



Comprehensive General Sewer Plan

December 2017



Clark Regional Wastewater District

Comprehensive General Sewer Plan

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Table of Contents

CHAPTER 1 EXECUTIVE SUMMARY

1.1	Introduction.....	1-1
1.2	Growth of Population and Wastewater Flows.....	1-5
1.3	System Capacity Analysis.....	1-6
1.4	Operations Programs.....	1-8
1.5	Policy Recommendations.....	1-8
1.6	Staffing Assessment.....	1-9
1.7	Capital Improvement Program (CIP).....	1-10
1.8	Financial Analysis.....	1-12
1.9	Conclusion.....	1-16

CHAPTER 2 INTRODUCTION

2.1	Clark Regional Wastewater District.....	2-1
2.2	Purpose and Need for Plan.....	2-4
2.3	Service Area Characteristics.....	2-6
2.4	Ownership and Management.....	2-6
2.5	System History and Background.....	2-7
2.6	System Planning.....	2-8

CHAPTER 3 SERVICE AREA AND LAND USE

3.1	Service Area Description.....	3-1
3.2	Vicinity Characteristics.....	3-4
3.3	Land Use.....	3-11
3.4	Local Partnerships and Plans.....	3-15

CHAPTER 4 DESIGN STANDARDS AND POLICIES

4.1	Performance and Design Criteria.....	4-1
4.2	Easements.....	4-4
4.3	Standard Details and General Notes.....	4-5
4.4	District Policies.....	4-5

CHAPTER 5 EXISTING FACILITIES

5.1	Introduction.....	5-1
5.2	Drainage Basins.....	5-2
5.3	Inventory.....	5-5

CHAPTER 6 EXISTING AND FUTURE POPULATION AND FLOW PROJECTIONS

6.1	Introduction.....	6-1
6.2	Approach.....	6-2
6.3	Existing Population.....	6-3
6.4	Future Projections.....	6-7
6.5	Flows.....	6-15

CHAPTER 7 MODEL DEVELOPMENT AND CAPACITY ANALYSIS

7.1	Introduction.....	7-1
7.2	Model Analysis Approach.....	7-2
7.3	Model Input Parameters.....	7-2
7.4	Model Calibration.....	7-7
7.5	Surcharge Criteria.....	7-13
7.6	2016 Analysis Results.....	7-14
7.7	2036 Analysis Results.....	7-15

CHAPTER 8 WASTEWATER TREATMENT FACILITY CAPACITIES

8.1	Introduction.....	8-1
8.2	Salmon Creek Wastewater Treatment Plant (SCTP).....	8-2
8.3	Vancouver Westside Wastewater Treatment Plant (VWTP).....	8-3
8.4	Treatment Plant Conclusions and Recommendations.....	8-4
8.5	Wastewater Reuse.....	8-5

CHAPTER 9 OPERATIONS & MAINTENANCE (O&M) PROGRAM

9.1	District Management and Personnel.....	9-1
9.2	O&M Activities and Programs.....	9-3
9.3	Pretreatment Program.....	9-4
9.4	Sewage Spill Response Plan.....	9-5
9.5	Capacity, Management, Operations and Maintenance (CMOM).....	9-5
9.6	Water Quality Management Plan.....	9-7
9.7	Management System / Record Keeping.....	9-7
9.8	Sewer Collection Department Staffing Needs.....	9-8

CHAPTER 10 COMPREHENSIVE PLAN AND CAPITAL IMPROVEMENTS

10.1	Introduction.....	10-1
10.2	CIP Summary.....	10-7
10.3	Basis for Cost Estimates.....	10-11
10.4	2036 Schematic Flow Routing.....	10-12

CHAPTER 11 FINANCIAL ANALYSIS

11.1	Introduction.....	11-1
11.2	Past Financial Performance.....	11-2
11.3	Current Financial Structure.....	11-5
11.4	Available Funding Assistance and Financing Resources.....	11-7
11.5	Financial Forecast.....	11-9
11.6	Current and Projected Rates.....	11-12
11.7	Affordability Evaluation.....	11-14
11.8	Conclusion.....	11-15

APPENDICES

APPENDICES VOLUME I: INFRASTRUCTURE

Appendix A	Mini-basin Maps
Appendix B	Population Forecasts
Appendix C	Capital Improvement Program

APPENDICES VOLUME II

Appendix D	SEPA Checklist and Determination of Non-Significance
Appendix E	Existing Facilities
Appendix F	Interlocal Agreements
Appendix G	Septic Elimination Program
Appendix H	Policies
Appendix I	Agency and Public Review Comments and Responses
Appendix J	District Design Manual 2010
Appendix K	Parcels Served Outside of UGA
Appendix L	Significant and Minor Industrial Users
Appendix M	Meadow Glade Hydraulic Analysis
Appendix N	Pump Station Capacity Graphs
Appendix O	Project Profiles and Cost Estimates
Appendix P	Plan Approval and Adoption

Table of Figures

Figure 1.1	Clark Regional Wastewater District.....	1-2
Figure 1.2	Gravity Sewer Pipe Aging.....	1-4
Figure 1.3	Calibration Flow Meter Locations.....	1-6
Figure 1.4	Capital Improvement Program Flow Diagram.....	1-11
Figure 1.5	Plan Summary.....	1-17
Figure 2.1	Service Area Map.....	2-2
Figure 2.2	Vicinity Map.....	2-3
Figure 3.1	Service Area Boundaries.....	3-3
Figure 3.2	Water Features.....	3-5
Figure 3.3	FEMA Flood Hazard Areas.....	3-6
Figure 3.4	Soils and Steep Slope Areas.....	3-7
Figure 3.5	Landslide Hazard Areas.....	3-8
Figure 3.6	Cascadia M9.0 Scenario Peak Ground Acceleration.....	3-9
Figure 3.7	Water Systems & Purveyors.....	3-10
Figure 3.8	Zoning Map.....	3-13
Figure 5.1	Mini-Basin Delineation Map.....	5-3
Figure 5.2	WVUGA 2016 and 2036 Schematic.....	5-6
Figure 5.3	NVUGA 2016 Schematic.....	5-7
Figure 5.4	RUGA 2016 Schematic.....	5-8
Figure 5.5	Gravity Sewer Pipe Aging.....	5-9
Figure 5.6	Force Main Aging.....	5-9
Figure 5.7	Pump Size.....	5-10
Figure 5.8	Pump Station Configuration.....	5-10

Figure 5.9 Pump Station Installation History.....	5-11
Figure 6.1 Schools.....	6-5
Figure 6.2 District Population Growth 2016 – 2036.....	6-11
Figure 6.3 NVUGA ERU Connection History & Forecast.....	6-14
Figure 6.4 SCTP – Average Dry Weather Flows (mgd).....	6-16
Figure 6.5 Average Monthly Flow at SCTP (mgd).....	6-17
Figure 6.6 SCTP Total Daily Flow (mgd).....	6-17
Figure 6.7 Salmon Creek and Ridgefield Flow per ERU (gallons per day (gpd)).....	6-19
Figure 7.1 Modeled System vs. GIS Comparison.....	7-5
Figure 7.2 Model Catchments.....	7-6
Figure 7.3 Calibration Flow Meter Locations.....	7-8
Figure 7.4 ADWF Calibration at Meter 14-3480.....	7-9
Figure 7.5 Wet Weather Flow Calibration at City of Vancouver Flume.....	7-10
Figure 7.6 Simulated Pump Operation.....	7-12
Figure 8.1 Summary of Distribution of Flows.....	8-2
Figure 8.2 Potential Reclaim Water Users.....	8-7
Figure 9.1 Organization Chart.....	9-9
Figure 9.2 Flow Monitoring Plan.....	9-10
Figure 10.1 Ridgefield Flow Diversion.....	10-5
Figure 10.2 Capital Improvement Program Map.....	10-6
Figure 10.3 CIP Summary Chart.....	10-8
Figure 10.4 2036 CIP Distribution.....	10-9
Figure 10.5 2036 NVUGA Schematic.....	10-13
Figure 10.6 2036 RUGA Schematic.....	10-14

Table of Tables

Table 1-1	Flow Rates per Population Segment.....	1-5
Table 1-2	Predicted Flows, 2016 and 2036.....	1-5
Table 1-3	O&M Staffing Comparison.....	1-9
Table 1-4	CIP Summary.....	1-10
Table 1-5	Revenue Requirement Forecast	1-14
Table 1-6	Rate Forecast.....	1-15
Table 1-7	System Development Charge Forecast.....	1-16
Table 2-1	Comprehensive General Sewer Plan Requirements per 173-240-050 WAC.....	2-5
Table 2-2	Additional Sewer Plan Requirements per State and Local Regulations.....	2-5
Table 3-1	District Service Area Boundaries.....	3-2
Table 6-1	2016 Population Summary.....	6-3
Table 6-2	2036 Scenario Projected ERUs – Summary.....	6-13
Table 6-3	Build-out Scenario Projected ERUs – Summary.....	6-13
Table 6-4	2066 Scenario Projected ERUs – Summary.....	6-14
Table 6-5	SCTP and VWTP Historical Flows.....	6-18
Table 6-6	Comparative Average Annual Unit Flows for other Western Washington Communities.....	6-20
Table 6-7	Flow Rates per Population Segment.....	6-20
Table 6-8	2016 Forecasted Flows.....	6-21
Table 6-9	2036 Scenario Forecasted Flows.....	6-21
Table 6-10	Build-out Scenario Forecasted Flows.....	6-21
Table 6-11	2066 Scenario Forecasted Flows.....	6-22
Table 6-12	EPA/Ecology Excessive I/I Criteria.....	6-22
Table 7-1	December 7, 2015 Parameter Set Assignments and Peak Flow Comparison with Meter Data.....	7-11
Table 8-1	City of Vancouver Westside VWTP Future Loadings.....	8-3

