions and pump stations are required to serve future development areas within the UGB and URA. The Frog Pond, Advance Road School, Advance Road URA and Coffee Creek developments have concept plans which define infrastructure sizing and alignments. Concept plan facility and pipeline sizes were updated to reflect flow and density assumptions in the CSMP. The improvements associated with these concept plan areas are described below and presented in Section 7, "Capital Improvement Program," Figure 7-3.

- *Frog Pond, Advance Road School, and Advance Road URA* (CIP-33 thru 38, 47 thru 51) – Frog Pond, Advance Road School, and Advance Road URA improvements include gravity piping, pump station, and force main improvements. All improvements were conservatively sized for build-out conditions of the UGB and URA. Gravity improvements between 10-inch and 18-inch diameters on SW Boeckman Road, SW Stafford Road, along Boeckman Creek (extension of the Boeckman Interceptor), South of Frog Pond Lane, and SW 60th Avenue are required for development of Frog Pond and Advance Road School within the UGB. A pump station and force main with 600 gpm capacity located on SW 60th Avenue and SW Kruse Road is required to serve Advance Road School. The pump station conveys flow north to the new gravity sewer on SW Boeckman Road. Gravity improvements between 10-inch and 15-inch diameters on Advance Road and SW Briar Patch Lane are required for development of Advance Road URA. Three local pump stations and force mains with approximately 200 gpm capacity each are also required to serve localized areas within Advance Road URA. Pump station sizing and pipeline sizing, alignments, and profiles were defined in the *"Frog Pond Area Plan (Wilsonville, Draft 2014)."* Infrastructure sizing was validated to accommodate build-out high density average flows multiplied by a wet plus dry peaking factor of 3.5. This factor accounts for peaking of all flow components including (DWF, GWI, and RDII).

- *Coffee Creek* (CIP-27 thru CIP-32) – Coffee Creek improvements include gravity piping between 8-inch and 18-inch diameters on Clutter Road, Ridder Road, Grahams Ferry Road, Garden Acres, Day Road, and Kinsman Road. The pipeline alignments and profiles were defined in the *"Coffee Creek Master Plan (Wilsonville, 2007)."* Pipe sizes were updated to accommodate full pipe flow during build-out high density average flows multiplied by a wet plus dry peaking factor of 3.5.

Additional development areas (without concept plans) within the UGB and URA were divided into 14 sub-basins as highlighted in Section 7, "Capital Improvement Program," Figure 7-3. New trunk line extensions (10-inches and larger) and pump stations (CIP-39 thru 46, 52 thru 57) were conceptually sized based on the following:

- Gravity pipe sizes assumed minimum slopes based on City design standards. Pipelines were verified for approximate depths of 10-15 feet based on 10 foot contour data.

- Gravity pipes were sized to flow full during build-out high density average flows multiplied by a wet plus dry peaking factor of four. This factor accounts for peaking of all flow components including (DWF, GWI, and RDII).
- Trunk line pipe lengths assumed 100 feet per developable acre based on similar pipe density in the Frog Pond, Advance Road, and Coffee Creek concept plans.
- Pump stations were limited to one station per sub-basin.
- Pump stations and force mains were sized to accommodate build-out high density average flows multiplied by a wet plus dry peaking factor of four.
- Pump station total dynamic head requirements were estimated based on elevation change plus friction losses in the downstream force main.
- Force mains were sized to accommodate a velocity of 3.5 fps. The low velocities minimize frictional losses and reduce total dynamic head pump requirements.
- Force main lengths were approximated based on the distance between the low point of the sub-basin and existing downstream gravity manhole.

The improvement sizes for each sub-basin are summarized in Table 6-7. The infrastructure sizing should be refined during future concept planning for these areas.

Table 6-7| Future Infrastructure Sizing

Subbasin Number	Improvement Type	Peak Flow (gpm)	Net Acres	Pipe Length (feet)	Minimum Slope (feet/feet)	Pipe Size (inch)	Pump Station Total Dynamic Head (feet)
1	Gravity	790	130	13050	0.0022	12	
2	Gravity	682	98	9846	0.0022	12	
3	Gravity	361	66	6567	0.0028	10	
4	Pump Station/Forcemain	290	42	4200		8	57
5	Pump Station/Forcemain	800	115	3250		12	80
6	Pump Station/Forcemain	205	30	1425		6	69
7	Gravity	908	131	13122	0.0015	15	
8	Pump Station/Forcemain	297	43	1750		8	12
9	Pump Station/Forcemain	405	77	2600		8	37
10	Pump Station/Forcemain	201	29	1300		6	24
11	Gravity	568	82	8209	0.0022	12	
12	Gravity	985	142	14224	0.0015	15	
13	Gravity	577	83	8340	0.0022	12	
14	Gravity	565	83	8306	0.0022	12	

GRAVITY SYSTEM CONDITION ASSESSMENT

The City maintenance staff reports that the gravity collection system is generally performing adequately with zero reported overflows. Routine cleaning and maintenance of the system includes high pressure washing and vacuum suction to remove clogged debris. City staff are currently performing video review of the gravity piping to identify specific condition issues for repair or replacement including root intrusion, cracks, and collapsed or poorly graded piping. Interviews with City staff regarding ongoing system maintenance have revealed isolated areas of poor performance or limited accessibility as summarized below:

- The Coffee Creek Interceptor has access challenges due to wetlands and proximity to P&W Railroad and Bonneville Power Administration transmission lines.
- Most of the Boeckman Creek Interceptor between Schroeder Road and Boeckman Road has limited accessibility due to its location adjacent to Boeckman Creek.
- Wood School Interceptor flows through a privately owned filbert orchard limiting aces for inspection and maintenance. The pipeline is of questionable integrity with potential root intrusion and limited accessibility.
- The Parkway Interceptor has isolated pipe "bellies" that have sagged over time creating sediment deposition and contributed to surcharging.
- City-wide concrete piping installed in the 1970s is experiencing root intrusion problems.
- Charbonneau sewer conditions include collapsed pipe, pipe separation, offset joints, major blockages and pipe sag.
- The Boberg diversion structure bypass frequently experiences blockages.
- The Memorial Drive Flow splitter structure has stagnant water conditions in the low-flow line.
- Seely Ditch Undercrossing has limited slopes and maintenance staff identify the undercrossing as having high potential for backwater.

The City plans and budgets annual improvement programs, as described below, to eliminate or minimize condition based issues in the gravity portion of the collection system.

Charbonneau Repair and Replacement Program

The City developed the "*Charbonneau Consolidated Improvement Plan [Weigel, 2014]*" which identifies a 20-year schedule for the Charbonneau basin to repair or replace sewer, water, storm, and road infrastructure. The sewer collection system portion of the plan includes prioritization of 38 project areas for improvement including more than 23,000 feet of piping (CIP-14, 15, 21, 24). The extents of the Charbonneau repair and replacement program are presented in Section 7, "Capital Improvement Program," Figure 7-2.

Pipeline Repair and Replacement

An annual repair and replacement program (CIP-16, 22, 25) exists for pipelines throughout the City. The program focuses on areas identified for repair through the City's video inspection work. The primary focus is on locations of known adverse grade, root intrusion, and older concrete piping as discussed below.

- *Adverse Grade* – If the soil supporting collection system piping settles over time, the pipe will also settle. The collapsed or "sagging" pipe restricts flow and creates an environment for sediment deposition resulting in potential blockage and backwater.

- *Aging Pipes* – Concrete piping installed in the 1970s is approaching 50 years of service and in many cases is nearing the end of its useful life. Significant root intrusion has occurred in some locations due to adjacent trees. The tree roots are causing blockages and also introducing groundwater into the collection system, which effectively reduces the capacity of the system to convey wastewater.

The extents of the annual repair and replacement program are presented in Section 7, "Capital Improvement Program," Figure 7-2. It is anticipated that approximately 50% of the identified concrete piping will be repaired or replaced over 20-years.

Pipeline Improvement Techniques

The following discussion summarizes common pipeline improvement techniques that may be applied to the City's Charbonneau and annual pipeline repair and replacement programs.

Chemical Grouting - Chemical grouting is commonly used to seal leaking joints in structurally sound pipe and manholes. The equipment used consists of a sealing packer and television (TV) camera pulled inside the sewer pipe with cables and winches. Because the sealing is done inside the pipe, excavation is not required unless unique problems develop.

The chemical grouts typically used are acrylamide, acrylate, or urethane gel. The chemicals necessary to form the gels are usually mixed in two separate tanks and pumped through separate hoses to the joint to be sealed. One tank is used to mix and dispense the grouting chemical and the other tank is used to mix and dispense a catalyst. The catalyst initiates a chemical reaction when mixed with the chemical grout. The materials are injected simultaneously into a leaking joint, a gel is formed and the leak is stopped. Urethane gel differs from acrylamide and acrylate gels in that water is the catalyst for the urethane gel material.

Chemical grouting does not improve the structural strength of the pipeline. This rehabilitation technology should not be used on pipes that are broken or deteriorated. If the ground water table drops below the level of the pipe, the chemical grout may become dehydrated and its useful life shortened. When used appropriately, rehabilitation by chemical grouting has a useful like of 10 to 15 years.

The costs for chemical grouting vary depending upon the number of grouting locations and the quality of sealant used. The chemical grouting process generally includes pipelines cleaning, television inspection, testing all joints, sealing deficient joints, and sealing leaking manholes where needed. The television inspection will occasionally locate a section of pipe not repairable by chemical grouting. A point excavation is required to repair such a leak.

Grouting must be repeated approximately every 10 years to control the quantity of RDII in the system because of the limited life of chemical grout. For portions of the system conducive to chemical grouting, one application performed initially and at the end of 10 years should effectively seal the pipeline during the planning period.

Conventional Pipe Replacement - Pipeline replacement by conventional, open-cut excavation and backfill is normally done when the existing pipeline is deteriorated so badly that other methods of rehabilitation are not feasible. Replacement provides the opportunity to correct misalignments, increase the hydraulic capacity of the line by increasing the pipe diameter, repair service connections, and eliminate sags or stormwater entry points. Replacing pipelines can also remove any “incidental” RDII (i.e., minor leaks that would not be cost-effective to remove). A rehabilitation alternative that is similar to complete pipe replacement is point repairs or spot repairs, which involve excavation, backfill, and pipe replacement for selected areas.

The advantage of pipe replacement is that service life with modern materials and methods is generally greater than 50 years. The cost of replacement is generally high. The replacement has associated inconveniences, and restoration requirements that may be costly in developed areas.

Pipe Bursting - Pipe bursting consists of expanding and breaking in-ground pipe and towing in segments of new polyethylene (PE) or polyvinyl chloride (PVC) pipe. For the pipe cracking operation, a modified soil displacement hammer is pulled through a pipe run via an above-ground winching system. Cutting blades of different size are fixed on the hammer to break the existing pipe. An expander fitted on the rear of the hammer enlarges the original bore so that pipe of equal or larger diameter can be pulled behind the pipe cracking process. The new pipe is fitted into the trailing end of the hammer unit. As the hammer advances through the old main, it cracks the pipe and the fragments are displaced laterally. Simultaneously, the new liner/pipe is then towed in. If a liner is required, the new conduit pipe is then towed in after the entire length of old main has been cracked and lined.

Pipe bursting is most often used under highways, railroads, and other structures where excavation is not possible or cost-effective. The service life is virtually identical to a new sewer pipe (50 years), since new pipe is actually being installed. Spot excavations are required to connect service laterals.

Sliplining - Sliplining involves inserting a slightly smaller new flexible pipeline, usually polyethylene, into the existing sewer pipe. This method is typically used where the existing sewer lines are extensively cracked such as in areas with unstable soil conditions, where the lines are badly deteriorating, or in lines with relatively flat grades. Sliplining will reduce the inside diameter of sewer pipe and reduce its flow capacity. Sliplining is generally used on mainlines larger than 8 inches in diameter.

Sliplining involves minimum excavation and accompanying dewatering work. Excavations are required only at insertion pits and for service lateral re-connections. For this reason, sliplining is advantageous in inaccessible or difficult areas, or under landscaping or structures. Sliplining can be installed in existing pipelines having moderate horizontal or vertical deflections. Wastewater flow may be allowed to continue while sliplining operations occur.

The liner pipe is commonly pulled through the existing pipe with a winch assembly placed at a manhole and the liner pipe fed into the existing pipe through an insertion pit. The pipe is pulled by steel cable with the cable attached to a pulling head at the pipe end. The polyethylene pipe will stretch during pulling (one foot per 100 feet is common) and a relax procedure is required after pulling and before connection at manholes. Increased temperatures will also tend to stretch the pipe.

The service life of a sliplined sewer is similar to a new sewer replaced by conventional trench excavation and backfill, which is about 50 years. The new liner pipe is a pressure-capable pipe itself. A disadvantage of sliplining is that excavations are required at service laterals. This is often time consuming, labor intensive, and correspondingly expensive.

Inversion Lining - Inversion lining installs a flexible lining material against the existing sewer pipe that is thermally hardened and requires access to the sewer pipe at a manhole. The liner is fed through the manhole and into the sewer pipe by filling the pipe and manhole with water. As water is pumped into the manhole, the flexible fabric is pushed through the pipe and inverted into place. The water is heated to cure and harden the thermo-setting resins.

Inversion lining is appropriate for pipelines requiring minor structural repair or with misalignments and for correcting corrosion problems. Because this method of rehabilitation does not require excavations, it may be used under highways and buildings. A television inspection of the existing sewer typically precedes the inversion lining work. Video inspection during a period of high groundwater table should be performed following lining to make sure laterals are not leaking or other small holes were not introduced into the side of the liner during lateral cutting. The life of an inversion lined pipe has been claimed by the lining manufacturers to be 50 years. Installations with almost 30 years of service are known to exist.

The inversion lining will reduce the inside diameter of an 8-inch pipe by up to ¾-inch depending on the service requirements. Flow capacity of the pipe may be reduced by the reduced pipe cross-sectional area, or increased by smoothing the flow channel.

Accessibility

The CSMP does not identify specific condition-based to improve pipeline accessibility; however, capacity projects to improve the Boeckman and Coffee Creek Interceptors will provide opportunities for pipeline re-routing and improved accessibility. The Boeckman

Interceptor work may include a coordinated trail system adjacent to Boeckman Creek which would also function as an access road to the sanitary sewer.

Flow Diversions and Splitters

Improvements identified to improve the Boberg diversion structure and Memorial Drive flow splitter structure are both capacity and condition related. These improvements will more efficiently use existing pipe capacities and also improve the stagnant water conditions by more evenly splitting or diverting flow into both downstream pipelines. Routine flushing is recommended in the overflow pipeline downstream of each structure.

Seely Ditch Undercrossing

The existing 10-inch Seely Ditch Undercrossing (CIP-13) has limited slope resulting in upstream backwater impacts. City maintenance staff identified this improvement as a potential condition and capacity improvement. The undercrossing improvement is recommended at 15-inches with potential consideration of maximizing pipeline slope.

PUMP STATION CONDITION ASSESSMENT

The City's public wastewater pump stations (lift stations) are functioning as intended within the context of their age and existing wastewater loading. During interviews with CH2M HILL operations staff, the structures that house these facilities were reported to be in good condition. Overall, the pump stations that utilized Gorman-Rupp brand pumps (Canyon Creek, Charbonneau, Memorial Park, Morey's Landing, and Town Center Loop) were reported to require weekly maintenance due to clogging problems, and several pump stations have site specific conditional problems as summarized below.

Corral Creek Pump Station

The Corral Creek Pump Station generally operates well, however a recent property development adjacent to the facility has blocked the "line of sight" for the radio telemetry monitoring and control equipment. Communication between the pump station and the City's central control room at the WWTP has essentially ceased. The City is presently addressing the problem through placement of an elevated antenna on an adjacent cell phone tower, and no further action is recommended.

Canyon Creek Pump Station

The Canyon Creek Pump Station generally operates well, however this facility also has a weak "line of sight" for the radio telemetry control equipment. Communication between the pump station and the WWTP control room has been intermittent since the equipment was switched to radio in 2009. The City has indicated that this intermittent communication is acceptable for the time being, and no further action is recommended.

Memorial Park Pump Station

The Memorial Park Pump Station is located within the 100-year flood plain of Boeckman Creek. The location places the pump station at risk during conditions of heavy rain and flooding. The pump station was inundated by approximately six feet of water during a flood event in the winter of 1996. Flood waters may overwhelm the capacity of the pumps or cause electrical failures, both of which would result in sewage overflows to Boeckman Creek. Relocation of the pump station is required to fully comply with Federal Emergency Management Agency and Oregon Department of Environmental Quality requirements.

Relocating the pump station is a complex issue that is significantly impacted by the recreational programming needs for Memorial Park and the location of the floodplain. The City is presently conducting a master plan of the park which includes an assessment of potential relocation sites for the pump station and force main. Although adequate capacity exists in the short-term, anticipated development of the Frog Pond planning area, Advance Road URA, and Elligsen Road URA will generate wastewater flows in excess of the pump station’s capacity. When eventually relocated, the pump station will be sized larger, making a portion of the pump station relocation project eligible for SDC funding.

Parkway/Town Center Loop Pump Station

Originally named the Parkway Sanitary Sewer Pump Station, the Town Center Loop Pump Station was constructed in 1997 in conjunction with surrounding development. The pump station is located on Town Center Loop near I-5. The City reports that the pumps frequently lose their prime due to debris that enters the station. The amount of trash in this facility is greater than the City’s other pump stations due to the exclusive commercial nature of the service area, including a movie theatre and Family Fun Center with high customer turnover.

More importantly, the entire discharge force main is below the elevation of the pump case, and therefore no effective backpressure is applied to the flap valve to hold it closed. It is believed this combination of factors greatly increases the frequency of pump failure relative to the City’s other stations. In order to reduce the City’s on-going maintenance expenses and reduce the potential for overflow due to failure, replacement of the pump station is recommended (CIP-17).

River Village Pump Station

The River Village Pump Station is a small station constructed in 1983 to serve a trailer park immediately south of the WWTP and areas of lower elevation. The pump station is one of the oldest facilities within the City and has exceeded its’ service life. The electrical components that control the pumps are beginning to fail on a regular basis. These components, such as the alternator and switches are disconnecting and require routine maintenance to restart.

Currently, the trailer park is abandoned and the pump station is only serving the Boones Ferry Park restrooms and Tauchman House. The City anticipates that the River Village parcel will be redeveloped in the future requiring a new developer-funded pump station.

Because of age, condition, and limited service, decommissioning of the River Village Pump Station is recommended (CIP-18). New grinder pumps discharging to the existing force main and downstream lower Charbonneau Interceptor are recommended to maintain service to the Boones Ferry Park facilities (CIP-19).

Other Pump Stations

Over the 20-year planning horizon, several public pump stations (not identified as having capacity or existing condition issues) are anticipated to reach the end of their useful service life. These pump stations include Corral Creek (1990), Rivergreen (1991), Charbonneau (1996), and Morey's Landing (1997). For these pump stations, pump and electrical rehabilitation are recommended at approximately 25-years of service (CIP-20, 23, 26).

SECTION 7 | CAPITAL IMPROVEMENT PROGRAM

INTRODUCTION

This section summarizes the City's Capital Improvement Program (CIP) which consists of a list of prioritized wastewater collection system projects and estimated costs in 2014 dollars. The CIP is a blueprint for forecasting capital expenditures, and is one of the most important means of meeting the City's obligation towards community development and financial planning.

The CIP is a direct result of the capacity and condition improvement analyses described in detail in Section 6, "System Analysis." All projects are analyzed at a planning level of accuracy based on population and land use assumptions described in Section 5, "Population and Flow Projections." Prior to implementation, each project should undergo standard engineering design phases to finalize improvement sizing and location.

COLLECTION SYSTEM CAPITAL IMPROVEMENT PROGRAM

The City's CIP is organized into categories based on project type and prioritized based on timing and development potential. The major organizational categories are described below.

Project Type

Existing System Capacity Upgrades - These improvements include existing trunk line and pump station upgrades to increase capacity for future development. The major improvement projects in this category are listed below and presented in Figure 7-1. Project descriptions and cost estimates are provided in Table 7-1 (CIP-01 thru 10).

- Coffee Creek Interceptor Phases 1, 2, & 3
- Parkway Interceptor
- Boeckman Interceptor Phases 1 & 2
- Memorial Park Pump Station and Force Main
- Canyon Creek Pump Station
- P&W Railroad Undercrossing

The Memorial Park pump station improvement is both a capacity upgrade and condition-based improvement. The pump station improvement is listed in the "Existing System Capacity Upgrades," Table 7-1.

Condition Based Improvements – These improvements include replacement of existing pipelines, pump stations, and diversions to address aging infrastructure and to satisfy current system loading as identified by Operations and Maintenance personnel. Additionally, rehabilitation projects are identified for pump stations exceeding their design life within the 20-year planning horizon. The major improvement projects in this category are listed below and presented in Figure 7-2. Project descriptions and cost estimates are provided in Table 7-2 (CIP-11 thru CIP-26).

- Annual pipeline replacement program (concrete piping)
- Charbonneau District pipeline repair program
- Boberg Diversion structure
- Memorial Drive Flow Splitter structure
- Seely Ditch
- Memorial Park Pump Station
- Town Center Loop Pump Station
- River Village Pump Station
- Corral Creek Pump Station
- River Green Pump Station
- Charbonneau Pump Station
- Morey's Landing Pump Station

The Boberg Diversion structure and Memorial Drive Flow Splitter structure improvements are both capacity and condition-based improvements. These improvements are listed in the "Condition-Based Improvements," Table 7-2.

New Infrastructure for Future Development – These improvements include new trunk line extensions (10-inches and larger) and pump stations to service future development areas. The improvement projects are presented in Figure 7-3 with project descriptions and cost estimates provided in Table 7-3 (CIP-27 thru 57). The improvements are further categorized as described below.

- Infrastructure identified in concept plans for Frog Pond, Advance Road School, and Coffee Creek within the existing UGB.
- Future development areas that do not currently have concept plans within the UGB.
- Infrastructure identified in concept plans for Advance Road URA.
- Future development areas that do not currently have concept plans within the URA.

The future development areas without concept plans have been subdivided into 14 sub-basins. Place-holder trunk line or pump station improvements have been identified for each area. Cost estimates for these areas should be refined once additional concept planning has been completed.

Project Prioritization

For condition based improvements, projects are prioritized into three timeframes: short-term (0-5 years), medium-term (6-10 years), and long-term (11-20 years) based on the following guidelines:

- Improvements to eliminate existing pump station condition issues as identified by Operations and Maintenance personnel are identified in the 0-5 year timeframe.
- Improvements to eliminate diversion and flow splitter structure condition and capacity issues as identified by Operations and Maintenance personnel are identified in the 0-5 year timeframe.
- Charbonneau District pipeline repairs as described in the *Charbonneau Consolidated Improvement Plan* (City of Wilsonville, 2014) are categorized for all three timeframes.
- Fifty percent of concrete piping is assumed to be replaced over 20 years with equal length of pipe replacement occurring in each year and $1/20^{th}$ of the cost assigned annually.
- Improvements to rehabilitate existing pump stations are identified during the timeframe at which the design life of the pump station ends.

For development driven improvements, projects are prioritized into three growth potential categories as described below:

UGB - These projects are required to provide service to in-fill and development growth within the UGB and are considered the highest priority.

UGB Concept Plan – These projects are required to provide service to development outside of the existing UGB and include the URA adjacent to Advance Road. Concept plans are currently being developed for these areas and METRO has designated the areas for potential UGB expansion. These projects are considered medium priority.

UGB Expansion – These projects are driven by development outside of the current UGB requiring a time intensive process involving METRO to expand the boundary. Because of the high level of uncertainty about the timing and extent of the development, these projects are considered the lowest priority.

Development driven improvements are also categorized into three timeframes: short-term (0-5 years), medium-term (6-10 years), and long-term (11-20 years) based on current City understanding of growth potential including the following assumptions:

- Coffee Creek – 25% developed in 0-5 year timeframe, 75% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
- Advance Road School – 100% developed in 0-5 year timeframe.
- Frog Pond - 40% developed in 0-5 year timeframe, 95% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
- Basalt Creek, SW Tualatin, West Railroad – 0% developed in 0-5 year timeframe, 25% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
- Advanced Road URA – 0% developed in 0-5 year timeframe, 25% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
- URA – development in 11-20 year timeframe.

Project Driver

In addition to the prioritization categories and timeframe, information is provided in the CIP tables identifying the project catalyst or driver. Common drivers include:

- Basin specific development
- Infrastructure age and condition
- Road construction projects

If the driver does not materialize, a project's timeframe can be postponed without impacting the performance of the collection system. At times, phased development may be allowed without full implementation of a project. Likewise, if the project driver occurs sooner than the assumed timeframe, some improvements projects may require acceleration. Notes are provided in the CIP tables to assist the City in understanding project timing related to specific development.

Timing of phased development and associated projects such as the pipeline upsizing for Coffee Creek, Boeckman, and Parkway interceptors may benefit from long-term flow monitoring to identify specific capacity and flow triggers. Flow meters should be placed immediately upstream and downstream of the proposed improvement phase.

Cost Estimation

Costs presented in the CIP tables are estimated using an approach outlined in the *Basis of Opinion of Probable Cost* contained in Appendix C. This document contains the assumptions used in developing project costs, addressing such items as unit costs for materials, labor and construction, contingency factors, and the City's administrative costs.

All project descriptions and cost estimates in this document represent a Class 5 budget estimate in 2014 dollars, as established by the *American Association of Cost Engineers*. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -30 percent on the low end, and +30 to +50 percent on the high end, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate.

The cost estimates are consistent with the definition of OAR 660-011-0005(2) and OAR 660-011-035 which define "rough cost estimates" for facility plans as "approximate costs expressed in current-year dollars." These estimates are intended to "provide an estimate of the fiscal requirements to support the land use designation" and "for use by the facility provider in reviewing the provider's existing funding mechanisms." They are intended to be used as guidance in establishing funding requirements based on information available at the time of the estimate. The CIP cost estimates should be reevaluated periodically to account for changes in inflation. It is important to note that the CIP omits costs for routine maintenance.

The cost estimates for improvements associated with the 14 areas identified for “service area extensions” in Figure 7-3 and Table 7-3 are place-holders and should be updated with specific concept planning. The cost estimates in this document for these areas assumed 100 feet of piping per developable acre (as outlined in Sections 5 and 6) for gravity trunk line improvements. For areas where pumping is required, one pump station per area was assumed with cost estimates based on rough calculations of total dynamic head and build-out flow projections.

CAPITAL IMPROVEMENT PROGRAM FUNDING

Capital improvements within the City are primarily funded through the following mechanisms:

- The City funds capital improvements impacting existing customers through utility revenues generated from wastewater rates. These costs are allocated to the City’s Sewer Operating Fund.

- Capital improvements for future development, or growth are funded through System Development Charges (SDCs) as allowed under Oregon Revised Statute 223.297 through 223.314. These costs are allocated to the City’s Sewer SDC Fund.

- The City’s current policy requires developers to fully fund/construct sewer line extensions of 8-inches in diameter or smaller. Sewer lines in excess of 8-inches in diameter are considered “oversized” by the City since they typically convey wastewater from properties upstream of the developer. Developers constructing oversized sewer lines are eligible to receive SDC credits above the cost to install an 8-inch sewer. Oversize costs for new infrastructure associated with future development are provided in Table 7-3.

The City may also seek funding and financing of specific projects through these additional internal and external sources:

- Business Oregon, including Community Development Block Grants, the Water/Wastewater program, and the Special Public Works Funds
- Developer dedications
- Oregon DEQ Clean Water State Revolving Fund
- Oregon Immediate Opportunity Program
- Oregon Industrial Development Revenue Bonds
- Oregon Infrastructure Bank
- City General Obligation Bonds
- City Local Improvement Districts
- City Sewer Revenue Bonds
- City Urban Renewal Program

SDCs and Percent Related to Growth

For each improvement project, a growth percentage is provided in the CIP tables to aid the City in establishing SDCs for the collection system. For improvements that benefit both current and new customers, the growth percentage can be applied to the project cost to allocate funding requirements through collection of SDCs.

The method used to calculate growth percentage for a proposed pipe or pump station project employs a formula (shown below) based on the ratio of existing and future flows.

Percent Related to Growth = 1 – (Peak Existing Flow / Peak Build-out Flow)

The growth percentage relates directly to SDC percentage. The percentage not related to growth is funded through wastewater rates (e.g. Sewer Operating Fund).

Table 7-1 Capital Improvement Program, Existing System Capacity Upgrades for Future Development

Project ID No.	Project Information				Estimated Cost[1, 2]	Prioritization Category	Time Frame[3]	Driver	Percent Related to Growth[5]
	Name	Type	Description[4]	Project Limits					
CIP-01	Coffee Creek Interceptor Railroad Undercrossing	Undercrossing	160 LF 21"Ø, Railroad Undercrossing	Under P&W Railroad	$480,000	UGB	0-5 Years	The existing undercrossing has capacity to serve Coffee Creek development and approximately 13% of Basalt Creek, West Railroad, and SW Tualatin development prior to improvement. May require bore and jack construction.	65%
CIP-02	Coffee Creek Interceptor Phase 1	Gravity - Pipe Upsizing	1030 LF 27"Ø; 610 LF 30"Ø; 1,020 LF 36"Ø	From Boeckman Road to Barber Street	$2,600,000	UGB	0-5 Years	Kinsman Road Construction Project. The existing interceptor has capacity to serve Coffee Creek development. Improvements are required for development of Basalt Creek, West Railroad, and SW Tualatin.	60%
CIP-03	Memorial Park Pump Station[6]	Pump Station + Force Main - Upsizing & Relocation	1,220 LF 16"Ø FM; Pump station relocation/expansion to 3,800 gpm	Pump Station relocation within Memorial Park, Force main from pump station to Rogue Ln	$5,130,000	UGB	6-10 Years	Flood plain impacts, Frog Pond & Advance Rd School development. Existing pump station can serve Advanced Road School and approximately 40% of Frog Pond development prior to improvement. Existing force main has capacity to serve Advanced Road School, Frog Pond, and Advanced Road URA prior to improvement.	85%
CIP-04	Coffee Creek Interceptor Phase 2	Gravity - Pipe Upsizing	2,000 LF 21"Ø	From P&W Railroad to Boeckman Road	$1,700,000	UGB	6-10 Years	The existing interceptor has capacity to serve Coffee Creek development and approximately 25% of Basalt Creek, West Railroad, and SW Tualatin development prior to improvement.	65%
CIP-05	Boeckman Interceptor Phase 1	Gravity - Pipe Upsizing	2,320 LF 18"Ø; 920 LF 21"Ø; 970 LF 24"Ø	From High School Interceptor to Memorial Park Pump Station	$4,270,000	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond). The existing interceptor has capacity to serve Advance Road School and Frog Pond.	80%
CIP-06	Boeckman Interceptor Phase 2	Gravity - Pipe Upsizing	3,760 LF 18"Ø;	From Boeckman Road to High School Interceptor	$3,240,000	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond). The existing interceptor has capacity to serve Advance Road School and Frog Pond.	100%
CIP-07	Master Plan Update	Other	Update the Collection System Master Plan	N/A	$300,000	URA	6-10 Years	5-10-years or significant URA development	70%
CIP-08	Canyon Creek Pump Station	Pump Station - Upsizing	Pump station expansion to 1,100 gpm	Existing pump station	$865,000	URA	11-20 Years	URA development	80%
CIP-09	Parkway Interceptor	Gravity - Pipe Upsizing	4,540 LF 12"Ø; 2,150 LF 15"Ø	From Elligsen Road to Boeckman Road	$4,360,000	URA	11-20 Years	URA development (east of Basalt Creek)	60%
CIP-10	Coffee Creek Interceptor Phase 3	Gravity - Pipe Upsizing	4,090 LF 36"Ø	From Barber Street to Orepac Avenue	$6,000,000	URA	11-20 Years	URA development (east of Basalt Creek)	65%
				Total	$28,945,000				

Table 7-2 Capital Improvement Program, Condition Based Improvements

Project ID No.	Project Information						
	Name	Type	Description[4]	Project Limits	Estimated Cost[1, 2]	Time Frame	Driver
CIP-11	Boberg Diversion Structure[6]	Diversion Structure - Replacement	Replace Diversion Structure	Boberg Rd	$150,000	0-5 Years	Condition and capacity (upstream development); overflow operation not fully functional
CIP-12	Memorial Drive Flow Splitter Structure[6]	Flow Splitter Structure - Replacement	Replace Diversion Structure	I-5 Downstream of Memorial Park Pump Station	$150,000	0-5 Years	Condition and capacity (upstream development); maximize capacity of dual pipe system
CIP-13	Seely Ditch Undercrossing[6]	Undercrossing	200 LF 15"Ø, modify slope and connection to downstream interceptor to minimize backwater	Ditch crossing near Industrial Way and Orepac Avenue	$390,000	0-5 Years	Backwater from downstream interceptor, stagnant conditions. May require bore and jack construction.
CIP-14	Charbonneau District Spot Repair[7]	Gravity - Pipe Repair	Per *Charbonneau Consolidated Improvement Plan*	Various	$442,000	0-5 Years	Pipe Age, Condition (collapse, separation), Root Intrusion, Grade Issues
CIP-15	Charbonneau District Complete Repair[7]	Gravity - Pipe Repair	Per *Charbonneau Consolidated Improvement Plan*	Various	$1,809,000	0-5 Years	Pipe Age, Condition (collapse, separation), Root Intrusion, Grade Issues
CIP-16	Pipe Replacement - (0 To 5 Years)[8]	Gravity - Pipe Replacement	Approximately 930 LF Annually, Varied Ø	Various, Approximately $360,000 Annually	$1,750,000	0-5 Years	Pipe Age, Root Intrusion, Grade Issues (concrete pipe)
CIP-17	Town Center Loop Pump Station	Pump Station - Replacement	Replace Pump Station	Existing pump station	$440,000	0-5 Years	Priming and debris issues, limited back pressure, excessive maintenance
CIP-18	River Village Pump Station	Pump Station - Decommission	Decommission Pump Station	Existing pump station	$30,000	0-5 Years	End of pump station service life, electrical equipment failure
CIP-19	Boones Ferry Park Grinder Pump	Pump Station - Restroom Grinder Pump	New grinder pump for park restrooms	Boones Ferry Park	$30,000	0-5 Years	Service to park restrooms with decommissioning of River Village pump station
CIP-20	Pump Station Rehabilitation - (0 To 5 Years)	Pump Station - Rehabilitation	Rehabilitate aging Pumps/Electrical	Corral Creek and Rivergreen pump stations	$375,000	0-5 Years	End of pump station service life
CIP-21	Charbonneau District Complete Repair[7]	Gravity - Pipe Repair	3,500 LF 8"Ø; 790 LF 10"Ø; 680 LF 12"Ø	Various	$1,275,000	6-10 Years	Pipe Age, Condition (collapse, separation), Root Intrusion, Grade Issues
CIP-22	Pipe Replacement - (6 To 10 Years)[8]	Gravity - Pipe Replacement	Approximately 930 LF Annually, Varied Ø	Various, Approximately $360,000 Annually	$1,750,000	6-10 Years	Pipe Age, Root Intrusion, Grade Issues (concrete pipe)
CIP-23	Pump Station Rehabilitation - (6 To 10 Years)	Pump Station - Rehabilitation	Rehabilitate aging Pumps/Electrical	Charbonneau pump station	$100,000	6-10 Years	End of pump station service life
CIP-24	Charbonneau District Complete Repair[7]	Gravity - Pipe Repair	9,835 LF 8"Ø; 1,240 LF 15"Ø	Various	$3,293,000	11-20 Years	Pipe Age, Condition (collapse, separation), Root Intrusion, Grade Issues
CIP-25	Pipe Replacement - (11 To 20 Years)[8]	Gravity - Pipe Replacement	Approximately 930 LF Annually, Varied Ø	Various, Approximately $360,000 Annually	$3,500,000	11-20 Years	Pipe Age, Root Intrusion, Grade Issues (concrete pipe)
CIP-26	Pump Station Rehabilitation - (11 To 20 Years)	Pump Station - Rehabilitation	Rehabilitate aging Pumps/Electrical	Morey's Landing pump station	$200,000	11-20 Years	End of pump station service life
				Total	$15,684,000		

Table 7-3 Capital Improvement Program, New Infrastructure for Future Development									
Project ID No.	Project Information				Estimated Cost[1, 2]	Oversize Cost[10]	Prioritization Category	Time Frame[3]	Driver
	Name	Type	Description[4]	Project Limits					
CIP-27	Coffee Creek - Clutter Road	Gravity - New Pipe	1,410 LF 15"Ø	From Grahams Ferry Road to Garden Acres Road	$1,990,000	$310,000	UGB	0-5 Years	Coffee Creek development
CIP-28	Coffee Creek - Ridder Road	Gravity - New Pipe	910 LF 18"Ø	From Garden Acres Road to BPA Substation	$1,890,000	$370,000	UGB	0-5 Years	Coffee Creek development
CIP-29	Coffee Creek - Grahams Ferry Road	Gravity - New Pipe	600 LF 8"Ø; 580 LF 12"Ø	From Clutter Road to Cahalin Road	$1,100,000	$70,000	UGB	0-5 Years	Coffee Creek development
CIP-30	Coffee Creek - Garden Acres	Gravity - New Pipe	1,480 LF 8"Ø	From 25450 SW Garden Acres Road to Cahalin Road	$990,000	$0	UGB	0-5 Years	Coffee Creek development
CIP-31	Coffee Creek - Day Road	Gravity - New Pipe	2,060 LF 18"Ø; 900 LF 12"Ø	From Grahams Ferry Road to Boones Ferry Road	$2,790,000	$580,000	UGB	0-5 Years	Coffee Creek development
CIP-32	Coffee Creek - Kinsman Road	Gravity - New Pipe	3,100 LF 18"Ø	From Day Road to Ridder Road	$5,390,000	$1,120,000	UGB	0-5 Years	Coffee Creek development
CIP-33	Frog Pond/Advance Rd URA - SW Boeckman Road	Gravity - New Pipe	2,800 LF 18"Ø	From Stafford Road to Boeckman Creek	$4,170,000	$910,000	UGB	0-5 Years	Frog Pond development
CIP-34	Frog Pond/Advance Rd URA – SW Stafford Road	Gravity - New Pipe	2,700 LF 12"Ø	From Kahle Road to Boeckman Road	$2,520,000	$300,000	UGB	0-5 Years	Frog Pond development
CIP-35	Frog Pond/Advance Rd URA - Boeckman Interceptor Extension	Gravity - New Pipe	3,350 LF 12"Ø	From UGB to Boeckman Road	$3,970,000	$480,000	UGB	0-5 Years	Frog Pond development
CIP-36	Frog Pond/Advance Rd URA - South Of Frog Pond Lane	Gravity - New Pipe	1,800 LF 10"Ø	From Frog Pond Lane to Boeckman Road	$820,000	$80,000	UGB	0-5 Years	Frog Pond development
CIP-37	Frog Pond/Advance Rd URA - SW 60th Avenue	Gravity - New Pipe	1,850 LF 10"Ø; 1,250 LF 12"Ø	From 28424 SW 60th Avenue to Advance Road	$2,180,000	$210,000	UGB	0-5 Years	Advance Rd School development
CIP-38	Frog Pond/Advance Rd URA - SW 60th Avenue Pump Station	Pump Station + Force Main - New	1,350 LF 8"Ø FM, ~600 gpm pump station	From pump station to 60th Avenue sewer	$1,360,000	Note 11	UGB	0-5 Years	Advance Rd School development
CIP-39	Area 1 (Basalt Creek - East)[9]	Gravity - New Pipe	13,100 LF 10-12"Ø	Basalt Creek East - Concept Plan Required	$10,490,000	$1,470,000	UGB	6-10 Years	Basalt Creek development
CIP-40	Area 2 (Basalt Creek - Central)[9]	Gravity - New Pipe	9,900 LF 10-12"Ø	Basalt Creek Central - Concept Plan Required	$7,920,000	$1,110,000	UGB	6-10 Years	Basalt Creek development
CIP-41	Area 3 (Basalt Creek - West)[9]	Gravity - New Pipe	6,600 LF 10"Ø	Basalt Creek West - Concept Plan Required	$4,930,000	$380,000	UGB	6-10 Years	Basalt Creek development
CIP-42	Area 4 (SW Tualatin)[9]	Pump Station + Force Main - New	4,200 LF 8"Ø FM, ~300 gpm pump station	SW Tualatin - Concept Plan Required	$2,260,000	Note 11	UGB	6-10 Years	SW Tualatin development
CIP-43	Area 5 (West Railroad - North)[9]	Pump Station + Force Main - New	3,300 LF 12"Ø FM; ~800 gpm pump station	West Railroad North - Concept Plan Required	$3,060,000	Note 11	UGB	6-10 Years	West Railroad development
CIP-44	Area 6 (West Railroad - South)[9]	Pump Station + Force Main - New	1,400 LF 6"Ø FM; ~200 gpm pump station	West Railroad South - Concept Plan Required	$1,170,000	Note 11	UGB	6-10 Years	West Railroad development
CIP-45	Area 9 (South UGB - West)[9]	Pump Station + Force Main - New	2,600 LF 8"Ø FM; ~400 gpm pump station	South UGB West - Concept Plan Required	$1,660,000	Note 11	UGB	6-10 Years	South UGB development
CIP-46	Area 10 (South UGB - East)[9]	Pump Station + Force Main - New	1,300 LF 6"Ø FM; ~200 gpm pump station	South UGB East - Concept Plan Required	$1,130,000	Note 11	UGB	6-10 Years	South UGB development