Table 8-2 SCTP and VWTP Future Projected Flows.....	8-4
Table 8-3 Top Water Users Sorted by Irrigation Usage.....	8-6
Table 8-4 Reclaimed Water Economic Analysis Summary.....	8-10
Table 8-5 Estimated Annual O&M Cost of Reclaimed Water Treatment and Conveyance.....	8-10
Table 9-1 O&M Staffing Comparison.....	9-8
Table 10-1 CIP Summary.....	10-7
Table 11-1 Statement of Revenues, Expenses and Changes in Net Position.....	11-2
Table 11-2 Statement of Net Position.....	11-3
Table 11-3 2017-2022 Capital Funding Strategy (millions of \$).....	11-6
Table 11-4 Revenue Requirement Forecast.....	11-11
Table 11-5 Sewer Rates Forecast.....	11-12
Table 11-6 System Development Charges (SDC) Forecast.....	11-13
Table 11-7 Customer Projections.....	11-13
Table 11-8 Affordability Evaluation by Median Household Income (MHI).....	11-14

Glossary

100-YEAR FLOOD

The magnitude of a flood likely to occur, on average, once every 100 years.

25-YEAR STORM

A storm event, as measured by amount of precipitation, that is likely to occur, on average, once every 25 years. There is a 4% chance of occurrence each year. Precipitation is usually measured for a single 24-hour period.

AVERAGE WET WEATHER FLOW

Wastewater flow during a period when the groundwater table is high and precipitation is at its peak, generally the four wet weather months, from November to February.

FORCE MAIN

Pressurized discharge pipe from a pump station.

INFILTRATION

Groundwater entering the sewage collection system through defective joints, pipes, and improperly sealed manholes.

INFLOW

Sewage flows resulting from stormwater runoff entering the sewage collection system, typically through manhole covers, roof leaders, and area drains connected directly to sewer, cross connections from storm drains and catch basins, and direct flows into broken sewers.

MAXIMUM MONTHLY FLOW

Average daily flow during the highest flow month of the year.

MINI-BASIN

Drainage catchment areas delineated by one common sewer outlet.

PEAK HOURLY FLOW

Wastewater flow during the highest flow hour of the year.

SENSITIVE AREA

Area in which development potential is limited by environmental factors such as steep slopes, wetlands, and valuable natural habitat.

SEWER LATERAL

A sewer with no other common sewers discharging into it.

SEWER SUBMAIN

A sewer that receives flow from one or more lateral sewers.

SEWER MAIN OR TRUNK

A sewer that receives flow from one or more submains.

SEWER INTERCEPTOR

A sewer that receives flow from a number of main or trunk sewers, force mains, etc.

URBAN GROWTH AREA

Area in which urban development must be contained, as stipulated by the Growth Management Act.

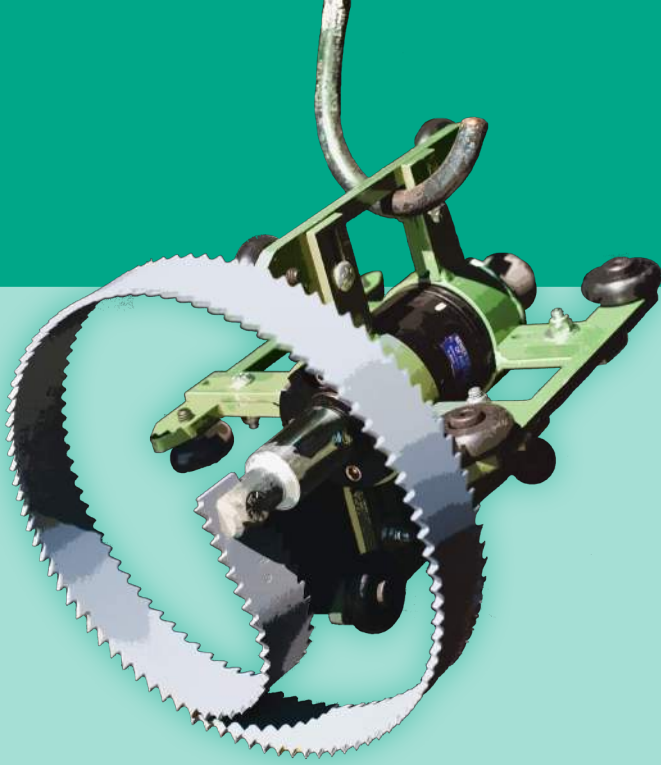
Abbreviations

AAF	Average Annual Flow	mg/l	Milligrams per Liter
ACS	American Community Survey	MOV	Motor Operated Valve
ADWF	Average Dry Weather Flow	NEPA	National Environmental Policy Act
Alliance	Discovery Clean Water Alliance	NPDES	National Pollutant Discharge Elimination System
AWWF	Average Wet Weather Flow	NVUGA	North Vancouver UGA
BOD	Biological Oxygen Demand	O&M	Operations and Maintenance
CFP	Capital Facilities Plan	OFM	Washington State Office of Financial Management
CFR	Code of Federal Regulations	OSS	On-site Sewage Systems
CIP	Capital Improvement Program	PDF	Peak Day Flow
CMOM	Capacity, Management Operations and Maintenance	PHF	Peak Hour Flow
County	Clark County	psi	Pounds per Square Inch
CPU	Clark Public Utilities	PVC	Polyvinyl Chloride
CWA	Clean Water Act	PWTF	Public Works Trust Fund
DCWTS	Discovery Corridor Wastewater Transmission System	PWWF	Peak Wet Weather Flow
District	Clark Regional Wastewater District	R&R	Restoration and Replacement
DMR	Discharge Monitoring Report	RTC	Southwest Washington Regional Transportation Council
Ecology	Washington Department of Ecology	RCW	Revised Code of Washington
EPA	United States Environmental Protection Agency	RTP	Ridgefield Wastewater Treatment Plant
ERU	Equivalent Residential Unit	RUGA	Ridgefield UGA
ESA	Endangered Species Act	SEPA	State Environmental Policy Act
FEMA	Federal Emergency Management Act	SCTP	Salmon Creek Wastewater Treatment Plant
FM	Force Main	SCWMS	Salmon Creek Wastewater Management System
FOGG	Fats, Oils, Grease and Grit	SRF	State Revolving Fund
FPS	Feet per Second	SSO	Sanitary Sewer Overflows
FTE	Full Time Equivalent	STEP	Septic Tank Effluent Pump
GMA	Growth Management Act	TSS	Total Suspended Solids
GPAD	Gallons per Acre per Day	UDC	Unified Development Code (of Clark County)
GPCD	Gallons per Capita per Day	ULID	Utility Local Improvement Districts
GPD	Gallons per Day	UGA	Urban Growth Area
GPM	Gallons per Minute	USGS	United States Geological Survey
GSP	General Sewer Plan	VBLM	Vacant Buildable Lands Model
I/I	Infiltration and Inflow	VWTP	Vancouver Westside Wastewater Treatment Plant
LFC	Local Facilities Charge	WAC	Washington Administrative Code
LID	Local Improvement District	WVUGA	West Vancouver UGA
MHI	Median Household Income		
MMF	Maximum Month Flow		
MGD	Million Gallons per Day		



Executive Summary





A root saw is used to cut through large roots intruding into a sewer main using a rotating blade driven by hydraulic water pressure

Executive Summary



1.1 Introduction

Clark Regional Wastewater District (District) operates a public wastewater system extending more than 50 square miles and serving nearly 100,000 residents in Clark County, Washington. The District serves all of the City of Ridgefield, portions of the cities of Battle Ground and Vancouver and large portions of unincorporated Clark County.

The District's customer base has nearly doubled in 20 years, spurred by high rates of growth in Clark County. Over the next 20 years, the customer base is projected to continue to rise rapidly in the Ridgefield area and more moderately in the other urban areas served by the District. Consistent with local comprehensive planning efforts and the state statute regulating discharge of pollutants to waters of the State (Chapter 90.48 Revised Code of Washington (RCW)), the District has produced this Comprehensive General Sewer Plan (Plan) to present its plans for improving, operating, and extending its wastewater system through 2036.

The Plan is an integral part of the District's ongoing focus on reliability, and its commitment to environmental stewardship and fiscal responsibility. It evaluates the current capacity of the collection and conveyance system, predicts future wastewater flows based on projected population changes, evaluates future capacity and schematically illustrates sewer extensions into areas where new growth is expected. The Plan incorporates management and policy recommendations, a capital improvement program (CIP) and a financial analysis.