Table 7-3 Capital Improvement Program, New Infrastructure for Future Development

Project ID No.	Project Information: Name	Type	Description[4]	Project Limits	Estimated Cost[1, 2]	Oversize Cost[10]	Prioritization Category	Time Frame[3]	Driver
CIP-47	Frog Pond/Advance Rd URA - Advance Road	Gravity - New Pipe	1,150 LF 10"Ø; 1,450 LF 15"Ø	From 5696 SW Advance Road to Stafford Road	$2,110,000	$300,000	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond)
CIP-48	Frog Pond/Advance Rd URA - SW Briar Patch Lane	Gravity - New Pipe	1,200 LF 10"Ø	From Newland Creek to Stafford Road	$1,460,000	$90,000	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond)
CIP-49	Frog Pond/Advance Rd URA - North Neighborhood Pump Station 1	Pump Station + Force Main - New	2,400 LF 4"Ø FM, ~200 gpm pump station	From pump station to Briar Patch Lane sewer	$1,680,000	Note 11	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond)
CIP-50	Frog Pond/Advance Rd URA - North Neighborhood Pump Station 2	Pump Station + Force Main - New	1,100 LF 4"Ø FM, ~200 gpm pump station	From pump station to Briar Patch Lane sewer	$1,140,000	Note 11	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond)
CIP-51	Frog Pond/Advance Rd URA - North Neighborhood Pump Station 3	Pump Station + Force Main - New	860 LF 4"Ø FM, ~200 gpm pump station	From pump station to Advance Road sewer	$1,050,000	Note 11	Advance Road URA	6-10 Years	URA development (adjacent to Advance Road and Frog Pond)
CIP-52	Area 7 (URA Near Westfall Rd & Grahams Ferry Rd)[9]	Gravity - New Pipe	13,100 LF 10"Ø	URA West Falls and Grahams Ferry North - Concept Plan Required	$11,280,000	$2,220,000	URA	11-20 Years	URA development
CIP-53	Area 8 (URA Near Willamette Way & Wilsonville Rd)[9]	Pump Station + Force Main - New	1,800 LF 8"Ø FM; ~300 gpm pump station	URA Willamette and Wilsonville - Concept Plan Required	$1,340,000	Note 11	URA	11-20 Years	URA development
CIP-54	Area 11 (URA Northeast - To Canyon Creek Interceptor - South)[9]	Gravity - New Pipe	8,200 LF 10-12"Ø	URA Northeast, Canyon Creek Trunk South - Concept Plan Required	$6,600,000	$920,000	URA	11-20 Years	URA development
CIP-55	Area 12 (URA Northeast - To Boeckman Interceptor)[9]	Gravity - New Pipe	14,200 LF 10-15"Ø	URA Northeast, Boeckman Trunk - Concept Plan Required	$12,240,000	$2,410,000	URA	11-20 Years	URA development
CIP-56	Area 13 (URA Northeast - To Canyon Creek Interceptor - North)[9]	Gravity - New Pipe	8,300 LF 10-12"Ø	URA Northeast, Canyon Creek Trunk North - Concept Plan Required	$6,700,000	$940,000	URA	11-20 Years	URA development
CIP-57	Area 14 (URA Northeast - To Parkway Interceptor)[9]	Gravity - New Pipe	8,300 LF 10-12"Ø	URA Northeast, Parkway Trunk - Concept Plan Required	$6,680,000	$940,000	URA	11-20 Years	URA development
				Total	$114,070,000	$15,210,000			

SUMMARY

This section presents a proposed City CIP for the 20-year period between 2014 and 2034, based on Tables 7-1 through 7-3. Improvements are defined to address condition issues within the existing system, future growth within the UGB, and potential UGB expansion. The total estimated project costs are summarized in Table 7-4.

Table 7-4 Capital Improvement Program Summary (Estimated Total Costs)					
Improvement Category	Prioritization Category	Time Frame (Cost)[1, 2, 3]			Total Cost
		0-5 Years	6-10 Years	11-20 Years	
Existing System Upgrades for Future Development[6]	UGB	$3,080,000	$6,830,000	---	$9,910,000
	Advance Road URA	---	$7,510,000	---	$7,510,000
	URA	---	$300,000	$11,225,000	$11,525,000
	Total	$3,080,000	$14,640,000	$11,225,000	$28,945,000
New Infrastructure for Future Development	UGB	$29,170,000	$32,620,000	---	$61,790,000
	Advance Road URA	---	$7,440,000	---	$7,440,000
	URA	---	---	$44,840,000	$44,840,000
	Total	$29,170,000	$40,060,000	$44,840,000	$114,070,000
Condition Based[13]	UGB	$5,566,000	$3,125,000	$6,993,000	$15,684,000

The CIP costs are categorized in Table 7-5 by funding mechanism including the following categories:

- City's Sewer Operating Fund – Condition-based improvements
- City's Sewer Operating Fund – Existing system upgrades [*Operating Fund Cost = Total Cost x (Peak Existing Flow / Peak Build-out Flow)*]
- City's SDC Fund – Existing system upgrades [SDC Fund Cost = *Total Cost x (1 - Peak Existing Flow / Peak Build-out Flow)*]
- City's SDC Fund – New Piping Infrastructure, Oversizing Component
- Developer Direct Contribution – New Piping Infrastructure, Non-oversizing Component
- Developer Direct Contribution – New Pump Stations and Associated Force mains (may require formation of reimbursement district)

Table 7-5 Capital Improvement Program Summary By Funding Mechanism (Estimated Total Costs)					
Funding Mechanism[12]	Prioritization Category	Time Frame (Cost)[1, 2, 3]			Total Cost
		0-5 Years	6-10 Years	11-20 Years	
City's Sewer Operating Fund - Condition Based[13]	UGB	$5,566,000	$3,125,000	$6,993,000	$15,684,000
City's Sewer Operating Fund - Existing System Upgrades	UGB	$1,208,000	$1,364,500	---	$2,572,500
	Advance Road URA	---	$854,000	---	$854,000
	URA	---	$90,000	$4,017,000	$4,107,000
	Total	$1,208,000	$2,308,500	$4,017,000	$7,533,500
City's SDC Fund - Existing System Upgrades	UGB	$1,872,000	$5,465,500	---	$7,337,500
	Advance Road URA	---	$6,656,000	---	$6,656,000
	URA	---	$210,000	$7,208,000	$7,418,000
	Total	$1,872,000	$12,331,500	$7,208,000	$21,411,500
City's SDC Fund - New Piping Infrastructure, Oversizing Component	UGB	$4,430,000	$2,960,000	---	$7,390,000
	Advance Road URA	---	$390,000	---	$390,000
	URA	---	---	$7,430,000	$7,430,000
	Total	$4,430,000	$3,350,000	$7,430,000	$15,210,000
Developer Direct Contribution - New Piping Infrastructure, Non-oversizing Component	UGB	$23,380,000	$20,380,000	---	$43,760,000
	Advance Road URA	---	$3,180,000	---	$3,180,000
	URA	---	---	$36,070,000	$36,070,000
	Total	$23,380,000	$23,560,000	$36,070,000	$83,010,000
Developer Direct Contribution - New Pump Stations & Associated Force mains	UGB	$1,360,000	$9,280,000	---	$10,640,000
	Advance Road URA	---	$3,870,000	---	$3,870,000
	URA	---	---	$1,340,000	$1,340,000
	Total	$1,360,000	$13,150,000	$1,340,000	$15,850,000

Notes for Tables 7-1, 7-2, 7-3, 7-4, and 7-5

Note 1. Cost estimates represent a Class 5 budget estimate, as established by the *American Association of Cost Engineers*. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -30 percent on the low end, and +30 to +50 percent on the high end, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate. The cost estimates are consistent with the definition of OAR 660-011-0005(2) and OAR 660-011-035. They are intended to be used as guidance in establishing funding requirements based on information available at the time of the estimate.

Note 2. Cost estimates for existing system upgrades and new infrastructure improvements assume unit costs for new materials and construction. Cost estimates for condition based improvements assume unit costs for replacement materials and construction. All cost estimates include markups for construction contingency, owner administrative costs, and contract costs.

Note 3. The timing for improvement implementation is dependent on development timing. The information presented in the "time frame" column assume the following:

a. Coffee Creek – 25% developed in 0-5 year timeframe, 75% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
b. Advance Road School – 100% developed in 0-5 year timeframe.
c. Frog Pond - 40% developed in 0-5 year timeframe, 95% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
d. Basalt Creek, SW Tualatin, West Railroad – 0% developed in 0-5 year timeframe, 25% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
e. Advanced Road URA – 0% developed in 0-5 year timeframe, 25% developed in 6-10 year timeframe, 100% developed in 11-20 year timeframe.
f. URA – development in 11-20 year timeframe.

Note 4. All improvements are sized for build-out of the upstream service area at a planning level of accuracy based on population, density and land use assumptions described in Section 5 of this document. Prior to implementation, each project should undergo standard engineering design phases to finalize improvement sizing and location.

Note 5. The growth percentage is an estimate of the percentage of the build-out flow associated with future development as of 2014. *Percent related to growth = 1 – (Peak Existing Flow / Peak Build-out Flow).* The growth percentage relates directly to SDC percentage. The percentage not related to growth is funded through wastewater rates (e.g. Sewer Operating Fund).

Note 6. The Boberg diversion (CIP-01), Memorial Drive Flow Splitter (CIP-02), Seely Ditch Undercrossing (CIP-05), and Memorial Park Pump Station (CIP-06) are required for both capacity and condition. The Boberg diversion (CIP-01), Memorial Drive Flow Splitter (CIP-02), Seely Ditch Undercrossing (CIP-05) improvements are listed in Table 7-2, "Condition Based Improvements." Memorial Park Pump Station is listed in Table 7-1, "Existing System Upgrades for Future Development."

Note 7. Charbonneau condition improvements (CIP-14, CIP-15, CIP-21, and CIP-24) assume a 20-year improvement schedule.

Note 8. Pipeline replacement cost estimates assume 50% of all concrete piping will be replaced over 20-years. Pipe replacement projects including location and scope will be refined through video inspection and pipe condition inventories.

Note 9. The future development areas without concept plans have been subdivided into 14 sub-basins. Place-holder trunk line or pump station improvements have been identified for each area (CIP-39 thru CIP-46 and CIP-52 thru CIP-57). Cost estimates and improvement sizing for these areas should be refined once additional concept planning has been completed.

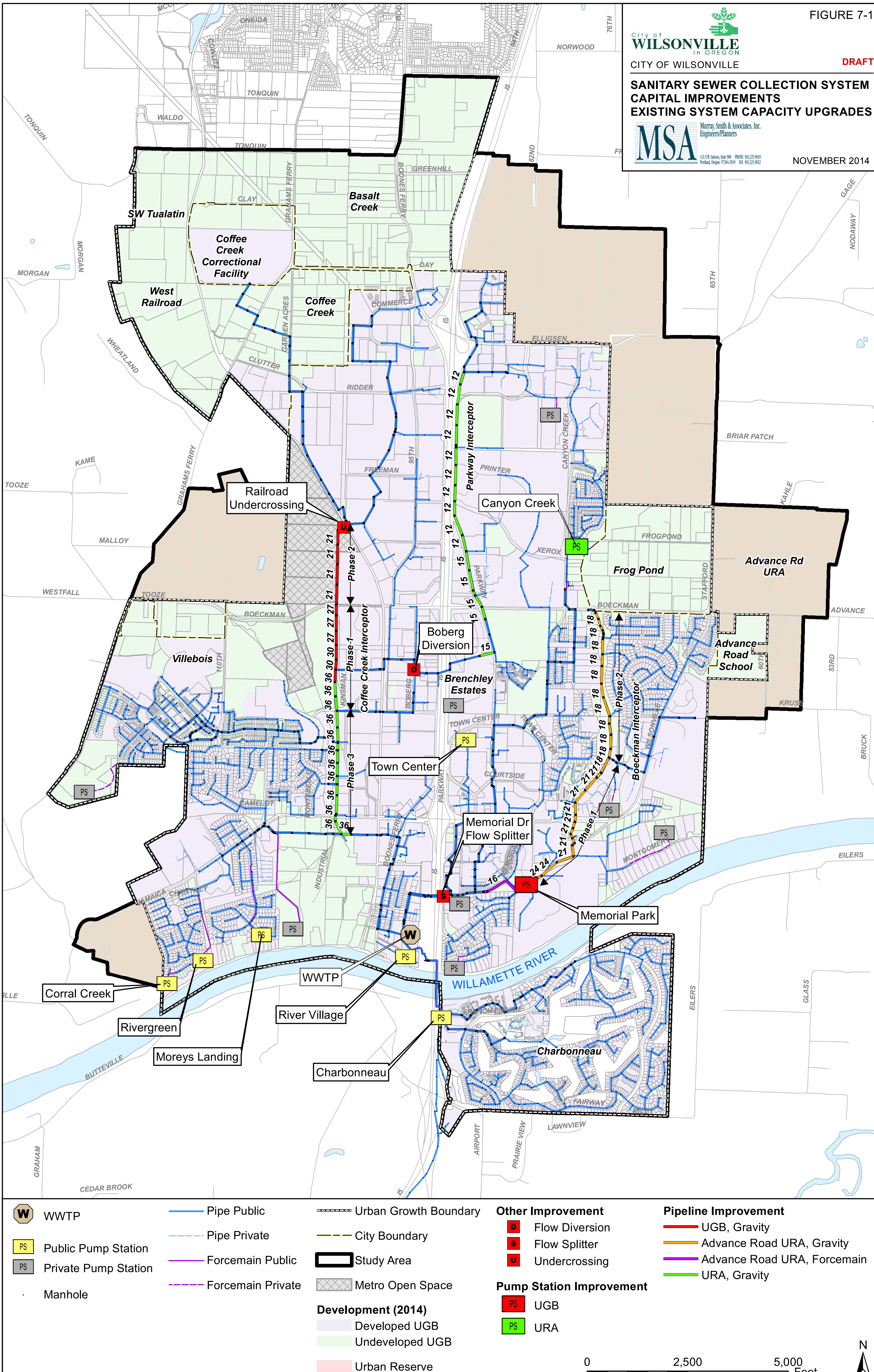
Note 10. The City's current policy requires developers to fully fund sewer line extensions of 8-inches in diameter or smaller. Sewer lines in excess of 8-inches in diameter are considered "oversized" by the City and may be eligible to receive SDC credits. The "oversize" cost estimate equals the total project cost minus the cost of the project if sized at 8-inches.

Note 11. Pump station improvements may require formation of a reimbursement district.

Note 12. The CIP costs are categorized in Table 7-5 by funding mechanism including the following categories:

- City's Sewer Operating Fund – Condition-based improvements
- City's Sewer Operating Fund – Existing system upgrades [*Operating Fund Cost = Total Cost x (Peak Existing Flow / Peak Build-out Flow)*]
- City's SDC Fund – Existing system upgrades [SDC Fund Cost = *Total Cost x (1 - Peak Existing Flow / Peak Build-out Flow)*]
- City's SDC Fund – New Piping Infrastructure, Oversizing Component
- Developer Direct Contribution – New Piping Infrastructure, Non-oversizing Component
- Developer Direct Contribution – New Pump Stations and Associated Force mains (may require formation of reimbursement district)

Note 13. Condition based portion of the Memorial Park Pump Station improvement (CIP-06) excluded. Full cost of Memorial Park Pump Station included in "Existing System Upgrades for Future Development."