The Plan satisfies the requirements for a General Comprehensive Plan (GCP) and a General Sewer Plan (GSP). The GCP is prepared in accordance with the requirements of Section 57.16.010 RCW. The GSP is prepared in accordance with the requirements of Section 90.48.110 RCW and Sections 173-240-010, 173-240-020, and 173-240-050 Washington Administrative Code (WAC).

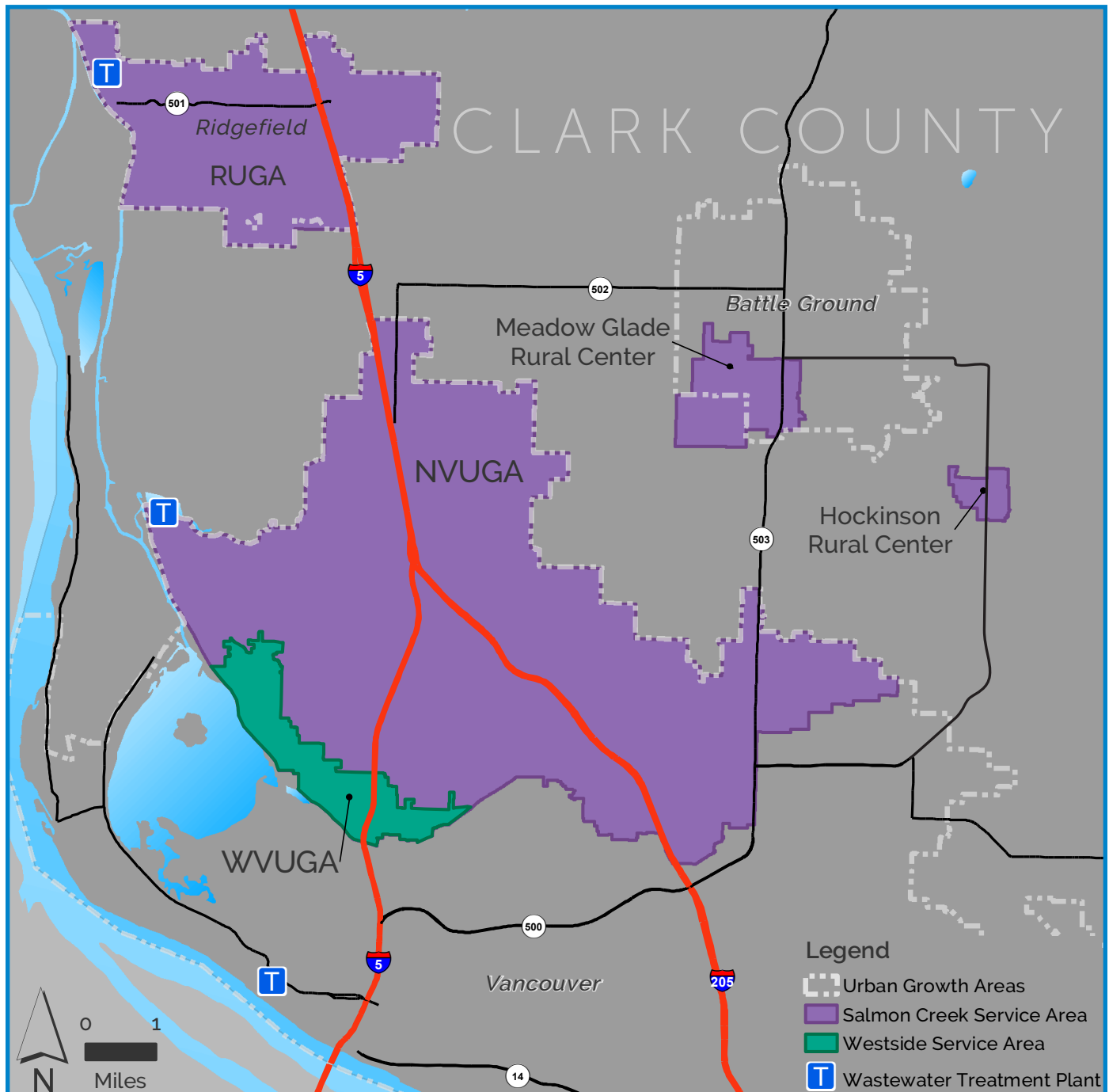
1.1.1 Service Area Description

The District is divided into 2 primary service areas, the Westside Service Area and the Salmon Creek Service Area, described below. The service area designations are based on the treatment facility ultimately receiving wastewater from the properties in each area.

A map of the District is presented in Figure 1.1.

FIGURE 1.1

Clark Regional Wastewater District





1.1.2 Land Use

The State of Washington adopted the Growth Management Act (GMA), Chapter 36.70A RCW, with the intent of concentrating new development and population gains within designated urban areas. Counties planning under GMA define a UGA within which urban services such as sewers can be provided. The District serves those areas where Clark County has designated it as the sewer purveyor. The service area is suburban in nature and is located within the UGA, except for isolated sites outside of the UGA where Clark County authorizes sewer service in accordance with local and state regulations.

WESTSIDE SERVICE AREA

The Westside Service Area consists largely of a portion of the Vancouver UGA immediately north of Vancouver along Interstate 5 (I-5). A few parcels served by the District within the City limits are also included. This area is referred to in this Plan as the West Vancouver UGA (WVUGA), and it covers a total of 1,936 acres. Wastewater flows are conveyed to a point of connection to the City-owned conveyance system and ultimately to the Vancouver Westside Wastewater Treatment Plant (VWTP).

SALMON CREEK SERVICE AREA

The Salmon Creek Service Area is the largest component of the District's system, both in terms of number of customers and acreage. The area includes Ridgefield and its UGA (RUGA) and a portion of the Vancouver UGA referred to as the North Vancouver UGA (NVUGA) in this Plan. The Salmon Creek Service Area covers more than 30,000 acres (about 48 square miles). The RUGA is 6,314 acres. Wastewater flows from the RUGA are currently conveyed either to the Salmon Creek Wastewater Treatment Plant (SCTP) or to the Ridgefield Wastewater Treatment Plant (RTP). The NVUGA is 24,624 acres. Wastewater flows from the NVUGA are directed to the SCTP.

The designated rural centers of Hockinson and Meadow Glade in unincorporated Clark County are also a part of the Salmon Creek Service Area. For planning purposes, the rural centers are included with the NVUGA. Both areas are served with a residential scale Septic Tank Effluent Pumping (STEP) system. Hockinson is a standalone area of approximately 280 acres at NE 159th Street and NE 182nd Ave. Meadow Glade covers approximately 1,389 acres near and in Battle Ground.

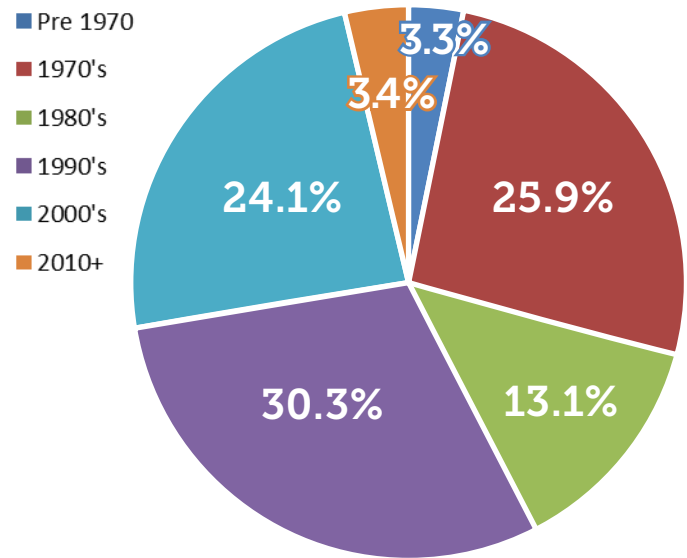
The District relies on GMA-compliant land use planning by local governments to help predict where demand for its services will increase. Comprehensive plan and zoning designations regulate the types of development and densities allowed. The demand for wastewater varies depending upon these and other factors. Today, the service area is predominantly residential with a mix of commercial, retail, light industrial and institutional uses. Approximately 70% of the District's customer accounts are single-family residential, 15% are multi-family residential and 15% are non-residential. Continued growth in the non-residential sectors is expected over the planning horizon in accordance with adopted land use plans.





FIGURE 1.2

Gravity Sewer Pipe Aging



1.1.3 System Inventory & Age

The District owns and operates a modern collection and conveyance system of gravity sewers, pump stations (with associated force mains) and STEP systems, including more than 370 miles of main-line gravity sewers and 67 pump stations. The system is in good condition and is relatively young. More than 50% of the District's gravity pipe inventory has been constructed since 1990. The aging of the District gravity pipes is shown in Figure 1.2. Pump station aging is similar, and approximately 80% of existing pump station inventory has been constructed since 1990.

Modern pipes are expected to have a typical usable life of 100 years. Modern pump station structures typically last 75 years; however, the control and mechanical equipment requires replacement every 10 to 20 years. Age is one of several factors used in determining maintenance levels and schedules for restoration and replacement of infrastructure.