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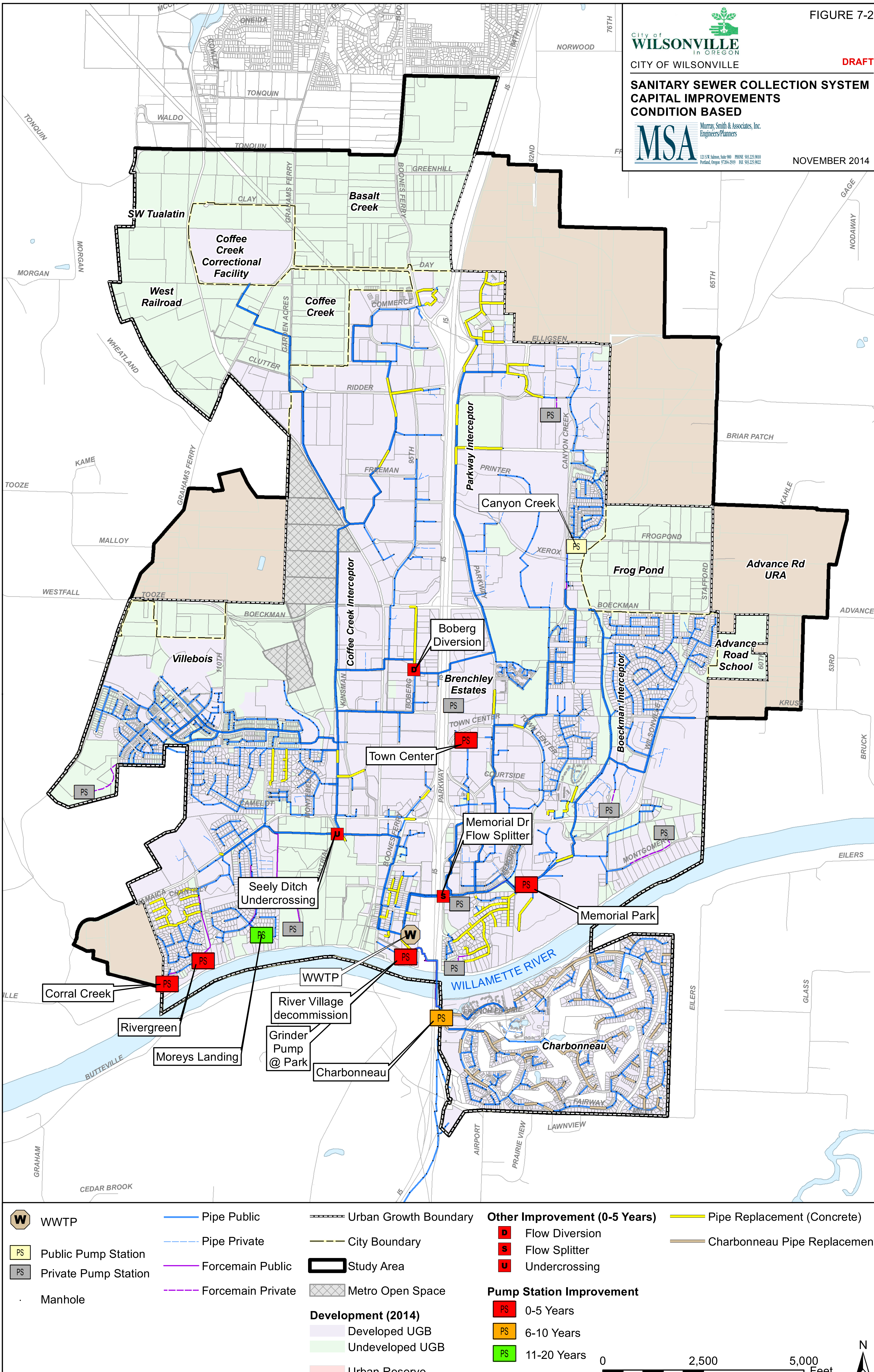


FIGURE 7-2
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
DRAFT
SANITARY SEWER COLLECTION SYSTEM
CAPITAL IMPROVEMENTS
CONDITION BASED
MSA Murray, Smith & Associates, Inc. Engineers/Planners
NOVEMBER 2014
SW Tualatin
Coffee Creek Correctional Facility
Basalt Creek
West Railroad
Coffee Creek
Parkway Interceptor
Canyon Creek
Frog Pond
Advance Rd URA
Coffee Creek Interceptor
Boberg Diversion
Brenchley Estates
Villebois
Advance Road School
Boeckman Interceptor
Town Center
Memorial Dr Flow Splitter
Seely Ditch Undercrossing
Memorial Park
WILLAMETTE RIVER
Corral Creek
WWTP
River Village decommission
Rivergreen
Grinder Pump @ Park
Moreys Landing
Charbonneau
WWTP
Public Pump Station
Private Pump Station
Manhole
Pipe Public
Pipe Private
Forcemain Public
Forcemain Private
Urban Growth Boundary
City Boundary
Study Area
Metro Open Space
Development (2014)
Developed UGB
Undeveloped UGB
Urban Reserve
Other Improvement (0-5 Years)
Flow Diversion
Flow Splitter
Undercrossing
Pump Station Improvement
0-5 Years
6-10 Years
11-20 Years
Pipe Replacement (Concrete)
Charbonneau Pipe Replacement
0 2,500 5,000 Feet
N
G:\PDX_Projects\13\1481\GIS\MXD\Wilsonville_CIP_Figures_10-01-2014_Fig7-2.mxd 11/26/2014 3:32:15 PM SJR

FIGURE 7-3

City of WILSONVILLE in OREGON

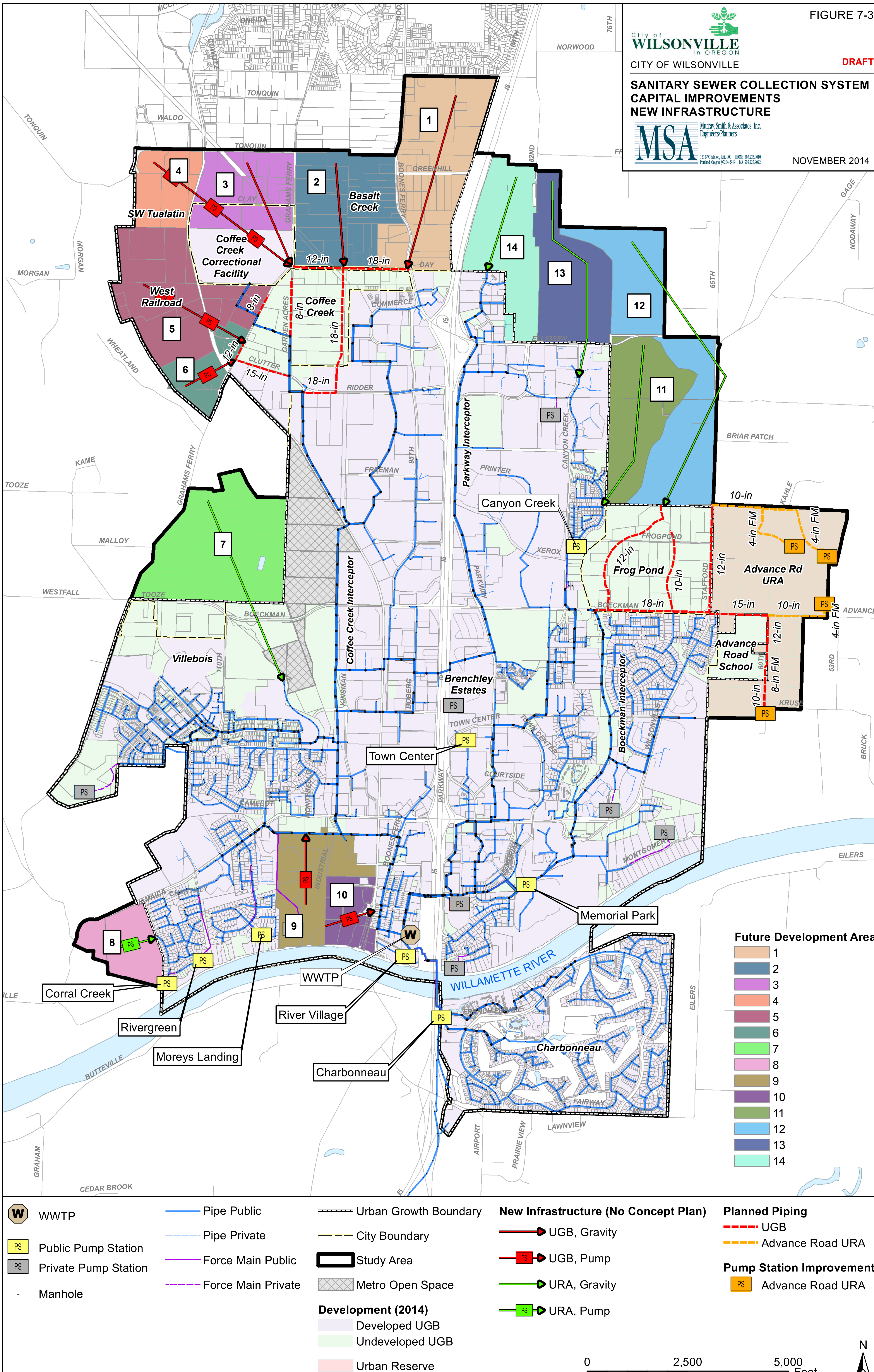
CITY OF WILSONVILLE

DRAFT

SANITARY SEWER COLLECTION SYSTEM CAPITAL IMPROVEMENTS NEW INFRASTRUCTURE

MSA Murray, Smith & Associates, Inc. Engineers/Planners

NOVEMBER 2014



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APPENDIX A | MODEL CALIBRATION PLOTS

Appendix A includes plots of metered versus modeled flow rates for the hydraulic model calibration. Figures A-1 through A-10 depict dry weather calibration results. Figures A-11 through A-17 depict wet weather calibration results during the January 2012 storm event.

Figure A-1 | Model dry weather flow calibration for Parkway Interceptor (2012)

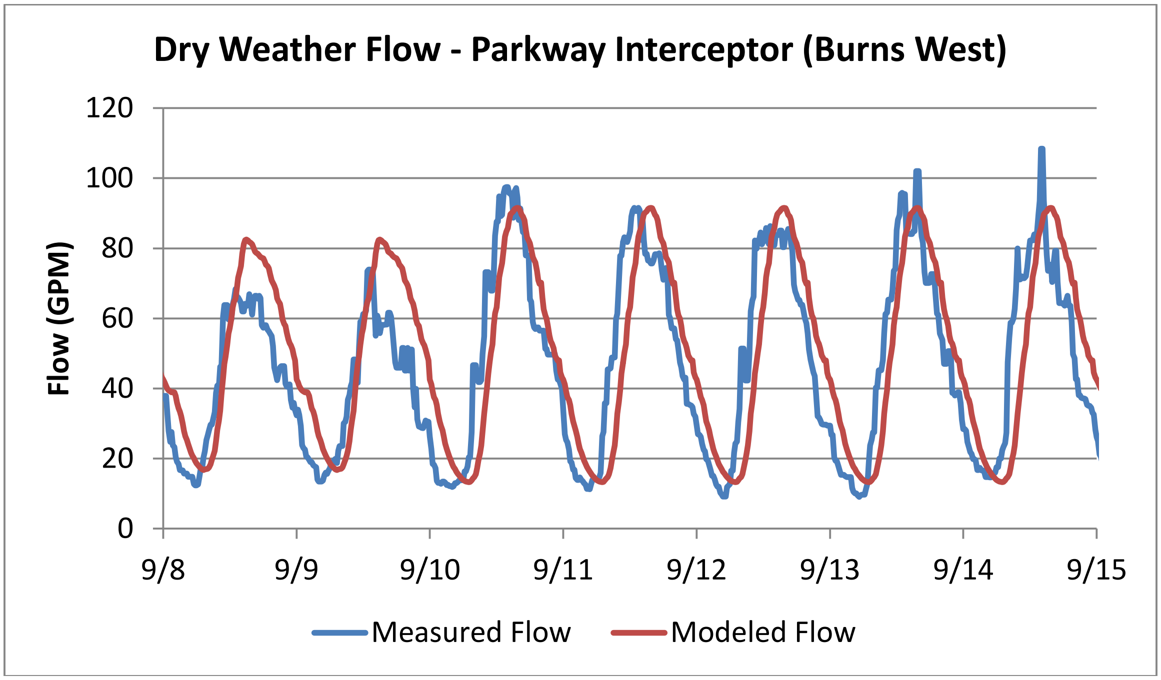


Figure A-2 | Model dry weather flow calibration for Canyon Creek (2012)

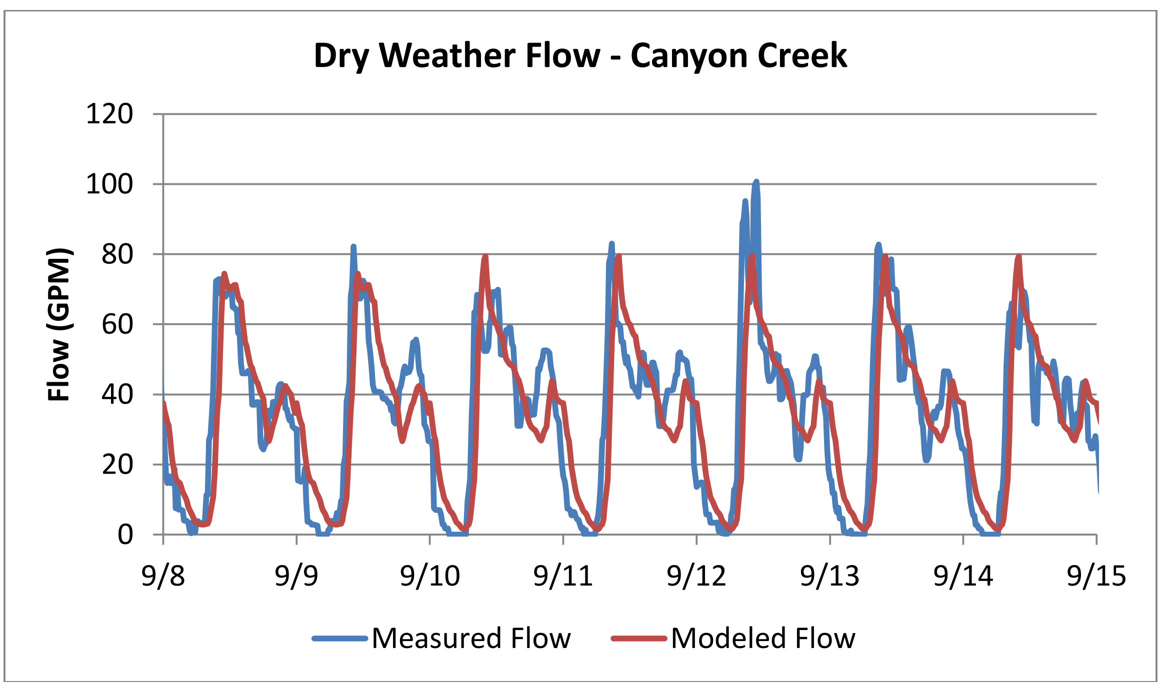


Figure A-3 | Model dry weather flow calibration for Boeckman Interceptor (2012)

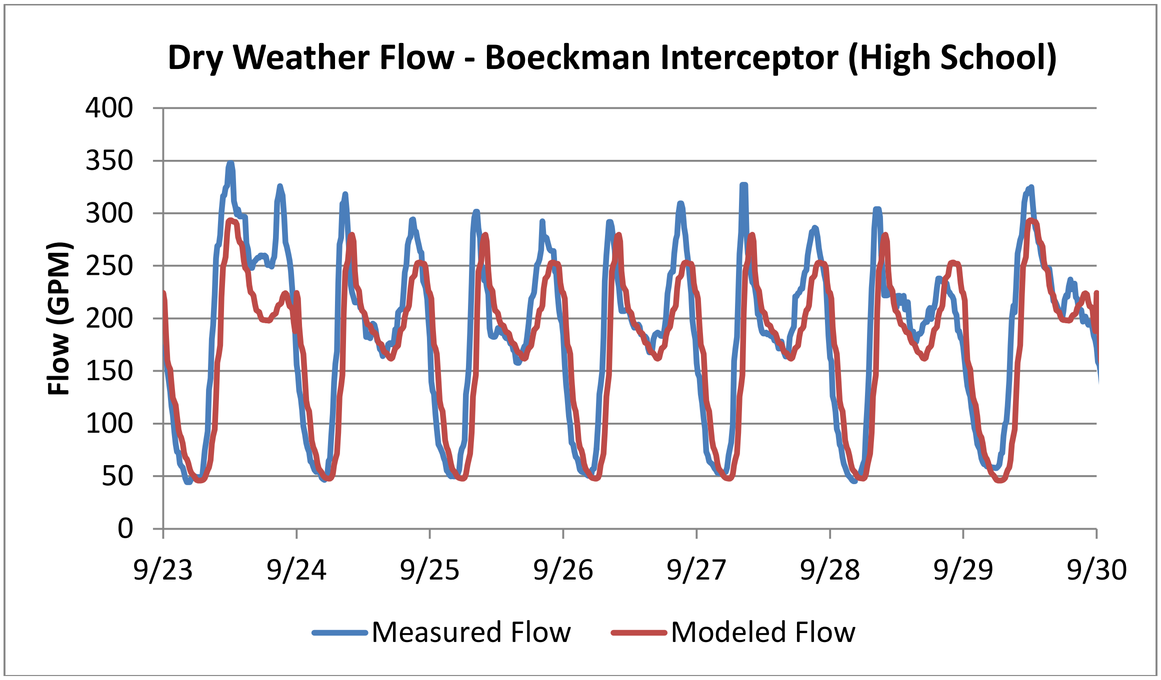


Figure A-4 | Model dry weather flow calibration for I-5 Crossing (2012)

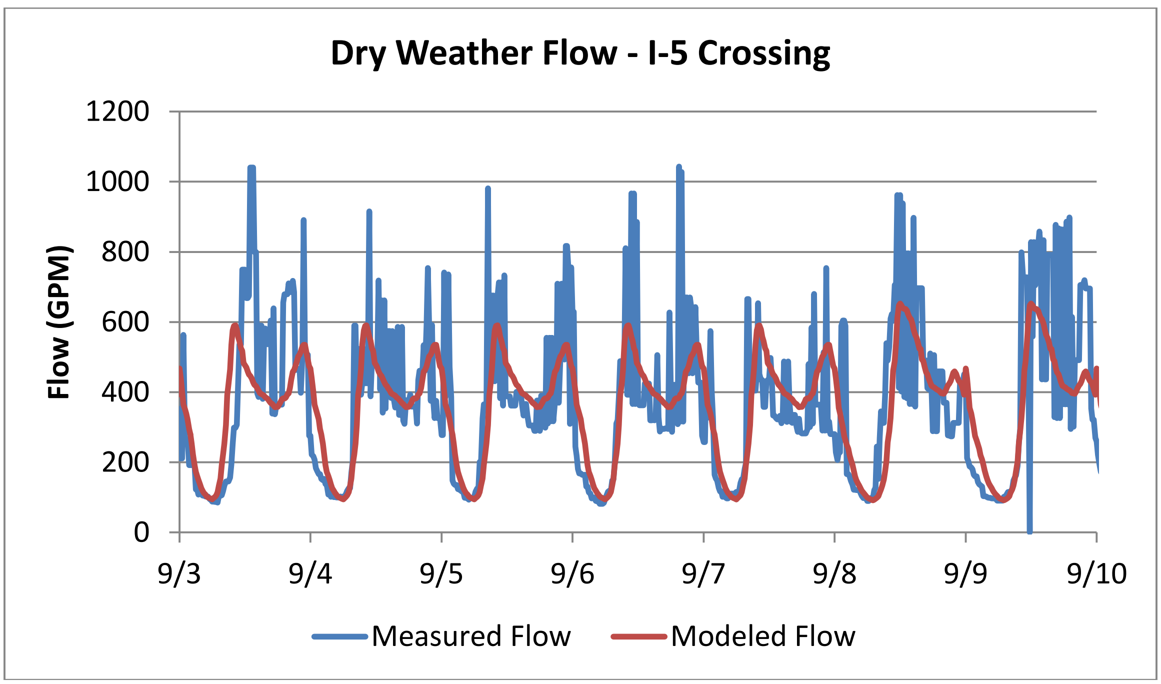


Figure A-5 | Model dry weather flow calibration for Memorial Park Pump Station (2012)

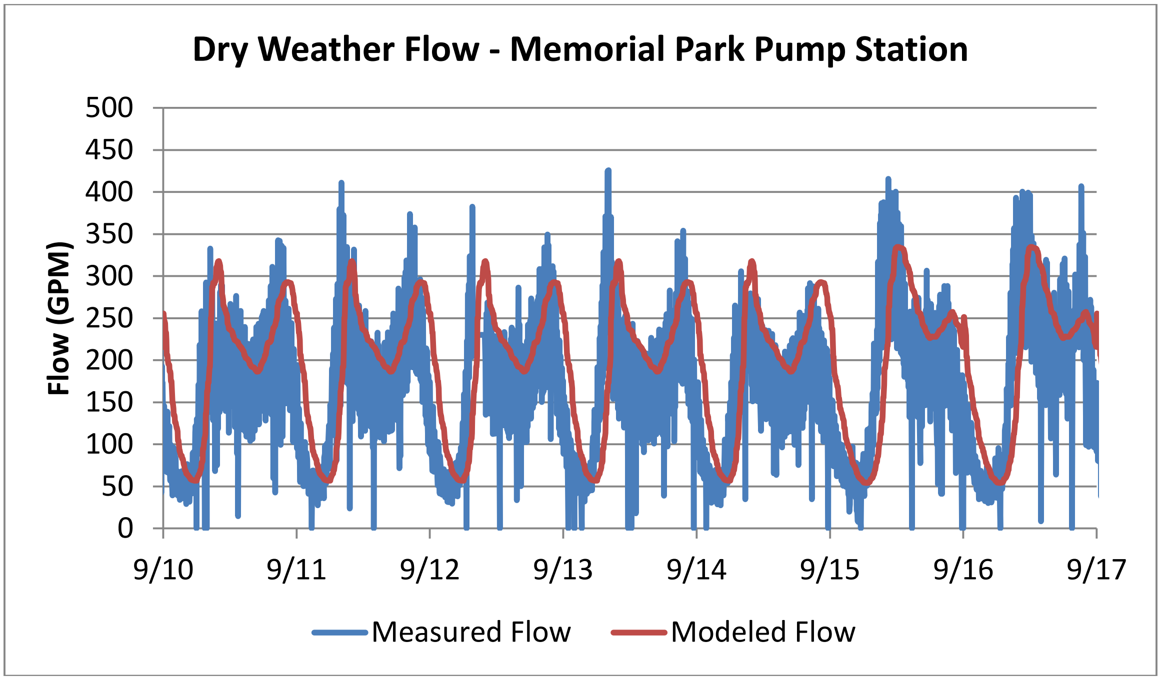


Figure A-6 | Model dry weather flow calibration for Coffee Creek Interceptor North (2012)

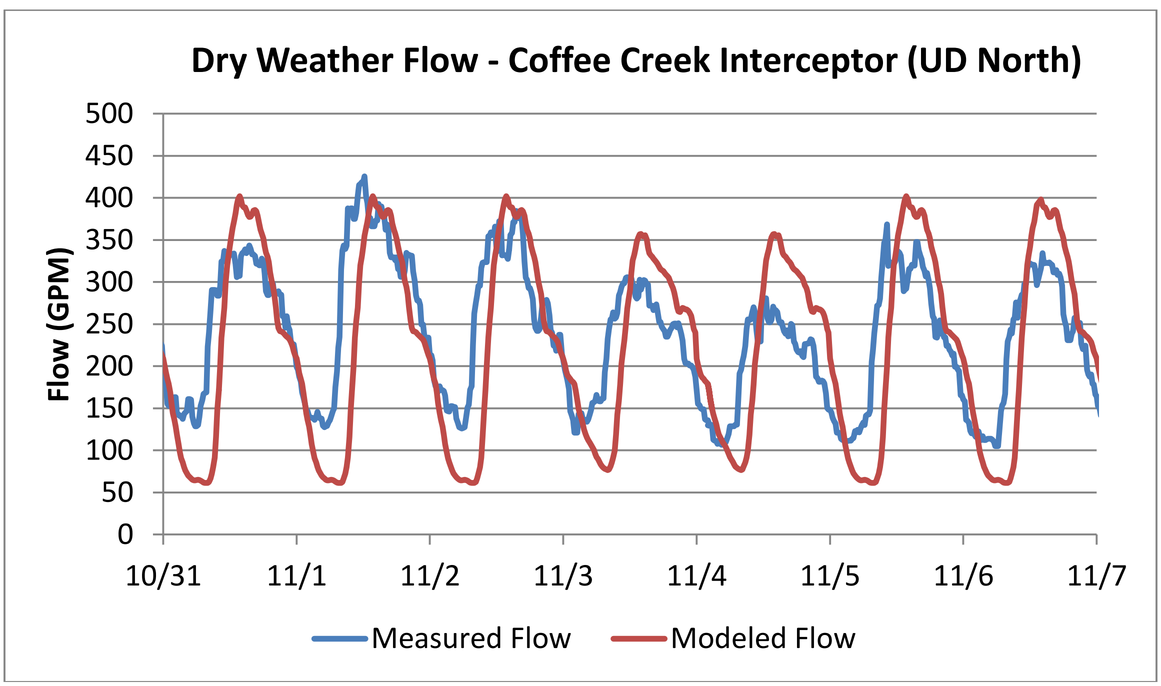


Figure A-7 | Model dry weather flow calibration for Coffee Creek Interceptor South (2012)

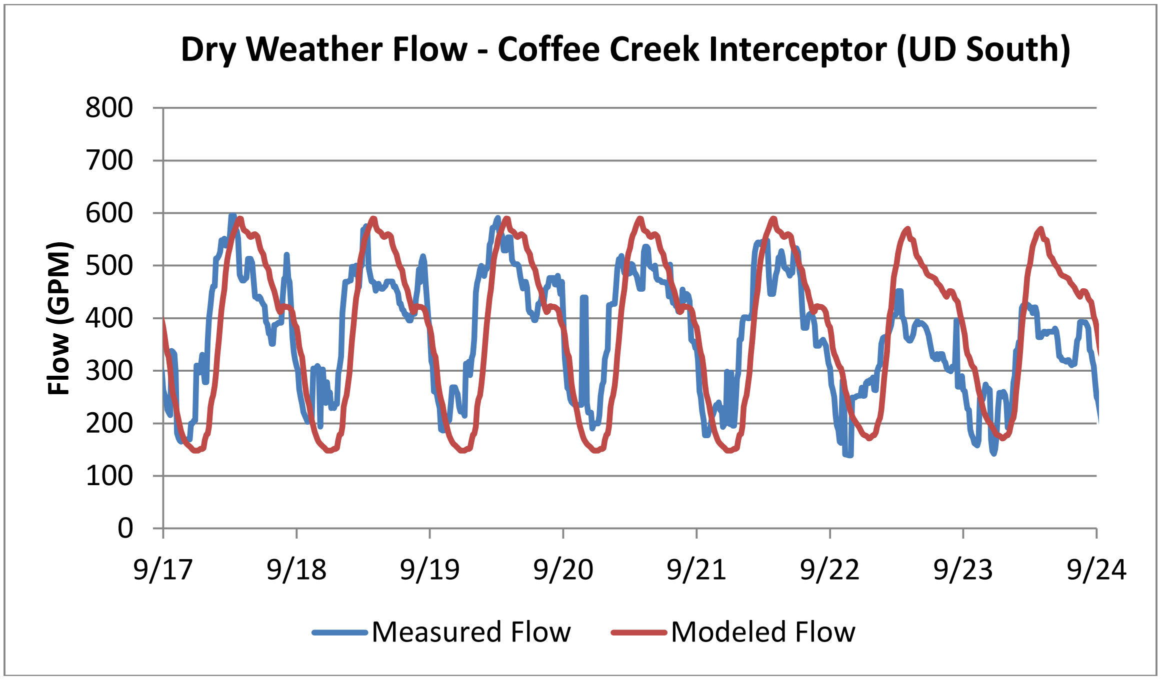


Figure A-8 | Model dry weather flow calibration for Villebois (2012)

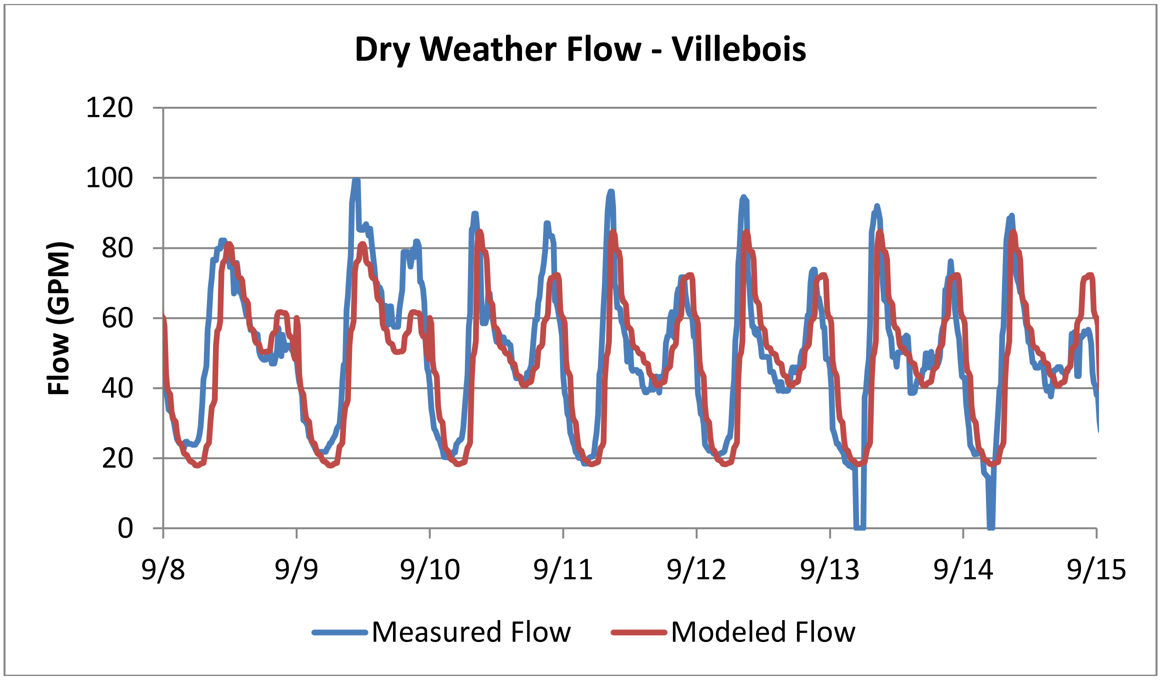


Figure A-9 | Model dry weather flow calibration for Wood School (2012)

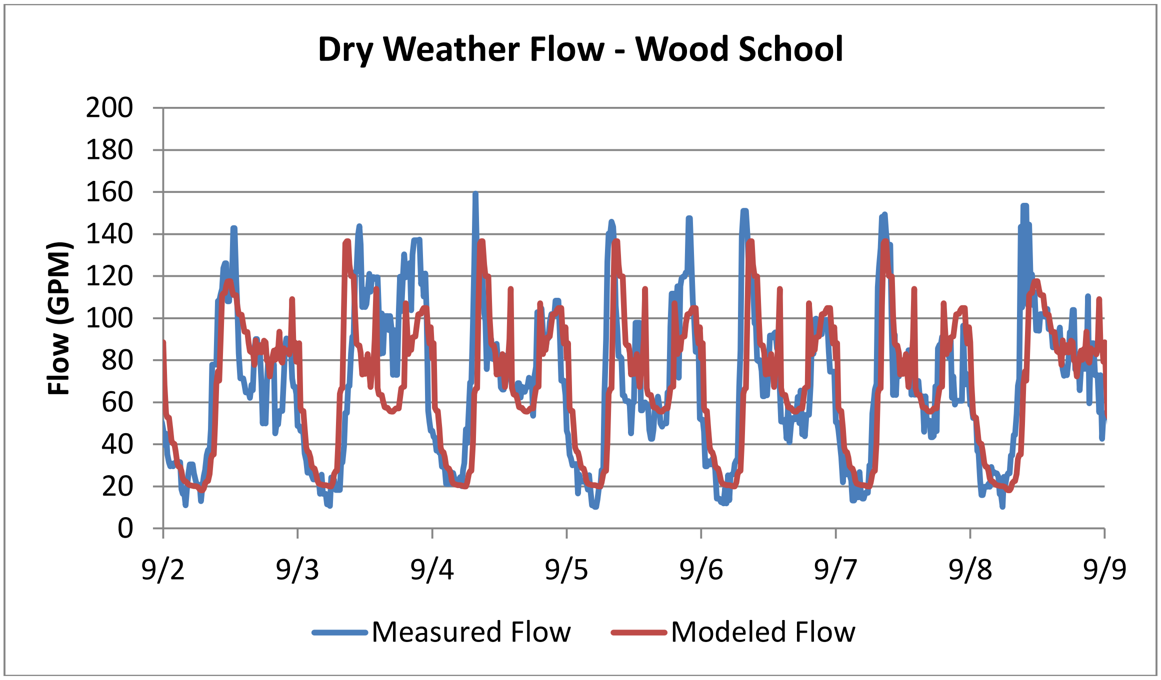


Figure A-10 | Model dry weather flow calibration for WWTP (2012)

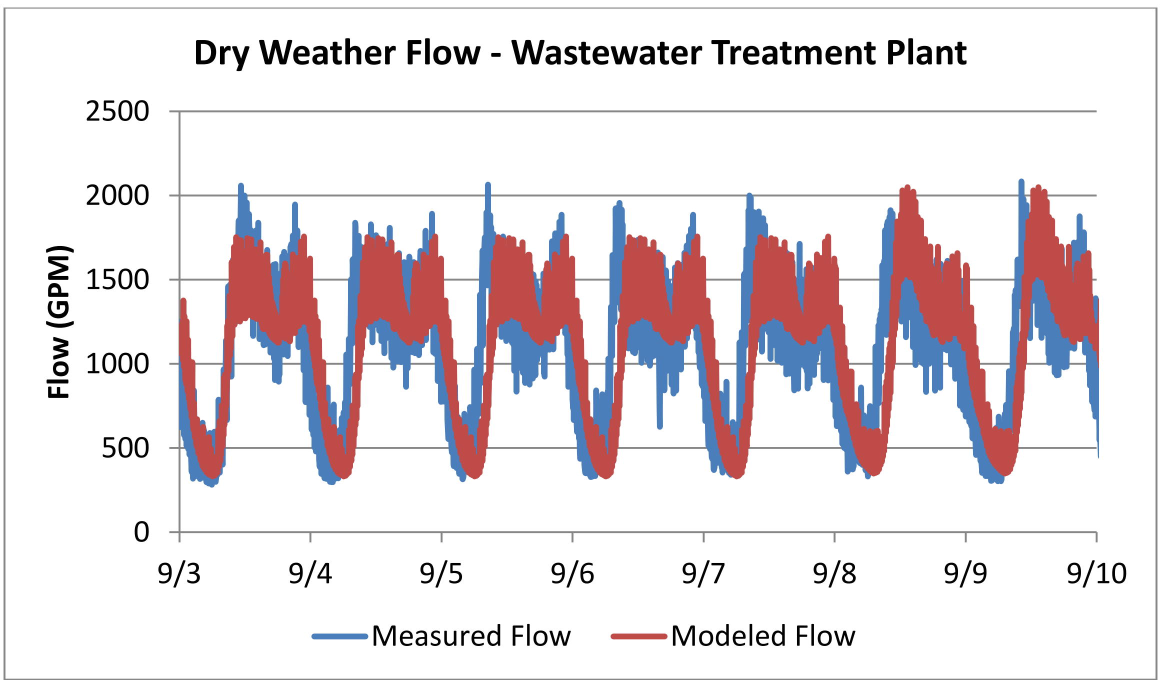


Figure A-11 | Model wet weather flow calibration for Parkway Interceptor (2012)

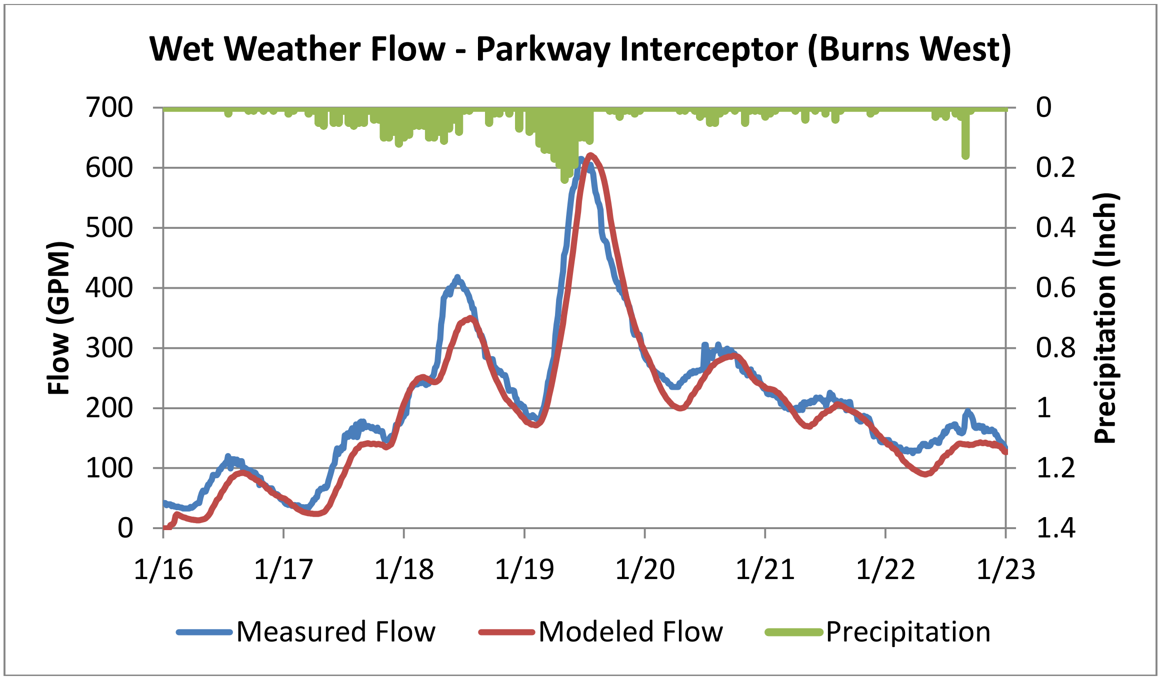


Figure A-12 | Model wet weather flow calibration for Evergreen (2012)

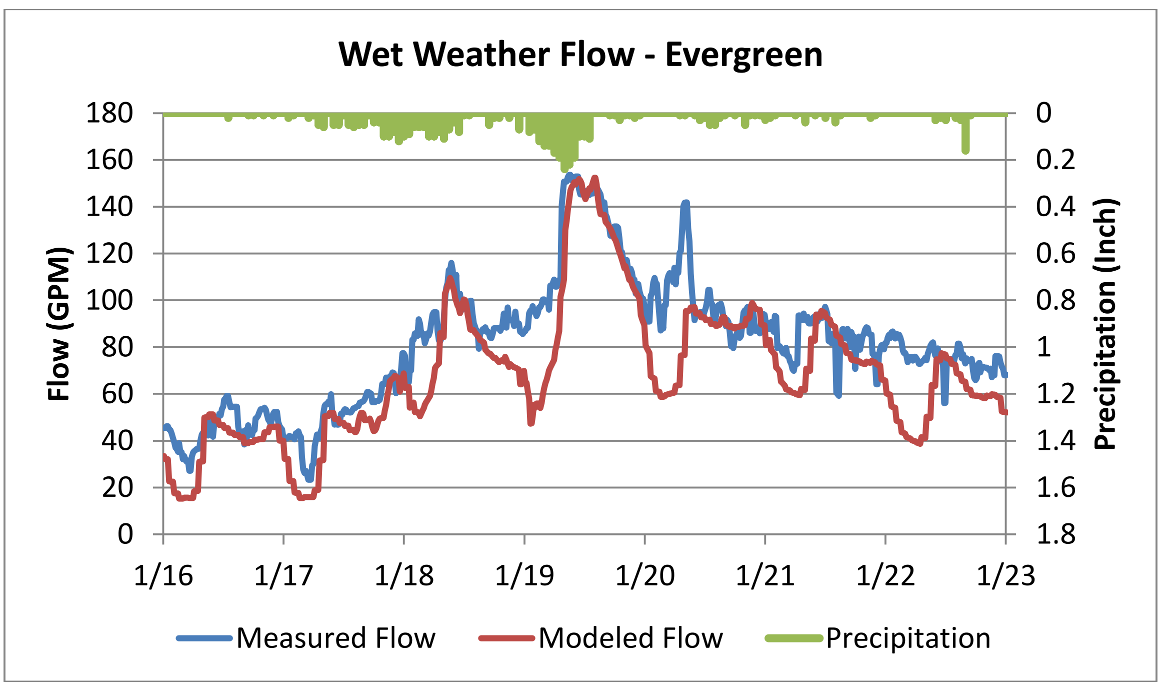


Figure A-13 | Model wet weather flow calibration for Boeckman Interceptor (2012)