1.2 Growth of Population and Wastewater Flows

The District must plan to collect and convey wastewater flows generated from expected future populations within its service area. Growing populations will generate related increases in wastewater flows, placing increased demand on the wastewater system. This Plan's demographic projections and engineering analyses anticipate continued growth of the customer base and associated increases in flows. Between 2016 and 2036 the WVUGA population will grow by 14%, NVUGA by 69%, and RUGA by 277%. On average, the District population is forecast to grow by 86%.

Future wastewater flows are estimated from population using a ratio of flow per capita. The unit flow values in Table 1-1 are used to estimate sewer flows. The values are based on observations of flows within the District's system and a review of values used around the region. Unit flow values are assigned to each of the 4 population segments studied in this Plan.

Expressed in gallons per day (gpd), average annual flows (AAF) in the District's systems are expected to rise from 8.3 million gpd in 2016 to nearly 16 million gpd in 2036. Table 1-2 presents expected flows by service area. By 2066, total District flows may rise to nearly 26.6 million gpd.



The unit values presented in Table 1-1 reflect an observed decrease in per capita flow within the District's system. Future populations are expected to generate less wastewater per capita. This trend is due in part to water conservation efforts and the promulgation of more efficient fixtures and equipment. Residential unit flows are forecast at 25% below planning values used in prior plans. If the unit values used in prior plans had been applied to this Plan's population projections, projected future wastewater demand would have been much higher.

TABLE 1-1
Flow Rates per Population Segment

SEGMENT	AAF (WITH BASELINE INFILTRATION AND INFLOW INCLUDED)
Residential	75 gal/capita/day
Employment	15 gal/employee/day
Student	15 gal/student/day
Industrial	1,500 gal/acre/day

TABLE 1-2
Predicted Flows, 2016 and 2036

	2016 AAF (MILLION GPD)	2036 AAF (MILLION GPD)
Westside Service Area (WVUGA)	0.8	0.9
Salmon Creek Service Area	7.5	15.1
RUGA	0.6	3.5
NVUGA	6.9	11.6
GRAND TOTAL	8.3	16

1.3 System Capacity Analysis

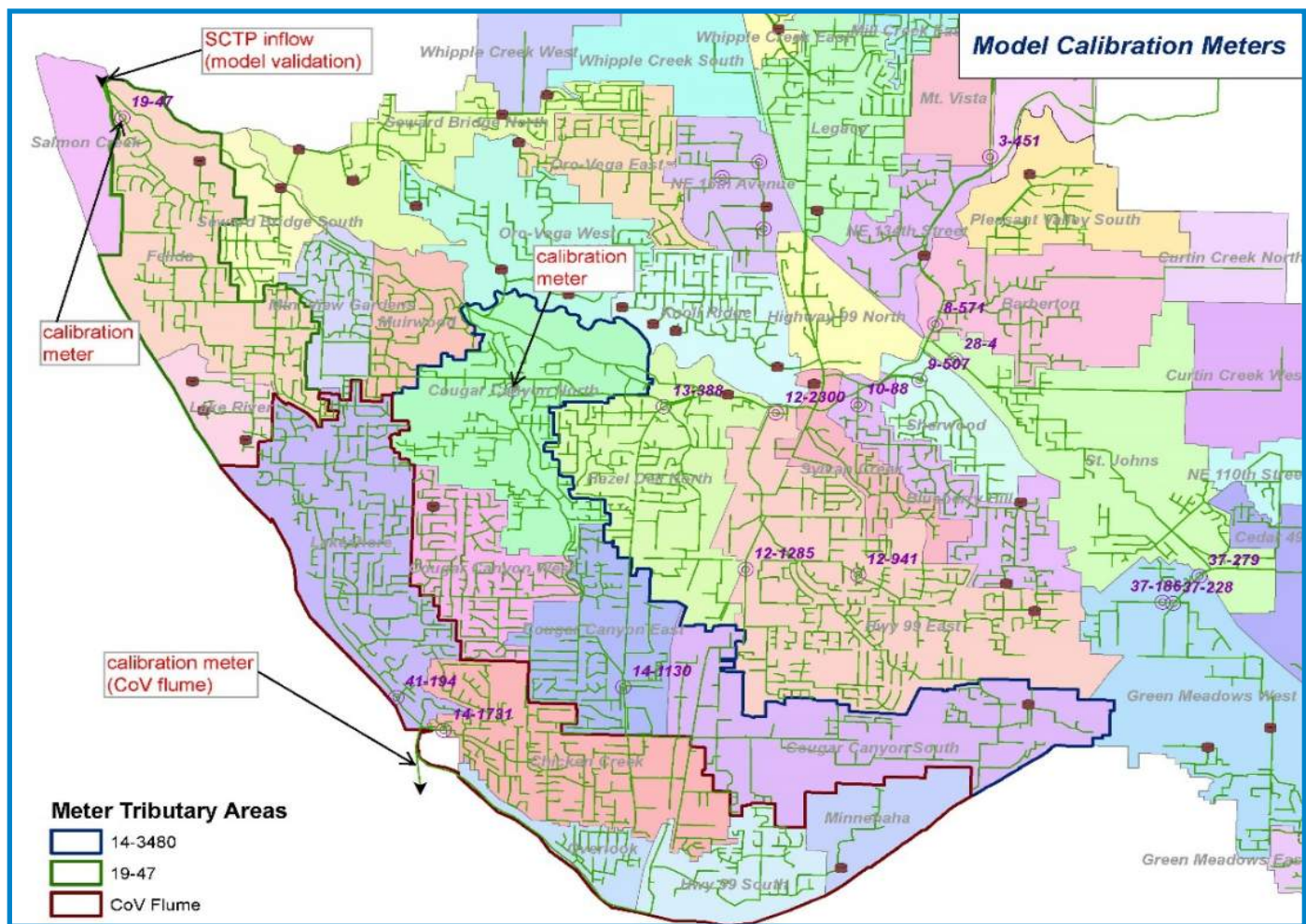
A hydraulic model is used to evaluate the capacity of the District's system to collect and convey wastewater flows under current and future projected flow conditions. The model constructed for this Plan shows that the majority of the District's existing pipes and pump stations are able to convey wet weather flows in the 2016 and 2036 modeled scenarios without surcharging. This result is influenced by conservative past engineering practices and the evident decline in wastewater flows per capita.

1.3.1 Hydraulic Modeling

The hydraulic model is a simplified digital simulation of the existing wastewater conveyance system. The model simulates wastewater flows through the system using a combination of flows projected based on population and flows simulated from a theoretical rain storm ("design storm").

The model is calibrated to ensure that the simulated collection system is an accurate representation of the physical system and its hydraulic response. The calibrated model output matches measured real world data within acceptable limits. Data from an inflow meter at the SCTP is used to validate the model after calibration at selected flow meters. Calibration flow meters and their respective contributing areas are shown in Figure 1.2.

FIGURE 1.3
Calibration Flow Meter Locations





1.3.2 Modeled Capacity

In the 2016 simulated scenario, only a few isolated locations are nearing capacity during the design storm. Only 3 gravity pipe segments, or less than 0.5% of the system, are capacity limited in the model. And only 4 pump stations, or approximately 6% of existing stations, are capacity limited.

In the 2036 simulated scenario, 13 locations in the District's wastewater system have capacity limitations during the design storm. These include 4 gravity pipe segments representing approximately 1% of the total system and 9 pump stations, or 13% of stations. Of the pump stations, 5 capacity limitations also include associated force mains and 1 includes an associated gravity pipe.

1.3.3 Conveyance Capacity Projects

Conveyance capacity limitations may be remedied by increasing the size of the infrastructure (upsizing) or by decreasing demand at the location by re-routing some or all flows directed to the pipe or pump station. Recommended capital projects include a mix of upsizing and diversion solutions for those pipes and pump stations with anticipated capacity limitations. Each capacity limitation has been resolved with the improvements proposed in this Plan

1.3.4 Treatment Plant Capacity

The District solely provides wastewater collection and conveyance, and it coordinates with local partners for treatment of its wastewater flows. Because it does not own a wastewater treatment plant, the District is not directly responsible for plant capacity planning, and the treatment plants are not a part of this Plan. However, the District's 20-year planning assumptions rely on certainty that it can continue to direct flows to two wastewater treatment plants in Clark County – the VWTP and the SCTP. Future flows predicted by the hydraulic model have been compared to plant capacity using information from approved facility plans provided by their operators. Both the VWTP and the SCTP will have adequate capacity to receive and treat projected District flows through 2036.

1.4 Operations Programs



District operations contribute to maintaining system functions and optimum capacity of conveyance components. A standardized level of service plan has been adopted throughout the service area providing for service at or above industry standards. The District uses an industry-standard maintenance management software to track inspections and work orders. The District maintains its conveyance system regularly and inspects components routinely. Maintenance and preventative activities are targeted where inspections show system functions are compromised by grease and grit or by deteriorating system conditions.