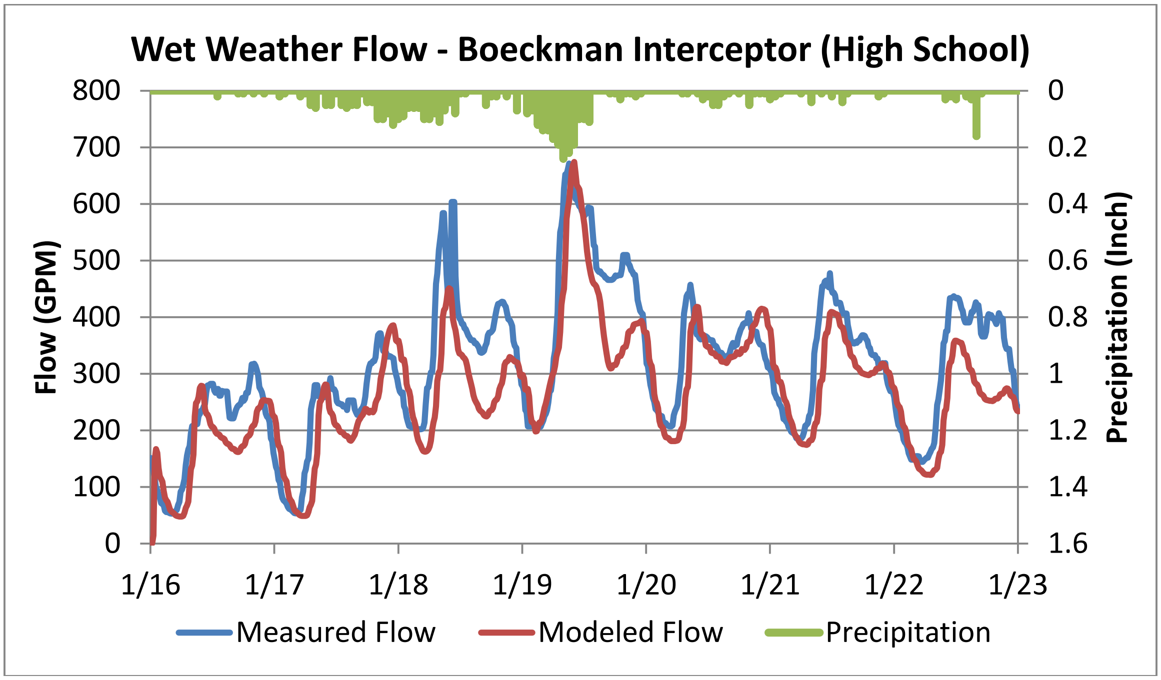


Figure A-14 | Model wet weather flow calibration for Memorial Park Pump Station (2012)

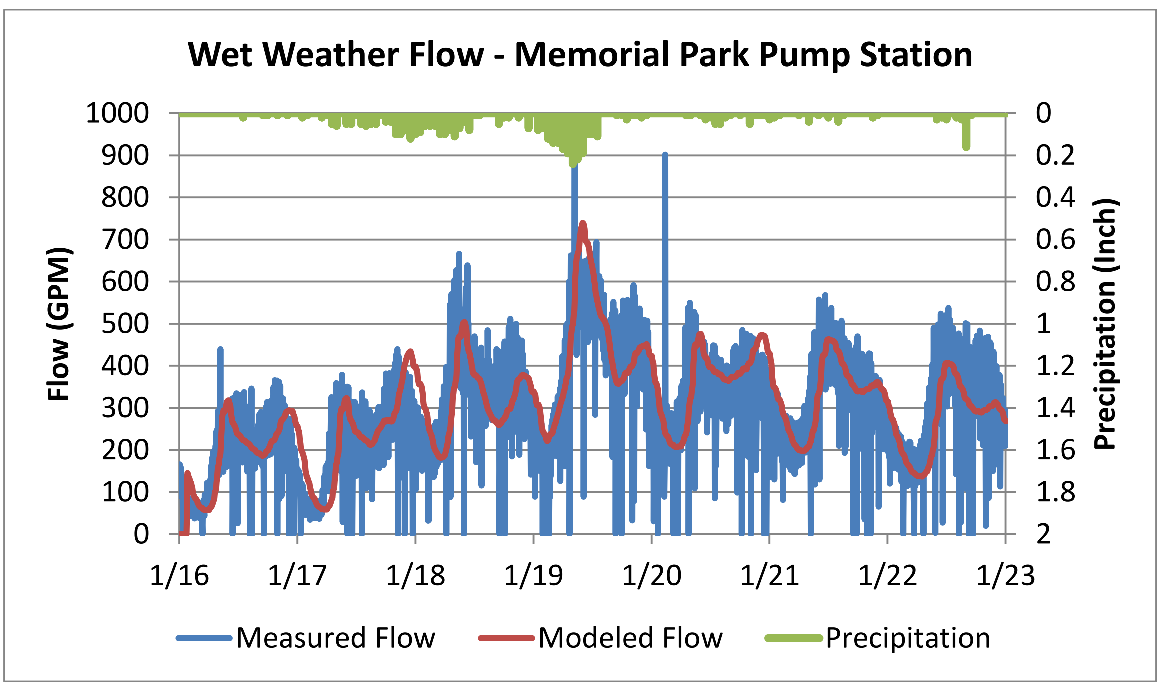


Figure A-15 | Model wet weather flow calibration for Coffee Creek Interceptor North (2012)

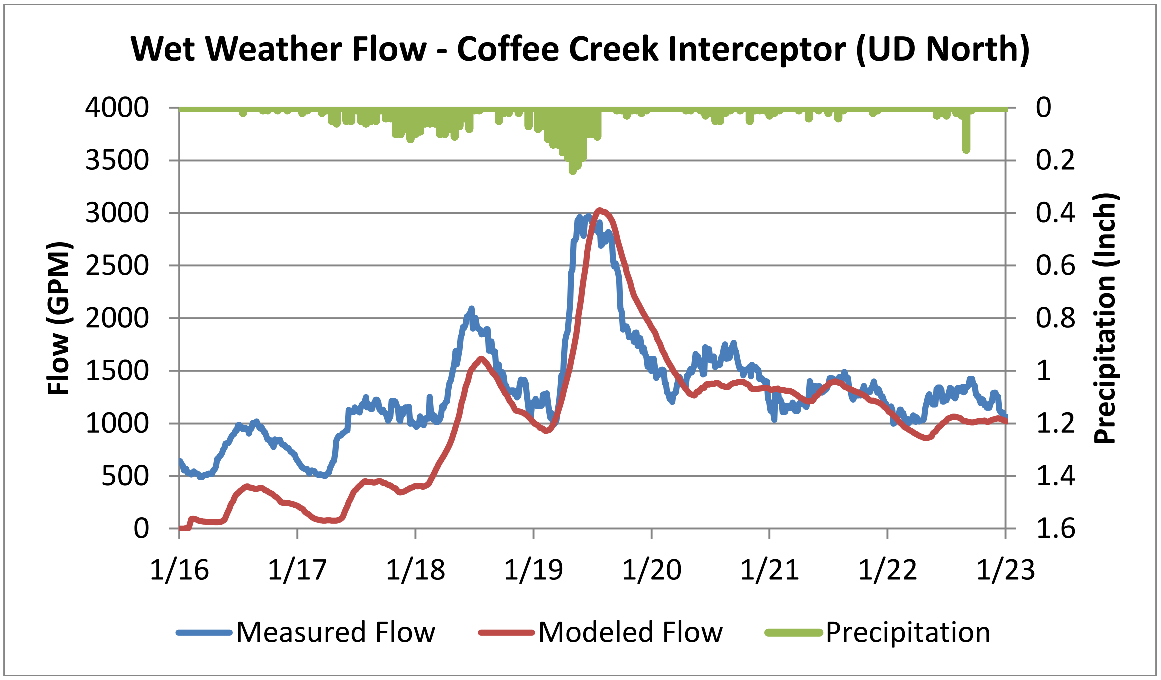


Figure A-16 | Model wet weather flow calibration for Wood School (2012)

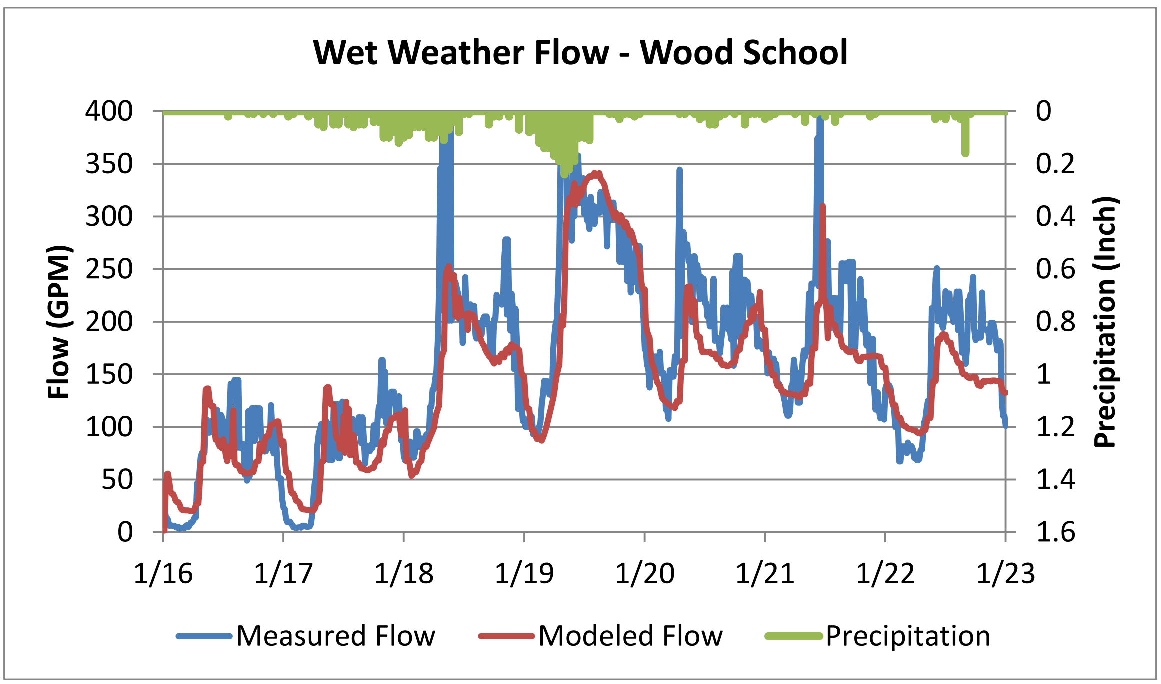
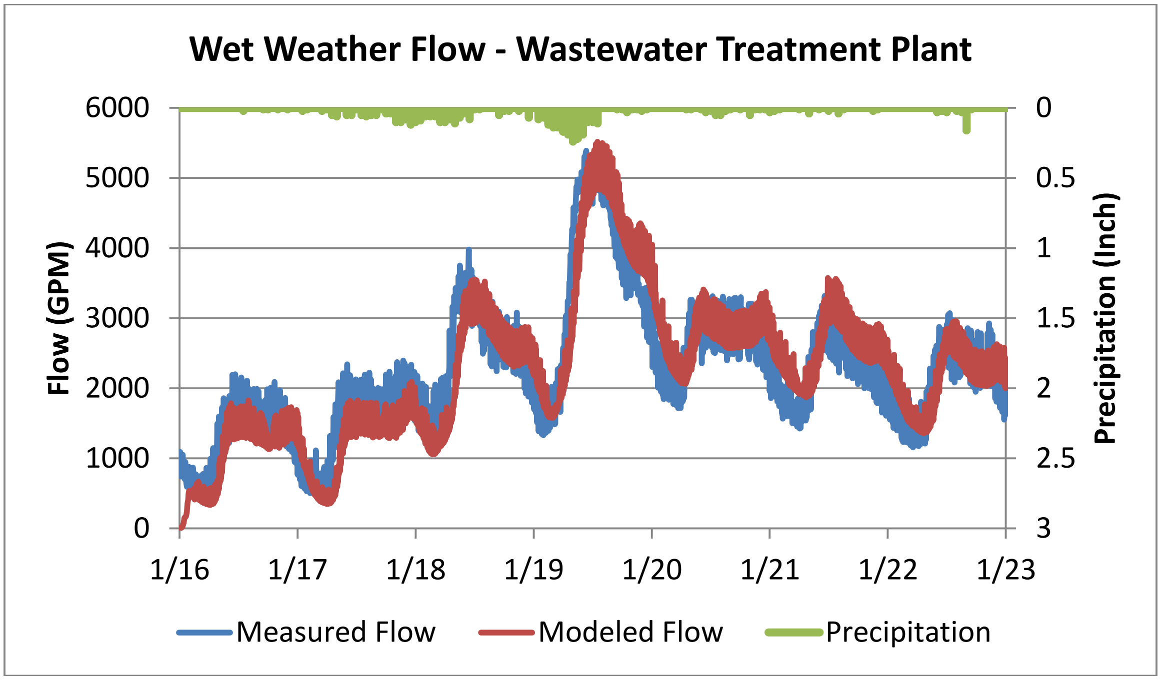


Figure A-17 | Model wet weather flow calibration for WWTP (2012)



APPENDIX B | MODEL RESULTS AND FLOW SENSITIVITY RESULTS MAPPING

Appendix B includes additional model results and flow sensitivity results mapping as referenced in Section 6, “System Analysis.”