1.5 Policy Recommendations

Over time, the District's knowledge of its wastewater system has improved. Industry standards for modeling assumptions and risk assessment have also changed over the years. For instance, the hydraulic model used to simulate system capacity in 2036, carried out to support this Plan, demonstrates that previous design and planning policies have been conservative. This has allowed the District to, where appropriate, amend existing and adopt new policies as part of this Plan. In addition to unit flow values previously discussed, the following policies that influence the design and analysis of the collection system are adopted in this Plan:

- » A 25-year simulated storm is selected as the basis of design; infrastructure is sized to carry peak flows associated with the design storm.
- » Gravity sewer pipes may surcharge within established limitations during the peak flow conditions.
- » A flow trigger for managing pump station capacity has been established. Capital planning measures are initiated when the run time for the lead pump in a pump station approaches 45 minutes per hour under peak flow conditions.



1.6 Staffing Assessment

The District employs 55.5 full-time equivalent (FTEs) employees. Of these, 14 FTE are assigned to operation and maintenance of the collection system, including 7 assigned to gravity sewers and 7 assigned to pump station/force main facilities. Table 1-3 compares District staffing level to several similar utilities in western Washington.

The District has comparable or slightly higher staffing levels than the other wastewater service providers. Economy of scale normally suggests that agencies with smaller systems, fewer linear feet of pipe, typically would have a higher ratio of personnel to pipe length. Other variables, however, have a substantive impact on staffing needs. These include the numbers of pump stations and STEP systems, both of which increase staffing needs, and levels of service. This is evidenced clearly with the data presented in Table 1-3. Given these and other factors, the District staffing levels are reasonable and appropriate.

TABLE 1-3
O&M Staffing Comparison

AGENCY	PUMP STATIONS	CURRENT STAFF	LENGTH PIPE (LF)	FTE / 100,000 LF
City of Lacey*	47	6	898,000	0.67
Southwest Suburban Sewer District	11	6	1,219,000	0.49
Alderwood Water and Wastewater District	14	10	1,942,900	0.50
District*	67	14	1,971,700	0.71

*Substantial STEP systems

1.7 Capital Improvement Program (CIP)

The development of a realistic, feasible, and defensible CIP is one of the primary goals of this Plan. Based on analyses of population growth as well as system capacity, age and condition, the CIP includes projects falling into two categories: restoration and replacement (R&R) and capital projects.

R&R projects address improvements to the existing collection system. These are commonly related to operations and maintenance (O&M), poor condition or obsolescence of existing infrastructure.

Capital projects are those construction projects that, in general, address system improvements that are necessary to accommodate growth. Capital projects can be further categorized as capacity or expansion related projects. Capacity projects increase the size of infrastructure to accommodate increased flow resulting from population growth. Expansion projects construct new infrastructure required to extend service to undeveloped areas.



1.7.1 CIP Summary

Over a 20-year planning period, the District identifies a grand total of \$147.22 million in projects by 2036. The 6-year 2017 to 2022 CIP identifies a total of approximately \$47.10 million in capital and R&R projects.

The 6-year and 20-year CIPs are summarized in Table 1-4 and Figure 1.4.

TABLE 1-4
CIP Summary

	(MILLIONS OF \$)		
	R&R PROJECTS	CAPITAL PROJECTS	GRAND TOTAL
6-YEAR CIP (2017-2022)	10.34	36.76	47.10
Salmon Creek Service Area	8.19	36.13	44.32
NVUGA	7.73	22.08	29.81
RUGA	0.46	14.05	14.51
Westside Service Area (WVUGA)	2.15	0.63	2.78
20-YEAR CIP (2036)	35.32	64.80	100.12
Salmon Creek Service Area	31.97	64.44	96.41
NVUGA	28.13	42.15	70.28
RUGA	3.84	22.29	26.13
Westside Service Area (WVUGA)	3.35	0.36	3.71
GRAND TOTAL	45.66	101.56	147.22

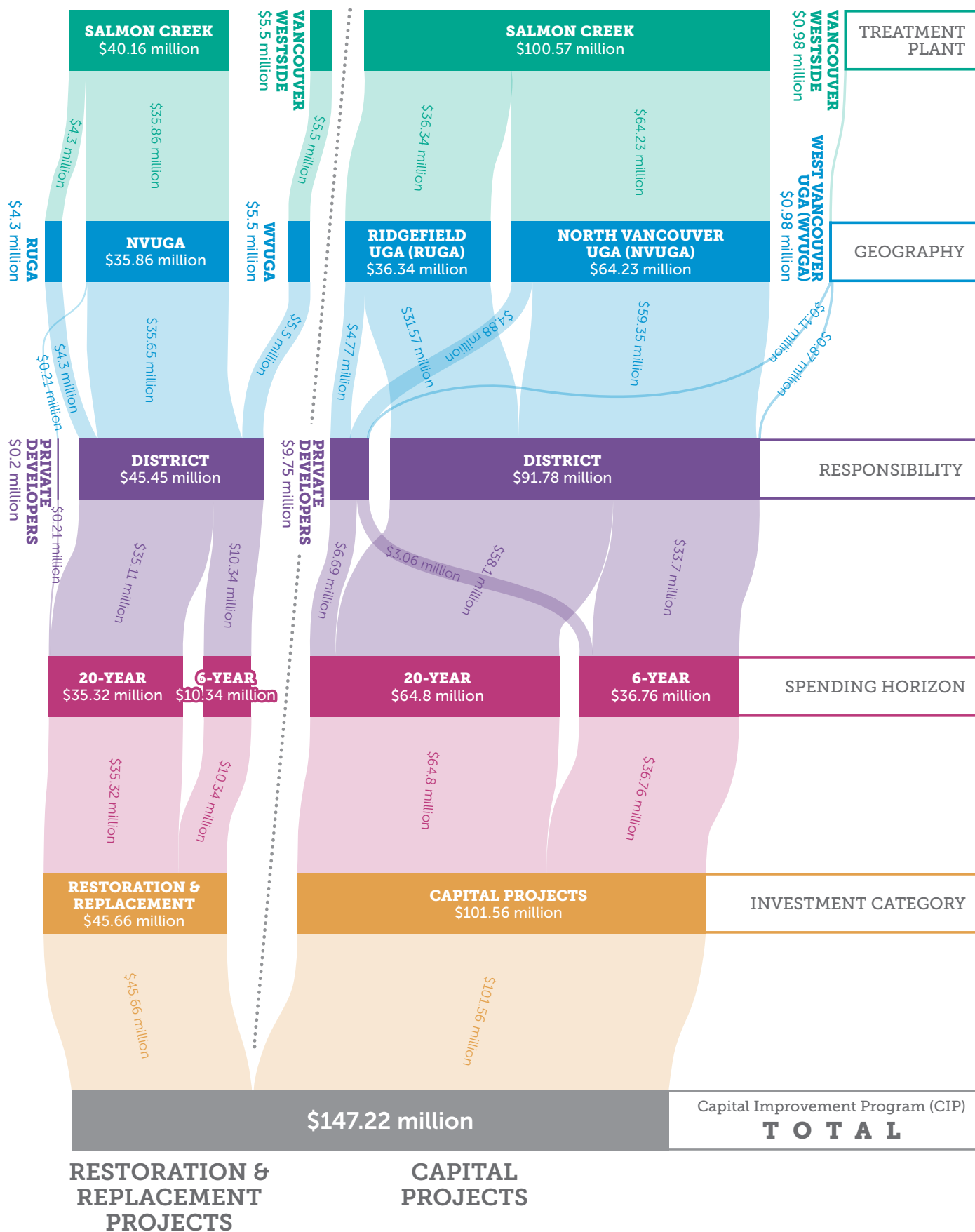


FIGURE 1.4

Capital Improvement Program Flow Diagram



1.8 Financial Analysis

The Plan includes the required 6-year financial analysis. The analysis estimates the total cost of providing wastewater service, including execution of the CIP, and defines a financial program of rates and charges to fund operations. The District Board has a practice to fund debt service on capital from rates, and to fund future capital needs from system development charges (SDCs) or debt undertaken to fund major discrete capital projects.

1.8.1 Financial Performance

The District has a long history of strong financial performance. Through the combination of customer growth and periodic rate increases, sewer rate revenue has increased to fund annual operating expenses. In addition, the District has maintained positive and healthy liquidity. Modest future rate increases are necessary to avoid eroding net income and to keep pace with inflation.

1.8.2 Sources of Funding (Resources)

To fund the CIP, the District will use its internal resources such as existing cash and investments, capital-related revenues and rate revenue. Ongoing revenues from rates are best suited to fund ongoing capital repair/replacement and maintenance needs. Furthermore, grant, loan, and bond opportunities can be available to the District through federal and state agencies to fund capital projects in the CIP. The District's revenue sources are:

- » Rates
- » SDCs
- » Local facilities charges
- » Developer extensions/latecomer agreements
- » Local improvement districts/utility local improvement districts
- » Government programs, such as the Public Works Trust Fund and the State Revolving Fund
- » Public debt (e.g. revenue bonds/private placements)

1.8.3 Financial Forecast

The financial forecast is developed from the 2017 budget. Rate revenue is projected based on actual 2016 rate collections and expected growth. The following assumptions are made in the analysis:

- » **Growth.** From a baseline 1,550 ERUs in 2017, strong growth continues in the next 5 years.
- » **Revenue.** Other (non-rate) revenues of \$1.6 million are forecast based on the 2017 Budget.
- » **O&M Expenses.** General cost inflation (3% per year), salary costs (5% per year), and benefit costs (6% per year) are expected.
- » **Capital.** Capital project costs are forecast to increase at 5% per year over the 6-year planning window based on the recent inflation in the ENR Construction Cost Index.
- » **Debt.** No new debt is forecast over the 6-year planning period; the District has an outstanding revenue bond and 3 outstanding loans.

A 6-year revenue requirement forecast is presented in Table 1-5. Annual revenue requirements based on the forecast of revenues, expenditures, fund balances and fiscal policies are summarized in Table 1-5. Planning period rate revenues and other revenues are forecast to incrementally grow over the following 5 years from 19.4 million and \$1.6 million in 2017 to \$23.5 million and \$1.8 million in 2022, respectively. SDC revenue is projected to be \$7.6 million.

As shown in Table 1-5, the combined fund balance will decrease over the planning period, beginning 2017 at \$35.2 million and ending 2022 with \$32.0 million. The District reserves are adequate to meet all financial needs and to permit the drawdown of fund balances while complying with all District financial policies.



TABLE 1-5

Revenue Requirement Forecast

	2017	2018	2019	2020	2021	2022
Revenues						
Charges for Services	\$19,387,581	\$19,997,241	\$20,710,606	\$21,868,151	\$22,415,551	\$23,470,808
Other operating revenues	1,593,500	1,689,234	1,601,405	1,650,504	1,697,066	1,758,222
Total Revenues	20,981,081	21,686,475	22,312,011	23,518,655	24,112,617	25,229,030
Expenses						
Operating expenses	18,286,500	19,373,791	19,758,880	20,319,825	21,379,864	22,019,457
Debt service	1,921,089	1,914,544	1,907,998	1,901,452	1,894,906	1,888,360
Rate funded capital	1,335,204	3,122,688	1,348,974	1,961,639	1,331,270	1,240,225
Total Expenses	21,542,793	24,411,023	23,015,852	24,182,916	24,606,040	25,148,042
Surplus/(Deficiency)	\$(561,712)	\$(2,724,548)	\$(703,841)	\$(664,261)	\$(493,423)	\$80,988
Annual Rate Adjustment	0.00%	0.00%	0.00%	2.63%	0.00%	2.56%
Collection/(Use) of Reserves for Rate Management	\$(695,233)	\$(3,036,817)	\$(838,738)	\$(860,425)	\$(626,550)	\$(43,034)
Coverage Ratio Realized	1.10	1.10	1.10	1.10	1.10	1.10
Coverage Ratio Required	1.10	1.10	1.10	1.10	1.10	1.10
Ending Combined Fund Balance	\$35,194,407	\$38,240,466	\$35,138,730	\$33,639,810	\$32,849,218	\$32,024,020
<i>Combined Minimum Target Balance</i>	<i>\$23,239,252</i>	<i>\$22,910,455</i>	<i>\$23,261,978</i>	<i>\$23,672,194</i>	<i>\$25,286,397</i>	<i>\$25,634,404</i>



1.8.4 Current and Projected Rates

EXISTING AND PROJECTED RETAIL RATES

The District's current and projected rate structure for residential customers is a fixed monthly charge per Equivalent Residential Unit (ERU) (see Table 1-6). The fixed base rate applies to all residential customers. Residents in Ridgefield pay the base rate plus a system integration charge. Eligible low-income senior customers pay a discounted rate depending on their specific qualifying income levels. Multi-family residential units are charged 0.80 ERU per unit.

TABLE 1-6
Rate Forecast

	2017	2018	2019	2020	2021	2022
SALMON CREEK SERVICE AREA						
NVUGA						
Monthly Sewer Rates	\$38.00	\$38.00	\$38.00	\$39.00	\$39.00	\$40.00
Senior Discount - 20%	30.40	\$30.40	\$30.40	31.20	31.20	32.00
Senior Discount - 35%	24.70	\$24.70	\$24.70	25.35	25.35	26.00
Multi-family Unit	30.40	\$30.40	\$30.40	31.20	31.20	32.00
RUGA						
Monthly Sewer Rates	55.70	\$55.00	\$54.10	54.30	53.70	54.10
Senior Discount - 20%	44.56	\$44.00	\$43.28	43.44	42.96	43.28
Senior Discount - 35%	36.21	\$35.75	\$35.17	35.30	34.91	35.17
Multi-family Unit	44.56	\$44.00	\$43.28	43.44	42.96	43.28
WESTSIDE SERVICE AREA (WVUGA)						
Monthly Sewer Rates	38.00	\$38.00	\$38.00	39.00	39.00	40.00
Senior Discount - 20%	30.40	\$30.40	\$30.40	31.20	31.20	32.00
Senior Discount - 35%	24.70	\$24.70	\$24.70	25.35	25.35	26.00
Multi-family Unit	30.40	\$30.40	\$30.40	31.20	31.20	32.00

EXISTING AND PROJECTED SYSTEM DEVELOPMENT CHARGES

SDCs are a form of connection charge authorized by Section 57.08.005 RCW. SDCs are imposed on new customers connecting to the system as a condition of service. The underlying premise of the SDC is that new growth (i.e. future customers) will pay an equitable share of existing and future system costs through an upfront charge for system capacity. SDC rates are reviewed periodically to ensure the revenues generated from new connections will sufficiently fund new infrastructure (or capital purchases) added to the District's collection system. SDCs are forecast to remain level over the study period 2017-2022 as noted in Table 1-7 below.

TABLE 1-7
System Development Charge Forecast

	2017	2018	2019	2020	2021	2022
<i>Salmon Creek Service Area</i>						
N. Vancouver UGA	\$4,708	\$4,708	\$4,708	\$4,708	\$4,708	\$4,708
Ridgefield UGA	\$7,550	\$7,550	\$7,550	\$7,550	\$7,550	\$7,550
<i>Westside Service Area (WVUGA)</i>	\$1,720	\$1,720	\$1,720	\$1,720	\$1,720	\$1,720

1.9 Conclusion

Ample system capacity and a strong financial position suggest the District is in a position to provide excellent service to existing and future customers. Plans are in place to proactively accommodate expected growth and increasing demand for sewer services over the next 20 years. The 6-year capital projects may be funded without increasing SDCs, while the 6-year R&R projects and operating expenses may be funded with modest changes to monthly customer rates. District rates will remain competitive both locally and regionally.

A summary of the planning sequence and selected conclusions is presented in Figure 1.5.

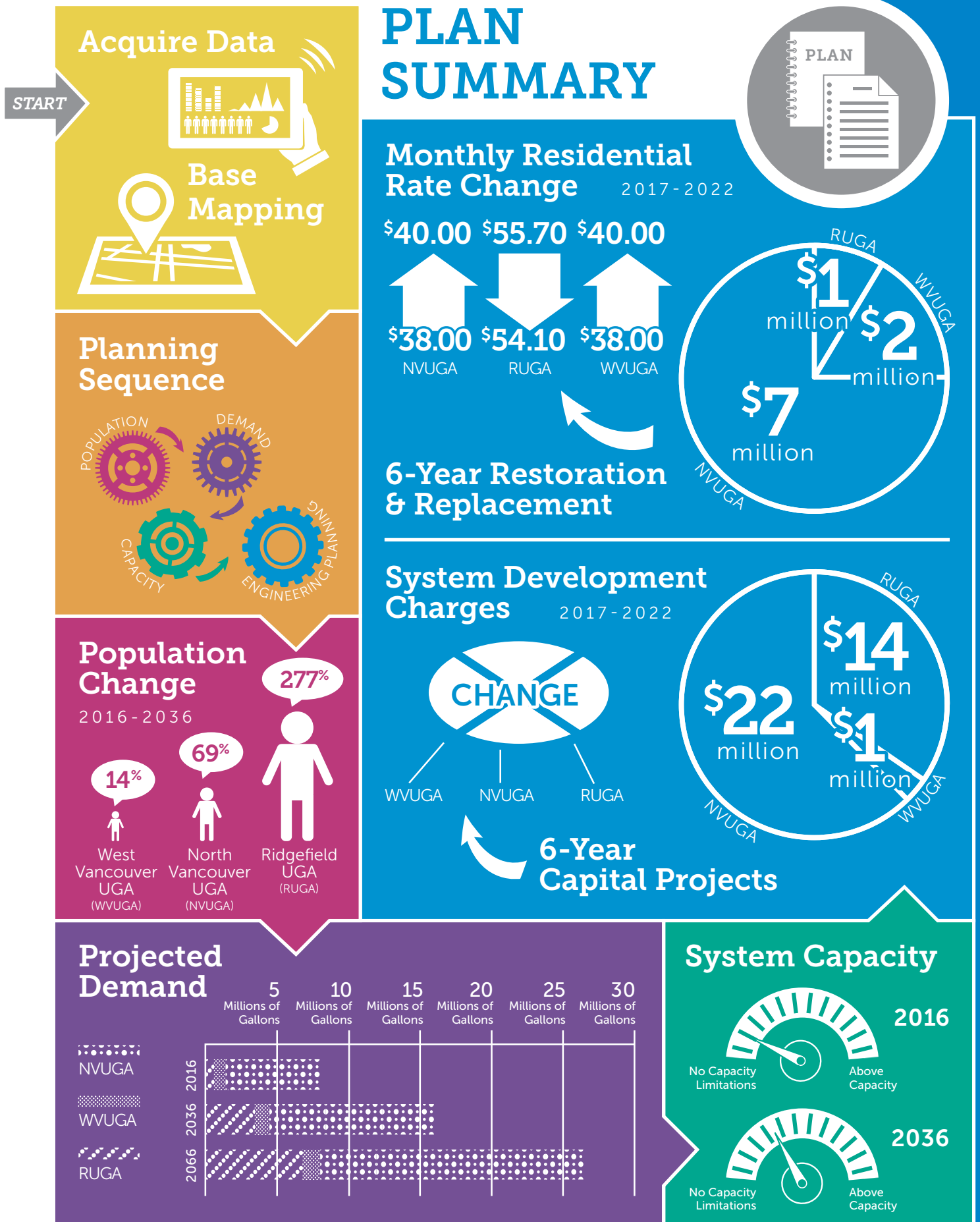


FIGURE 1.5
Plan Summary



Introduction





The design of this large diameter nozzle allows the operator to clean and flush debris from the bottom of large sewer lines