FIGURE B-1

City of WILSONVILLE in OREGON

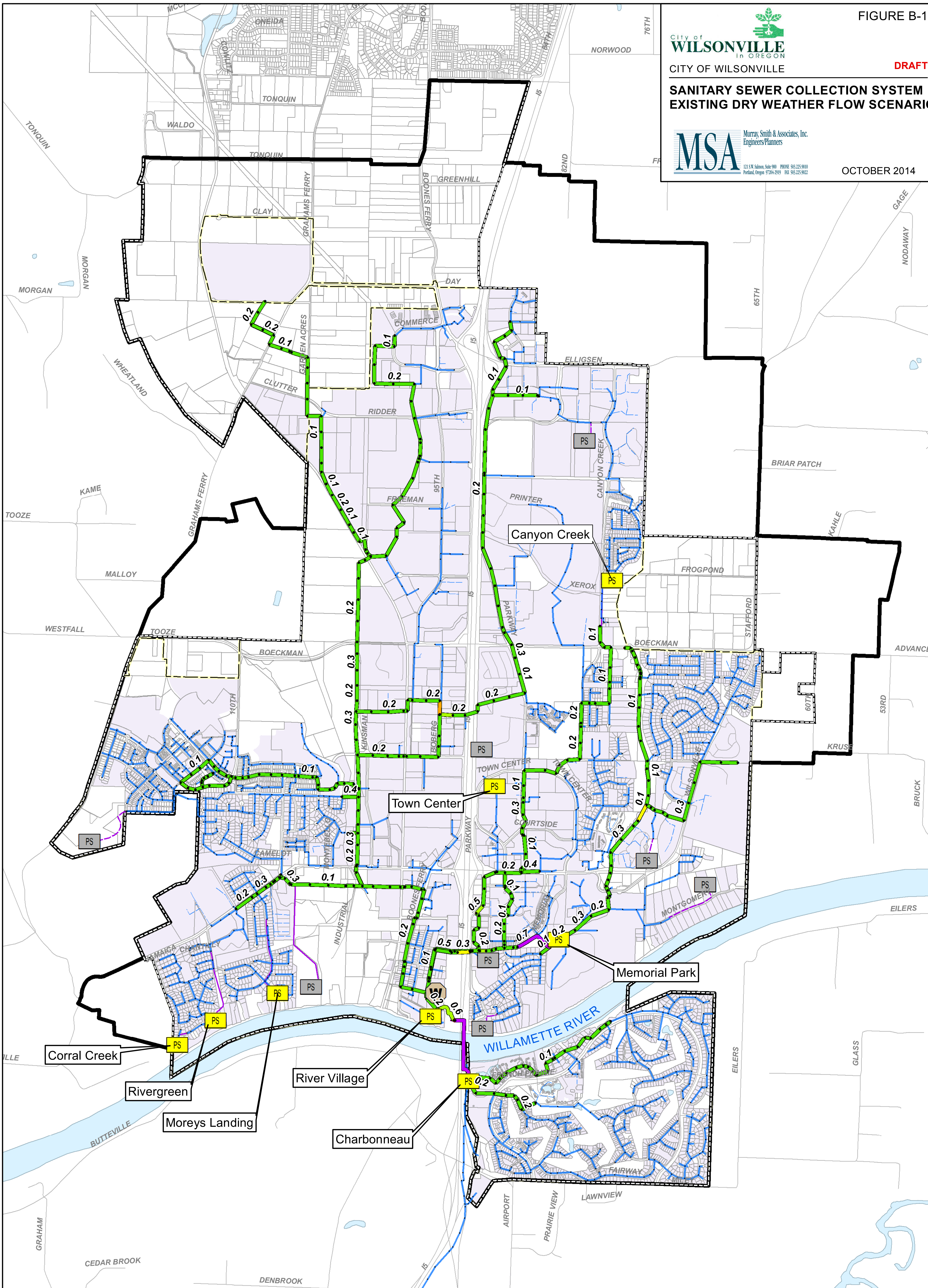
CITY OF WILSONVILLE

DRAFT

SANITARY SEWER COLLECTION SYSTEM
EXISTING DRY WEATHER FLOW SCENARIO

MSA Murray, Smith & Associates, Inc. Engineers/Planners

OCTOBER 2014



W WWTP

PS Public Pump Station

PS Private Pump Station

Manhole

Pipe Public

Pipe Private

Force Main Public

Force Main Private

Urban Growth Boundary

City Boundary

Study Area

Street

Water Body

Developed UGB

Dry Weather Results Modeled Trunk line
depth/diameter ratio

Less than 0.5

0.5 - 0.6

0.6 - 0.7

0.7 - 0.8

0.8 - 0.9

0.9 - 1.0

0 2,500 5,000 Feet

N

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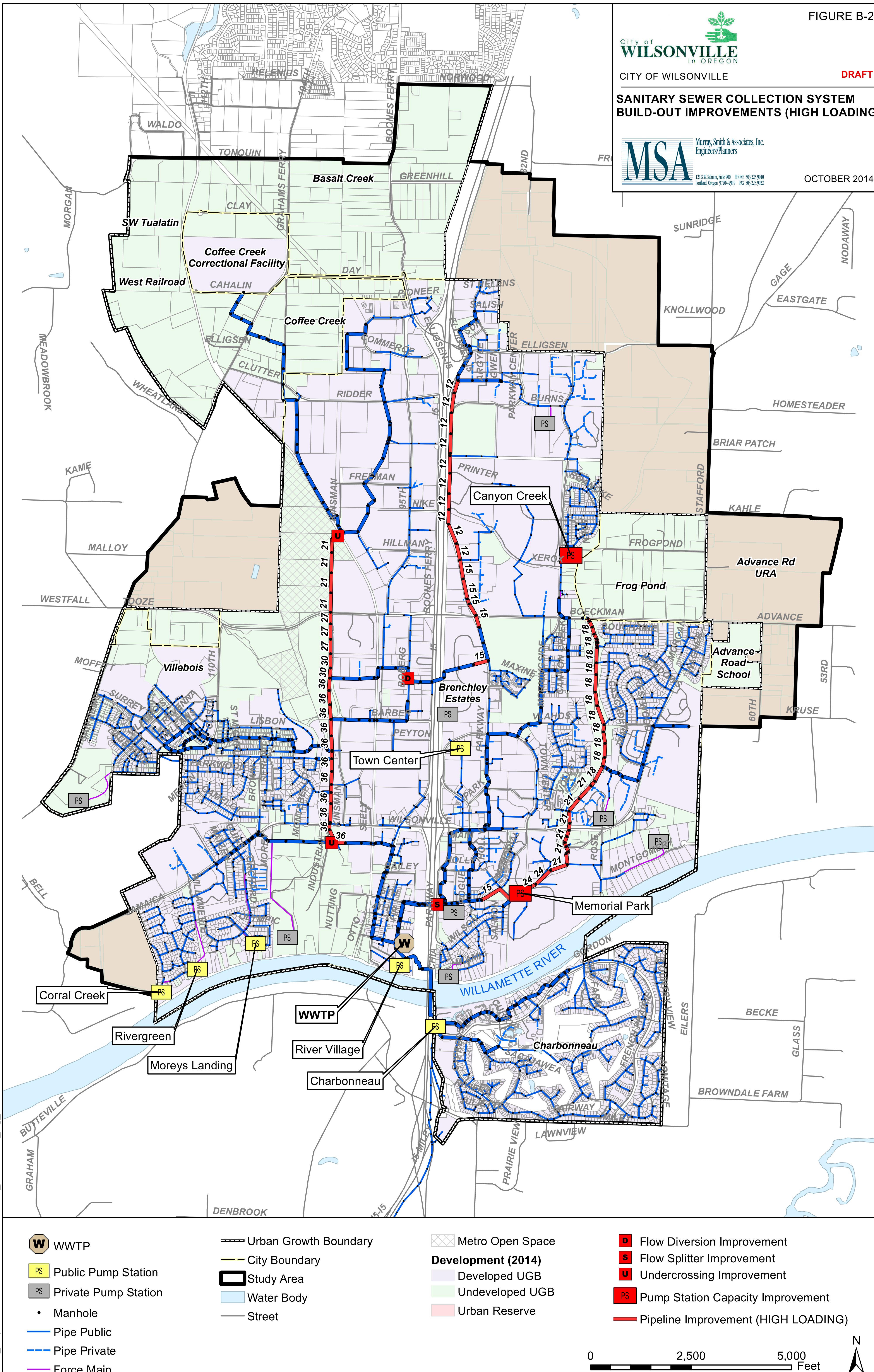
FIGURE B-2
City of WILSONVILLE in OREGON
CITY OF WILSONVILLE
DRAFT
SANITARY SEWER COLLECTION SYSTEM
BUILD-OUT IMPROVEMENTS (HIGH LOADING)
MSA Murray, Smith & Associates, Inc. Engineers/Planners
OCTOBER 2014
Basalt Creek
SW Tualatin
Coffee Creek Correctional Facility
West Railroad
Coffee Creek
Canyon Creek
Frog Pond
Advance Rd URA
Advance Road School
Villebois
Brenchley Estates
Town Center
Memorial Park
WILLAMETTE RIVER
Charbonneau
Corral Creek
Rivergreen
Moreys Landing
WWTP
River Village
Charbonneau
WWTP
Public Pump Station
Private Pump Station
Manhole
Pipe Public
Pipe Private
Force Main
Urban Growth Boundary
City Boundary
Study Area
Water Body
Street
Metro Open Space
Development (2014)
Developed UGB
Undeveloped UGB
Urban Reserve
Flow Diversion Improvement
Flow Splitter Improvement
Undercrossing Improvement
Pump Station Capacity Improvement
Pipeline Improvement (HIGH LOADING)
0
2,500
5,000
Feet
N
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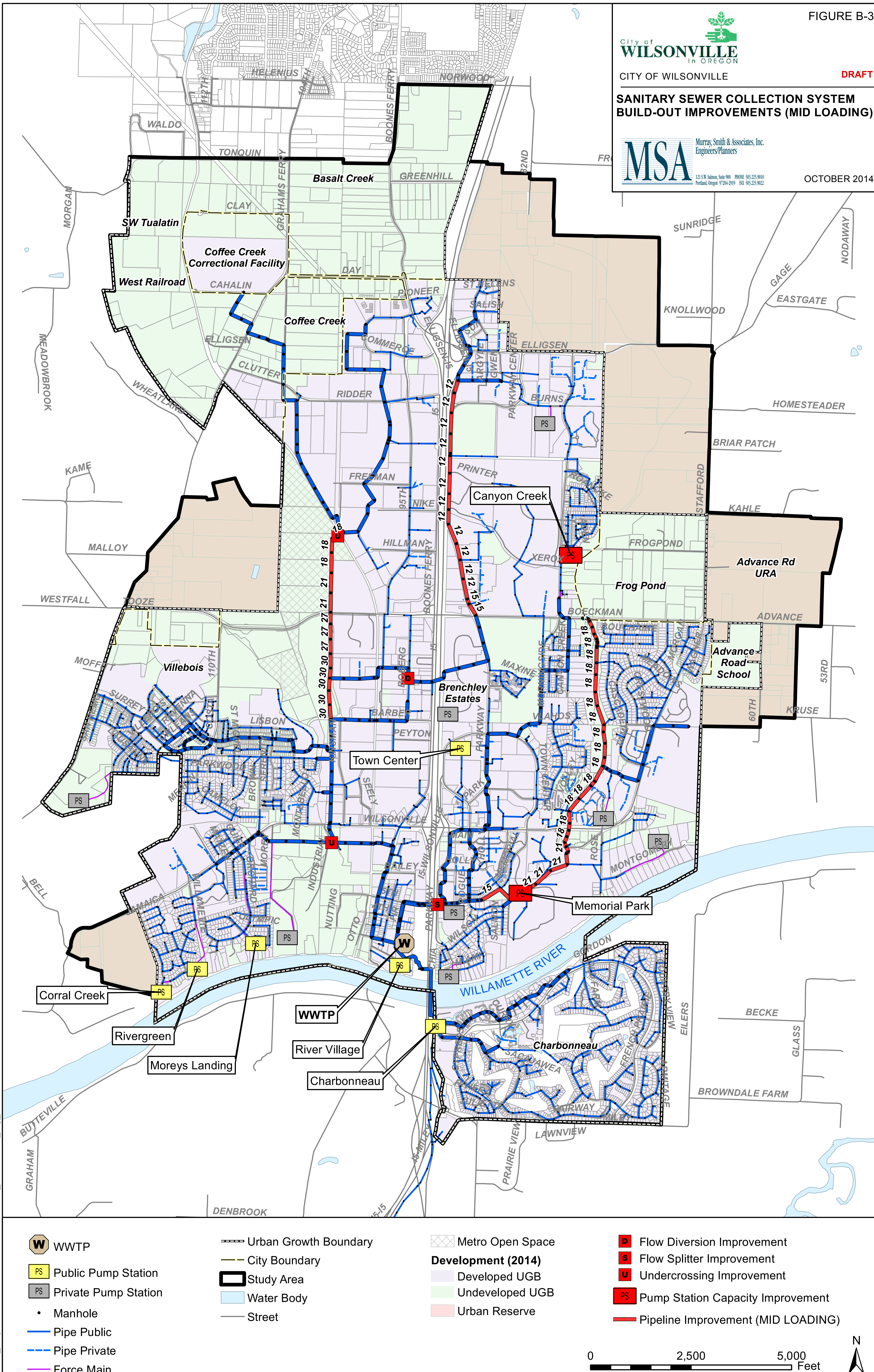

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FIGURE B-4

City of WILSONVILLE in OREGON

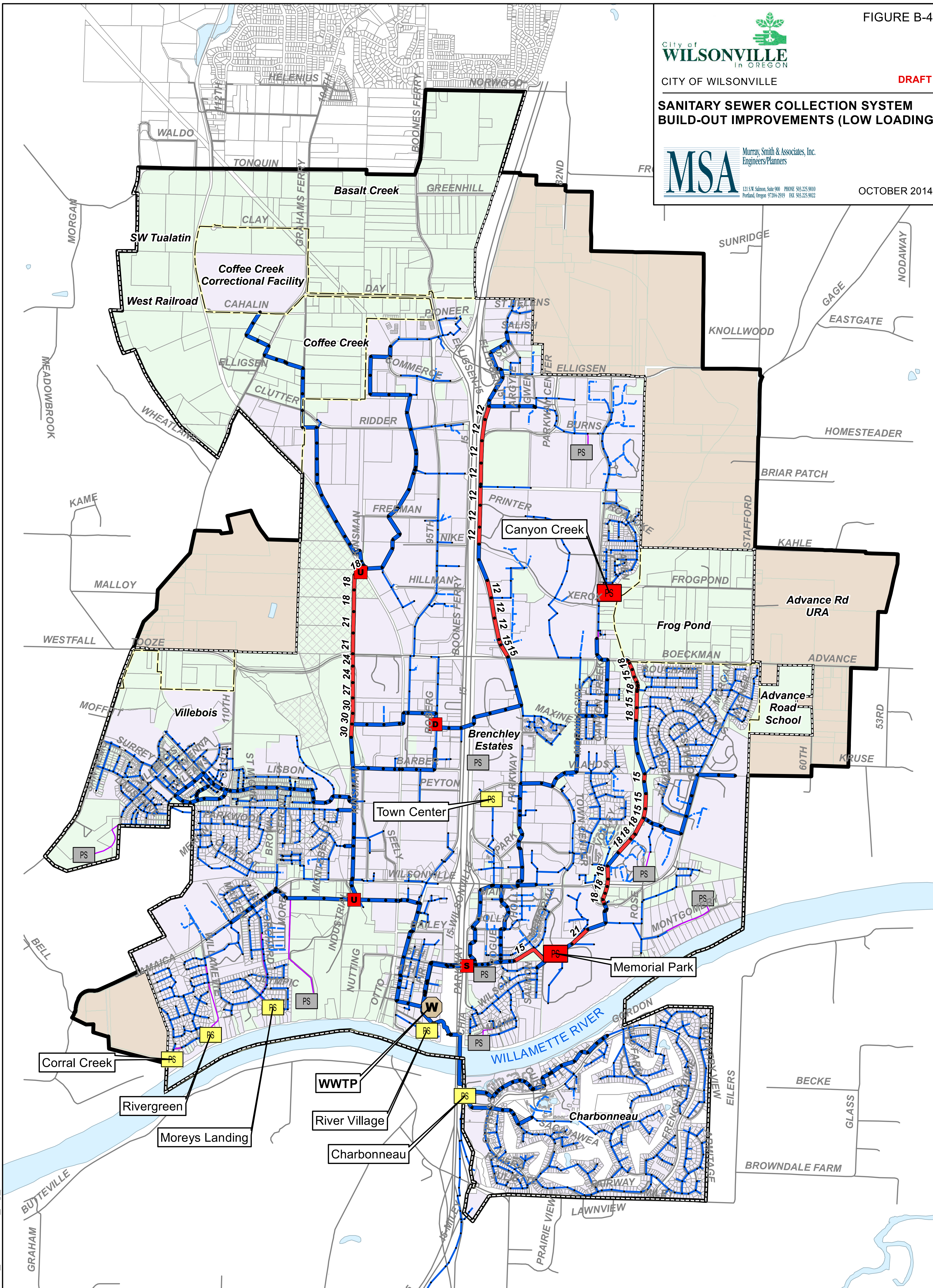
CITY OF WILSONVILLE

DRAFT

SANITARY SEWER COLLECTION SYSTEM BUILD-OUT IMPROVEMENTS (LOW LOADING)

MSA Murray, Smith & Associates, Inc. Engineers/Planners

OCTOBER 2014



W WWTP
PS Public Pump Station
PS Private Pump Station
• Manhole
Pipe Public
Pipe Private
Force Main
Urban Growth Boundary
City Boundary
Study Area
Water Body
Street
Metro Open Space
Development (2014)
Developed UGB
Undeveloped UGB
Urban Reserve
D Flow Diversion Improvement
S Flow Splitter Improvement
U Undercrossing Improvement
PS Pump Station Capacity Improvement
Pipeline Improvement (LOW LOADING)

0 2,500 5,000 Feet

N

FIGURE B-5

City of WILSONVILLE in OREGON

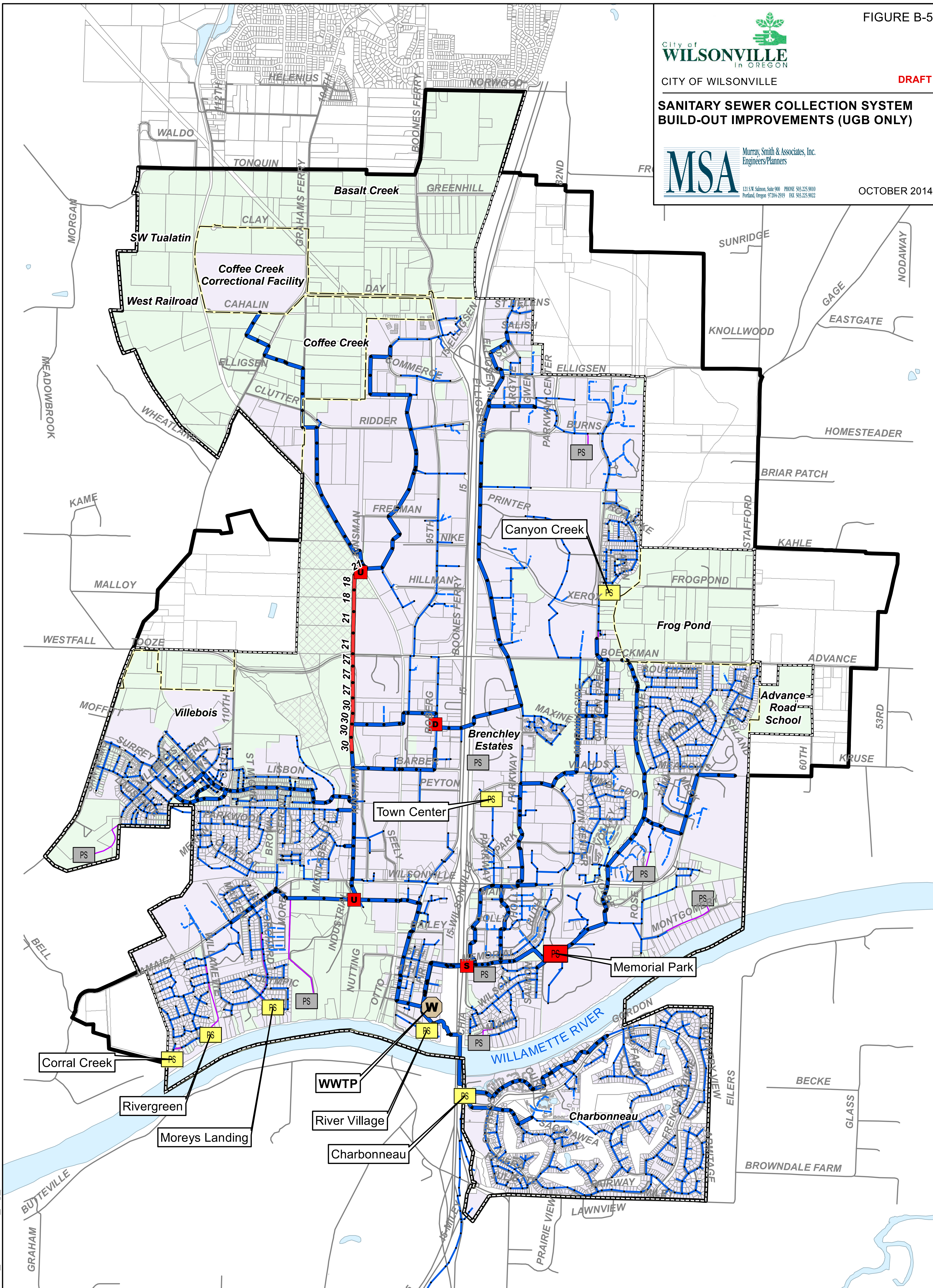
CITY OF WILSONVILLE

DRAFT

SANITARY SEWER COLLECTION SYSTEM BUILD-OUT IMPROVEMENTS (UGB ONLY)

MSA Murray, Smith & Associates, Inc. Engineers/Planners

OCTOBER 2014



W WWTP
PS Public Pump Station
PS Private Pump Station
• Manhole

Urban Growth Boundary
City Boundary
Study Area
Pipe Public
Pipe Private
Force Main
Street
Water Body

Metro Open Space

Development (2014)
Developed UGB
Undeveloped UGB

D Flow Diversion Improvement
S Flow Splitter Improvement
U Undercrossing Improvement
PS Pump Station Capacity Improvement
Pipeline Improvement (UGB Only)

0 2,500 5,000 Feet

N

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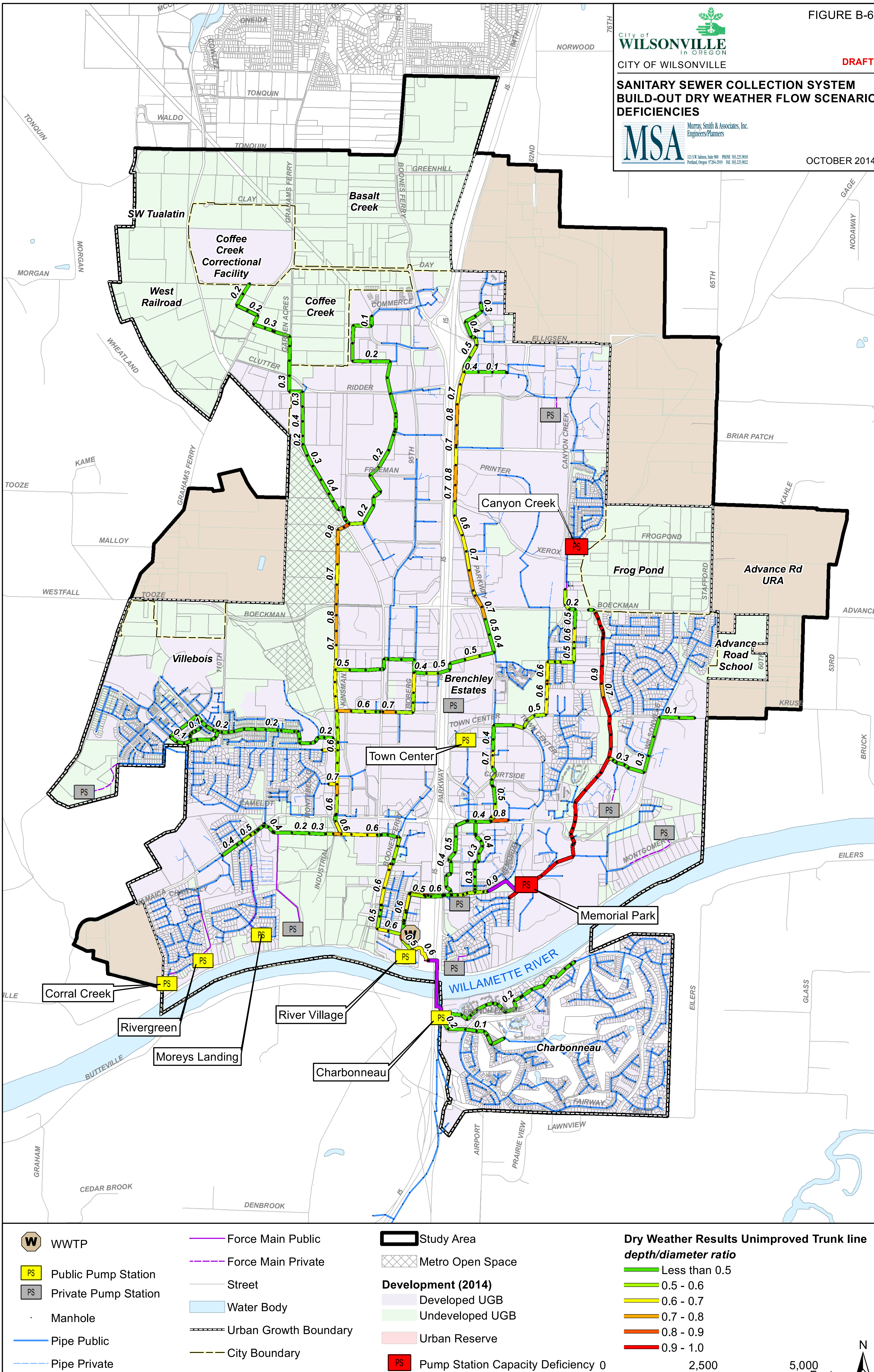