Introduction



2.1 Clark Regional Wastewater District

Clark Regional Wastewater District (District) provides collection and conveyance of wastewater in Clark County, Washington. There are 6 sewer utilities in the county, and the other 5 are owned and operated by cities. The District is the second largest, at approximately half the size of the City of Vancouver's sewer utility. The District is the only Special Purpose District in Clark County and is one of the largest sewer districts in the state, currently providing service to nearly 100,000 people, 30,000 employees, 25,000 students and 300 acres of industrial users. Its customer base has nearly doubled in 20 years, spurred by high rates of growth in the county. The service area extends for more than 50 square miles and includes the City of Ridgefield and its Urban Growth Area (UGA) and portions of the City of Vancouver and City of Battle Ground UGAs along with the rural centers of Meadow Glade and Hockinson (see Figure 2.1).

The District owns or maintains more than 600 miles of sewer pipes, 60 pump stations and 800 individual septic tank effluent pump (STEP) systems. Agency partners such as the Discovery Clean Water Alliance (Alliance) and the City of Vancouver provide treatment and discharge of District wastewater. To accommodate high growth and to provide dependable and affordable service, the District is proactive in analyzing, extending, and upgrading its wastewater system. As it strives to be a community partner, the District actively engages with its stakeholders, routinely seeking input from local leaders, developers, and agency partners.

A regional vicinity map showing wastewater treatment facilities within a 20-mile radius is presented in Figure 2.2.

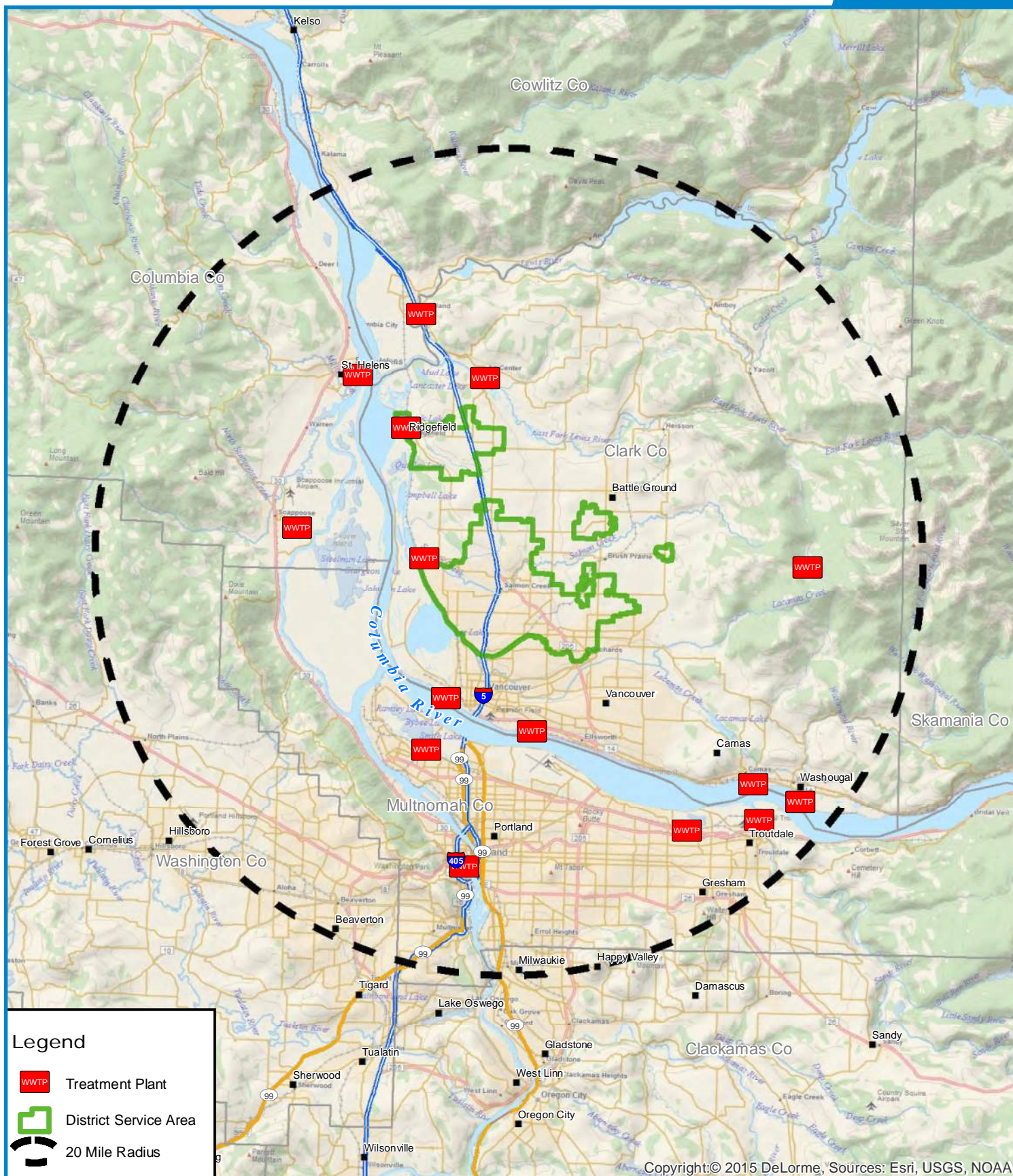


FIGURE 2.2
Vicinity Map

2.2 Purpose and Need for Plan

The *Comprehensive General Sewer Plan* (Plan) is an integral part of the District's proactive response to growth, its focus on reliability and its commitments to environmental stewardship and fiscal responsibility. To guide policy development and decision-making for the District, the Plan identifies current capacity limitations of the collection and conveyance system, predicts future wastewater flows based on projected land use and population, evaluates potential future capacity limitations, and schematically illustrates sewer extensions into areas where new growth is expected. The Plan incorporates management and policy recommendations, a capital improvement program (CIP), and a financial analysis.

Proper planning and sizing of future infrastructure will be influenced by several critical components of this Plan, such as the following:

- » Policies that govern system design, including defining the design storm event and system surcharging allowances
- » Reasonable and documentable residential, employment, and student population and industrial forecasts that have been vetted with the cities, County and school districts
- » Per capita flow values based on historical trending
- » Hydraulic modeling calibrated to observed rainfall data and flow records
- » Cost-effective capital projects

Ultimately, the Plan describes the expected sewer services in 2036. Service is to be achieved by managing and upgrading existing infrastructure (through a CIP) and by coordinating with private developers to equitably extend local sewer service to undeveloped areas as new growth occurs.

This Plan fulfills the requirements of a General Comprehensive Plan (GCP) and a General Sewer Plan (GSP). The GCP is prepared in accordance with the requirements of Section 57.16.010 Revised Code of Washington (RCW). The GSP is prepared in accordance with the requirements of Section 90.48.110 RCW and Sections 173-240-010, 173-240-020, and 173-240-050 Washington Administrative Code (WAC). The requirements of the Plan are outlined in Table 2-1.



TABLE 2-1**Comprehensive General Sewer Plan Requirements per 173-240-050 WAC**

REFERENCE PARAGRAPH	DESCRIPTION OF REQUIREMENT	LOCATION IN DOCUMENT
3a	Purpose and need for proposed plan	Section 2.2
3b	Who will own, operate, & maintain system	Section 2.4
3c	Existing and proposed service boundaries	Figure 3.1
3d	Layout map showing boundaries; existing sewer facilities; proposed sewers; topography and elevations; streams, lakes; and other water bodies; water systems	Chapter 3 Figures and Appendix A
3e	Population trends	Chapter 6
3f	Existing domestic and/or industrial wastewater facilities within 20 miles	Figure 2.2
3g	Infiltration and inflow problems	Section 6.5.4 and Chapter 7
3h	Treatment systems and adequacy of treatment	Chapters 5 and 8
3i	Identify industrial wastewater sources	Table 6-7, Section 6.3.5, Section 8.5.2, Fig 8.2 and Table 8-3
3k	Discussion of collection alternatives	Chapter 9
3k	Discussion of treatment alternatives	Chapter 8
3k	Discussion of disposal alternatives	Chapter 8
3l	Define construction cost and O&M costs	Chapter 10 and Appendix O
3m	Compliance with management plan	Chapter 9
3n	SEPA compliance	Appendix D

In addition to the WAC requirements cited above, other recent state and local regulations must be incorporated into this Plan. These additional requirements are outlined in Table 2-2.