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FIGURE B-7

City of WILSONVILLE in OREGON

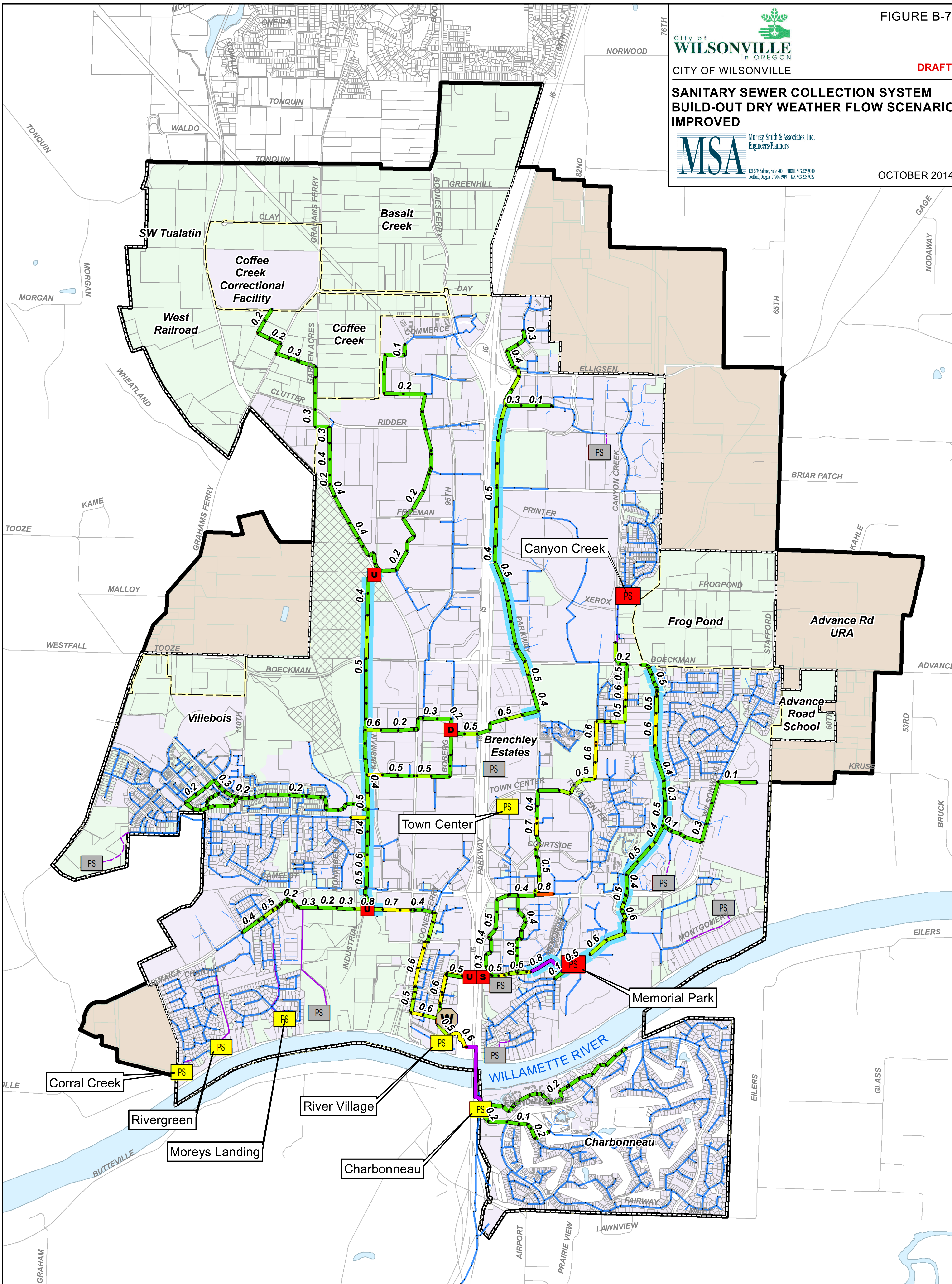
CITY OF WILSONVILLE

DRAFT

SANITARY SEWER COLLECTION SYSTEM BUILD-OUT DRY WEATHER FLOW SCENARIO IMPROVED

MSA Murray, Smith & Associates, Inc. Engineers/Planners

OCTOBER 2014



W WWTP

PS Public Pump Station

PS Private Pump Station

Manhole

Pipe Public

Pipe Private

Force Main Public

Force Main Private

PS Pump Station Improvement

D Flow Diversion Improvement

S Flow Splitter Improvement

U Undercrossing Improvement

Improved Pipe Segment

Urban Growth Boundary

City Boundary

Study Area

Street

Water Body

Development (2014)

Developed UGB

Undeveloped UGB

Urban Reserve

Dry Weather Results Improved Trunk line *depth/diameter ratio*

Less than 0.5

0.5 - 0.6

0.6 - 0.7

0.7 - 0.8

0.8 - 0.9

0.9 - 1.0

0 2,500 5,000 Feet

N

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APPENDIX C | BASIS OF OPINION OF PROBABLE COST

INTRODUCTION

This section summarizes the approach used in development of unit costs and project costs used in the Capital Improvement Plan (CIP).

All project descriptions and cost estimates in this document represent a Class 5 budget estimate, as established by the American Association of Cost Engineers. This preliminary estimate class is used for conceptual screening and assumes project definition maturity level below two percent. The expected accuracy range is -20 to -30 percent on the low end, and +30 to +50 percent on the high end, meaning the actual cost should fall in the range of 30 percent below the estimate to 50 percent above the estimate.

Cost estimates are intended to be used as guidance in establishing funding requirements based on information available at the time of the estimate. The procedure used to generate cost information presented herein is consistent with the definition of "rough cost estimates" under OAR 660-011-0005(2) and OAR 660-011-035. The final cost of individual projects will depend on actual labor and material costs, site topography, existing utility installations within the limits of work, competitive market conditions, regulatory requirements, project schedule, contractor bidding strategies and other factors. All cost estimates are in 2014 dollars.

Due to the project definition maturity level at this phase in system planning, the following considerations are excluded from the opinion of costs:

- Land or Right-of-Way Acquisition;
- Required improvements or upgrades to the WWTP to accommodate system expansion;
- Studies, planning or modeling of the Transportation System, Collection System, Water System, or Stormwater System;
- Borrowing or finance charges during the planning, design, or construction of assets;
- Improvements to distribution, conveyance, pumping, storage, or treatment facilities in response to changes in regulatory standards or rules;
- Remediation or fines associated with system violations.

PROJECT COST DEVELOPMENT

Project costs were developed through a progression of steps, starting with development of construction costs. Construction costs consist of the sum of materials, labor and equipment of easily identifiable features of a project. The estimated costs for each improvement are based on averages from the *RS Means Heavy Construction Cost Data* (Reed Construction Data, 2014), supplemented with quotes from local suppliers, City input and construction costs for similar projects near Wilsonville. Information from RS Means is derived from a national average of construction cost indexes from over 700 cities. As of the date of publication, construction costs for labor and materials in proximity to the City of Portland correlate essentially on par with the national average, therefore a city cost index to adjust unit prices from RS Means to Wilsonville was not used. The historical cost index for the date of publication is 202.7 (January 2014).

Component Unit Costs

The unit costs are applied to improvement pipe lengths for varied depths and manhole spacing at approximately 400 feet. The unit costs account for the materials, labor, and equipment necessary to complete the improvements. Unit costs for wastewater collection system improvements are shown in Tables C-1 through C-6. These costs include considerations for:

- Trench saw cutting, excavation and hauling of waste;
- Encountering rock at 10-foot excavation depths;
- Importing and placement of pipe zone bedding;
- Importing and placement of trench backfill when encountering rock excavations;
- Pipe material and installation labor;
- Trench safety systems (temporary shoring or trench box);
- Testing and video inspection;
- Surface restoration of unpaved streets, or paved local versus arterial roads;
- Dewatering;
- Bypass pumping on pipe replacement projects.
- Subcontractor's markup for profit and overhead

The CIP presents projects defined into three categories; existing system capacity upgrades, condition based improvements, and new infrastructure for future development. The unit costs were applied differently depending on the category of project, as summarized below:

- Cost estimates for projects specifying replacement of existing pipes for condition utilize the unit costs tabulated in Tables C-1, C-2, C-3 and C-4.
- Cost estimates for projects specifying pipe trunk line upsizing or new infrastructure utilize the unit costs contained within Tables C-1, C-2, C-5 and C-6.

Table C-1 | 2014 Unit Costs for Surface Restoration of Pipelines ($/linear-foot)		
Surface Restoration Cost with Road Category		
Local – 4" Asphalt	Arterial – 6" Asphalt	Unpaved
$53	$62	$5

Table C-2 | 2014 Unit Costs for Force Mains ($/linear-foot)		
Pipe Diameter (inch)	Material	Installation and Equipment Cost with Depth Category
		<10 ft
4	$6	$126
6	$11	$138
8	$15	$147
10	$22	$158
12	$26	$169
16	$54	$186
18	$60	$204
21	$63	$221
24	$86	$238

Table C-3 | 2014 Unit Costs for Condition Based Replacement of Existing Gravity Pipelines ($/linear-foot)					
Pipe Diameter (inch)	Material Cost	Installation and Equipment Cost with Depth Category			
		<10 ft	10-15 ft	15-20 ft	20-25 ft
8	$11	$57	$94	$161	$258
10	$19	$62	$100	$167	$265
12	$26	$67	$104	$172	$270
15	$22	$73	$112	$181	$280
18	$27	$81	$121	$190	$290
21	$30	$88	$128	$198	$299
24	$39	$97	$137	$208	$309
27	$47	$110	$152	$223	$325
30	$62	$118	$161	$233	$336
36	$75	$120	$164	$238	$342
42	$87	$132	$178	$253	$359
48	$117	$151	$198	$275	$382

Table C-4 | 2014 Unit Costs for Condition Based Repair of Existing Manholes ($/each)					
Manhole Diameter (inch)	Corresponding Pipe Size	Installation and Equipment Cost with Depth Category			
		<10 ft	10 to 15 ft	15 to 20 ft	20 to 25 ft
48	Pipe Ø< 24”	$735	$940	$1,145	$1,350
60	24” ≤ Pipe Ø < 48”	$1,060	$1,375	$1,680	$1,980
72	Pipe Ø ≥ 48”	$1,825	$2,620	$3,485	$4,415

Table C-5 | 2014 Unit Costs for New and Upsized Gravity Pipelines ($/linear-foot)					
Pipe Diameter (inch)	Material Cost	Installation and Equipment Cost with Depth Category			
		<10 ft	10-15 ft	15-20 ft	20-25 ft
8	$11	$147	$267	$414	$587
10	$19	$158	$285	$439	$619
12	$26	$169	$302	$463	$651
15	$22	$186	$331	$502	$701
18	$27	$204	$359	$541	$750
21	$30	$221	$386	$579	$799
24	$39	$238	$415	$618	$849
27	$47	$260	$448	$662	$903
30	$62	$277	$475	$700	$952
36	$75	$299	$519	$765	$1,038
42	$87	$331	$572	$839	$1,134
48	$117	$367	$629	$918	$1,234

Table C-6 | 2014 Unit Costs for New Manholes ($/each)									
Manhole Diameter (inch)	Corresponding Pipe Size	Material Cost with Depth Category				Installation and Equipment Cost with Depth Category			
		<10 ft	10 to 15 ft	15 to 20 ft	20 to 25 ft	<10 ft	10 to 15 ft	15 to 20 ft	20 to 25 ft
48	Pipe Ø< 24”	$2,100	$2,800	$3,425	$3,975	$4,715	$6,375	$8,250	$12,010
60	24” ≤ Pipe Ø < 48”	$3,850	$5,200	$6,625	$7,950	$6,050	$9,600	$13,670	$17,200
72	Pipe Ø ≥ 48”	$4,950	$6,985	$8,860	$10,580	$6,250	$10,700	$16,360	$19,170

Unit Cost Notes Applicable to Tables C-1 through C-6:

1. Unit costs exclude lateral tie-ins.
2. Unit costs exclude utility relocation associated with potential conflicts.
3. Road resurfacing assumes:
   a. Local = 4-inch AC + 12-inch base course
   b. Arterial = 6-inch AC + 12-inch base course
   c. Unpaved = 8-inch base course.
4. All trench work is assumed to be vertical (no side slope) with either trench box or temporary shoring.
5. The pipe material for gravity sewer was assumed to be PVC (ASTM D-3034, SDR 35) for 15-inch diameter pipe and smaller, and Class III (ASTM C-76) reinforced concrete for pipe with a diameter greater than 15 inches.
6. The pipe material assumed for new sewer force mains was PVC (AWWA C-900) for 4-inch to 12-inch diameter pipe. Force mains were assumed to be at a minimum cover depth of four feet.
7. Manhole installation assumes that surface restoration effort is covered under the surface restoration cost associated with the pipeline (Table A-1).
8. The bypass pumping is for above grade application (no trenchwork) and includes the cost of the piping, installation and removal.

Lift Stations

Where improvements to existing pump stations are recommended, costs include allowances for mechanical piping, electrical, and system controls. These estimates exclude expansion of the pump house or wet well. New pump station projects include provisions for architectural housing of the mechanical devices.

New lift station project costs were developed through comparison of recently constructed projects of similar size and scope around the Northwest. The lift stations are served by force mains ranging in diameter from 4 to 12 inches. For conservative planning cost estimates it was generally assumed the lift station would utilize concrete wet well construction and submersible pumping equipment with power provided by a dedicated supply and a backup standby generator. Installations are assumed to include liquid level, pressure and flow monitoring and a bypass pumping port. The costs include basic site, civil, mechanical, electrical, and instrumentation and control conditions and already include mobilization, contractor overhead and profit, contingency, engineering, legal and administration fees.

Rock Excavation

Specific geotechnical investigations were not provided during this master planning effort; however the Natural Resource Conservation Service (NRCS) Soil Survey was referenced for any obvious conflicts for pipe installation with lithic bedrock. Additionally, well logs were referenced from the Oregon Water Resources Department with mixed results. There are numerous domestic water wells within the study area reporting encountering rock within 10 feet of the ground surface. For this reason, unit costs associated with construction of new and upsized pipelines conservatively included rock excavation. Pipeline replacement costs for condition-based improvements excluded rock excavation since presumably any rock encountered during installation of the existing pipeline has been removed and replaced with granular backfill.

Trenchless Construction Methods

Where existing pipes are recommended to be replaced with new larger pipes, upsizing within two pipe diameters of the original pipe size is assumed to be a candidate for pipe bursting. In the absence of site specific geotechnical information which would preclude this construction practice, this trenchless approach is typically less expensive than open trench construction. Pipe bursting costs are highly variable and rely upon site specific influences such as soil type, installation depth, length of construction, and ability to excavate departure and receiving pits.

The information presented in Table C-7 is provided for the City’s reference in budgeting future pipe replacement projects utilizing the pipe bursting approach. Due to the absence of geotechnical information for the projects presented in the CIP, these prices have been excluded from use during preparation of project cost estimates.

Table C-7 | 2014 Unit Costs for Replacing Existing Gravity Pipelines Using Pipe Bursting ($/linear-foot)			
	From Existing Pipe Dia. To New Pipe Dia. (Inch)	Material Cost	Installation and Equipment Cost
Increase One Pipe Diameter	8 to 10	$19	$47
	10 to 12	$26	$53
	12 to 15	$41	$61
	15 to 18	$46	$70
	18 to 21	$48	$95
	21 to 24	$66	$107
	24 to 27	$74	$125
	27 to 30	$89	$143
Increase Two Pipe Diameter	8 to 12	$26	$81
	10 to 15	$41	$90
	12 to 18	$46	$102
	15 to 21	$48	$115
	18 to 24	$66	$155
	21 to 27	$74	$172
	24 to 30	$89	$198
	27 to 36	$130	$225

CONSTRUCTION COST ALLOWANCES

Costs for commonly occurring general work elements in wastewater collection projects were factored into the construction costs through the use of assumed allowances. Table C-8 presents a summary of these allowances, and when they are combined with the unit costs and multiplied by the improvement lengths, create an estimated “bid price” for the work. Detailed information justifying the assumed allowance values is provided below.

Table C-8 | Construction Cost Allowances	
Additional Cost Factor	Percent
Traffic Control	2%
Erosion Control	5%
General Contractor’s Overhead	10%
General Contractor’s Profit	8%
Mobilization	10%

Traffic Control

Traffic control will be required for all projects that occur in roadways. The traffic control mark-up is intended to account for such costs as signage, flagging and temporary barriers, pavement markings, lane delineators and lighting at flagging locations.

Erosion Control

The erosion control mark-up accounts for materials and practices to protect adjacent property, stormwater conveyance systems, and surface water in accordance with regulatory requirements. The City of Wilsonville's NPDES Permit stipulates that construction site runoff control is required for activities that result in a land disturbance exceeding 1,000 square feet. More complex projects may require the development of a stormwater pollution prevention plan, 1200-C permit application and reporting, installation of erosion control best management practices (BMPs), and routine maintenance, testing and inspection of all installed BMPs.

General Contractors Overhead

Overhead costs associated with the General Contractor's day-to-day operations such as staff salary, taxes, benefits, insurance, marketing, and proposal preparation are an inherent cost of running their business. Contractors will typically markup their subcontractor's costs as a management expense as a way to keep their business running.

General Contractors Profit

In addition to the overhead costs, contractors will typically markup their subcontractors to realize a profit for their effort. This is one of the most highly variable parts of a budget and depends upon the type of project, its size, the amount of risk involved, how much money the contractor wants to make, the general market conditions, and bidding strategies.

Mobilization

Before construction of a project may begin, setup and preparatory activities are necessary to become ready to perform the work. Mobilization is a general term that used to capture many variables but typically relates to:

- Moving staff, equipment, supplies, and incidentals to the project site
- Establishing site trailers or offices or other facilities necessary for the project
- Incurring costs as necessary before beginning work on the project. This may include expenses associated with acquisition of bonds and insurance.

PROJECT COST ALLOWANCES

The project cost is the sum of construction component unit costs with additional cost allowances for contingency, engineering, permitting, legal and administration fees. Table C-9 below presents the cost allowances for each additional project cost. These project cost allowances are factored on top of the total construction cost, not the individual unit costs. The engineering costs include design and surveying. Construction administration is the cost associated with managing the construction of the project. The administration and legal costs are those associated with the City providing financial and legal oversight of the contract.

Table C-9 | Project Cost Allowances	
Additional Cost Factor	**Percent**
Engineering, Legal, Permitting and Construction Services	20%
Contingency	30%
City Internal Overhead	12%

Engineering, Legal, Permitting and Construction Services

This category is intended to capture the costs needed for development of all the upfront project related documentation to make a project bid ready. Construction drawings, specifications and permit applications are both time and resource intensive, often requiring months of preparatory work before a project may be bid. Additional services typically provided by the engineering team during construction include site inspections, assisting the contractor in interpretation of the contract documents and preparation of record drawings.

Contingency

A contingency was included in each project's cost to account for the uncertainties inherent within the preliminary level of the estimate. Contingency is a term used in estimating that refers to costs that will probably occur based on past experience, but with some uncertainty regarding the amount. This factor was applied to all estimated project costs except for the City Internal Overhead. The contingency is provided to account for factors such as:

- Unanticipated utilities;
- Relocation and connection to existing infrastructure;
- Minor elements of work not addressed in component unit cost development;
- Details of construction;
- Changes in site conditions;
- Variability in construction bid climate.

The contingency excludes:

- Major scope changes such as end product specification, capacities and location of project;
- Extraordinary events such as strikes or natural disasters;
- Management reserves;
- Escalation and currency effects.

City Internal Overhead

The City of Wilsonville has an assortment of departments and personnel that are involved in the realization of a construction project. This cost allowance is intended to capture the effort needed on the part of the City related to project management, plan review, permit processing, code compliance, construction inspections and financial management.

PROJECT COST MULTIPLIER

For simplicity in estimating overall project costs, a multiplier can be applied against the construction costs determined from unit pricing. This multiplier accounts for the allowances for both construction costs and project costs into one easily used factor. An example calculation showing how this multiplier was developed is provided in Table C-10 below.

Table C-10 | Project Cost Multiplier

Construction and Project Cost Allowances	Allowance Factor	Cost
Example Construction Cost Total	-	$1,000,000
Traffic Control	2%	$20,000
Erosion Control	5%	$50,000
Mobilization	10%	$100,000
	Subtotal	*$1,170,000*
General Contractor's Overhead	10%	$117,000
General Contractor's Profit	8%	$94,000
Engineering, Legal, Permitting and Construction Services	20%	$234,000
	Subtotal	*$1,615,000*
Contingency	30%	$485,000
	Subtotal	*$2,100,000*
City Internal Overhead	12%	$252,000
	Project Cost Subtotal	**$2,352,000**

Project Cost Multiplier	
Total Project Cost divided by	$2,352,000
Unit Construction Costs	$1,000,000
= Project Cost Multiplier	**2.4**

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