TABLE 2-2**Additional Sewer Plan Requirements per State and Local Regulations**

DESCRIPTION OF REQUIREMENT	LOCATION IN DOCUMENT
Evaluation of wastewater reuse per <i>Substitute Secondary Senate House Bill 1338</i>	Section 8.5
Capacity, Management, Operations and Maintenance (CMOM)	Chapter 9

2.3 Service Area Characteristics

The District is located in Clark County immediately north of the City of Vancouver. The service area contains 2 contiguous portions of the Vancouver UGA and 3 other non-contiguous areas. A more detailed description of the service area, including a detailed map, is provided in Chapter 3. The service area is predominately suburban although it also includes 2 rural centers. It is characterized by a mixture of single

and multi-family residential units and a core commercial area. Three industrial centers are currently served. Topography ranges from flat and gently rolling to hilly with steep slopes. Generally, elevations decrease from north to south and from east to west toward the Columbia River and Salmon Creek. Wetlands are found adjacent to the many creeks, small streams and lakes in the area.



2.4 Ownership and Management

The District owns and manages a public wastewater collection system. A discussion regarding the collection system assets and inventory is presented in Chapter 5. The District is a Special Purpose District organized under Title 57 RCW to provide a public wastewater system. A 3-member Board of Commissioners is the governing body. A General Manager, Assistant Manager and 4 department leads manage the District:

- » District Engineer
- » Operations Manager
- » Finance Director/Treasurer
- » Board Clerk/Administrative Services Manager

The District employs 55.5 full-time equivalent (FTE) employees.



2.5 System History and Background

The Hazel Dell Sewer District was formed in 1958 to provide wastewater conveyance and treatment for 300 customers. The service area, urban growth boundaries, and the customer base expanded in the 1970's and 1980's. The organization's name was changed to Clark County Public Sewer District No. 1 and eventually to Clark Regional Wastewater District. Beginning in the 1970's, the District began coordinating with City of Vancouver and Clark County for wastewater treatment services. Operations began to focus solely on collection

and conveyance, while financial partnerships ensured treatment capacity was available at plants operated by City of Vancouver and Clark County. Boundaries expanded again in the 1990's and yet again with urban expansion in the mid-2000's. Over the last decade, the District has continued to refine its relationships with other local jurisdictions, form new partnerships and upgrade its system and management practices. Most recently, in 2014 the District began operating the collection system in the City of Ridgefield.

2.6 System Planning



The District's sole purpose is the collection and conveyance of wastewater. Its services are coordinated with Clark County, City of Vancouver, City of Ridgefield, City of Battle Ground and the Alliance to provide effective collection and conveyance for existing and future populations. See Chapter 3 for a detailed discussion of regional partnerships and plans that inform the District's preparations for the future.

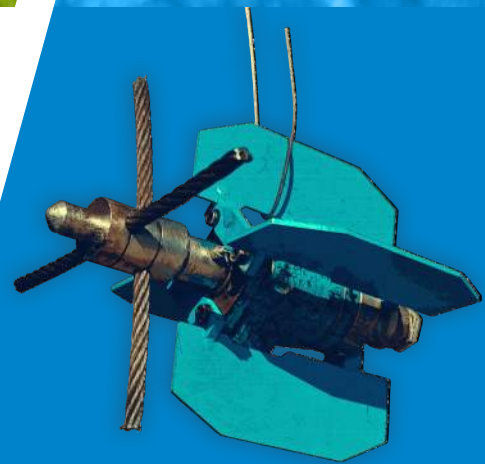
Interlocal agreements between the District and neighboring agencies define the terms by which sewer service is provided. This Plan was developed based on the assumption that flows will continue to be managed in accordance with the current terms. Agreements are presented in Appendix F. A change to flow routing is possible only through the agreement of both parties.

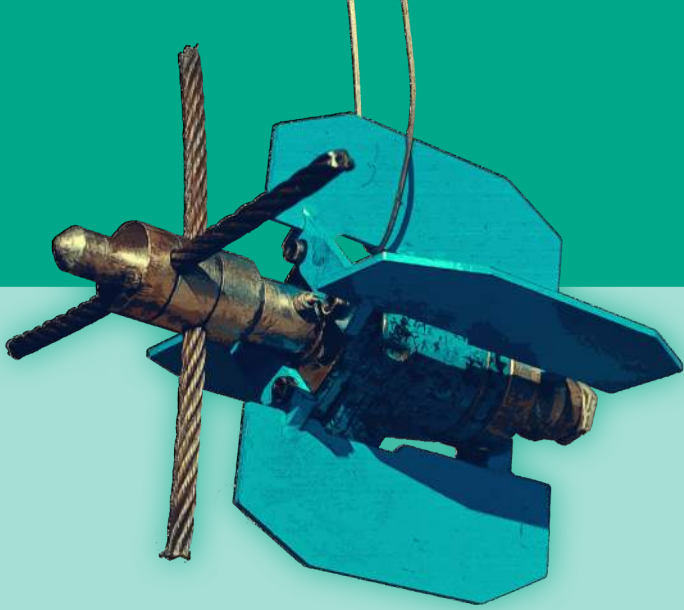
The District's system is expanded as necessary to accommodate growth and economic development. Extensions of public sewer into undeveloped areas are generally constructed by the property owner or developer, at their cost, and pursuant to developer extension agreements with the District. The District plans for these extensions to ensure the collection system is built in a logical and efficient manner. A portion of anticipated extensions and improvements may result in cost-sharing arrangements between the District and the developer. Cost sharing occurs for general facilities, which are defined as trunk sewers and permanent pump stations. The costs for general facilities are included in the CIP presented in Chapter 10. Most extensions of local gravity sewers (e.g. 8-in diameter), however, are not part of the CIP. See Chapter 4 for cost-sharing policies.





Service Area & Land Use





The wire tipped end of this grease & debris nozzle rotates using hydraulic water pressure to remove grease and debris from sewer main walls

Service Area & Land Use



3.1 Service Area Description

The District is divided into 2 primary service areas, the Westside Service Area and the Salmon Creek Service Area, described below.

A map of the District is presented in Figure 3.1, and service area statistics are summarized in Table 3-1.

3.1.1 Westside Service Area

The Westside Service Area consists largely of a portion of the Vancouver UGA immediately north of Vancouver along Interstate 5 (I-5). A few parcels served by the District within the City limits are also included. This area is referred to in this Plan as the West Vancouver UGA (WVUGA), and it covers a total of 1,936 acres. Wastewater flows are conveyed to a point of connection to the City-owned conveyance system and ultimately to the Vancouver Westside Wastewater Treatment Plant (VWTP). The WVUGA is largely developed and residential in nature, with a commercial core along Highway 99. Future development is generally limited to infill.



TABLE 3.1
District Service Area Boundaries

SERVICE AREA	TRIBUTARY WASTEWATER TREATMENT PLANT	AREA	
		(ACRES)	(SQUARE MILES)
Westside Service Area (WVUGA)	VWTP	1,936	3.03
Salmon Creek Service Area	RTP and SCTP	30,938	48.35
RUGA	RTP and SCTP	6,314	9.87
NVUGA	SCTP	24,624	38.48
TOTAL		32,874	51.38

3.1.2 Salmon Creek Service Area

The Salmon Creek Service Area is the largest component of the District's system, both in terms of number of customers and acreage. The area includes the City of Ridgefield and its UGA (RUGA) and a portion of the Vancouver UGA referred to as the North Vancouver UGA (NVUGA) in this Plan. The Salmon Creek Service Area covers more than 30,000 acres (about 48 square-miles). The RUGA is 6,314 acres. Wastewater flows from the RUGA are currently conveyed either to the Salmon Creek Wastewater Treatment Plant (SCTP) or to the Ridgefield Wastewater Treatment Plant (RTP). The NVUGA is 24,624 acres. All wastewater flows from the NVUGA are directed to the SCTP.

The designated rural centers of Hockinson and Meadow Glade in unincorporated Clark County are also a part of the Salmon Creek Service Area and are provided with public sewer service by the District. For planning purposes, the rural centers are included with the NVUGA. Both areas are served with a residential scale Septic Tank Effluent Pumping (STEP) system. The STEP systems discharge to the City of Battle Ground's pump station and equalization basin where flow is then conveyed through the regional transmission system to SCTP. Hockinson is a standalone area of approximately 280 acres. Meadow Glade covers approximately 1,389 acres and includes 3 components: 1) some parcels within the city limits of Battle Ground, 2) some unincorporated parcels within the Battle Ground UGA and 3) the unincorporated Rural Center of Meadow Glade.

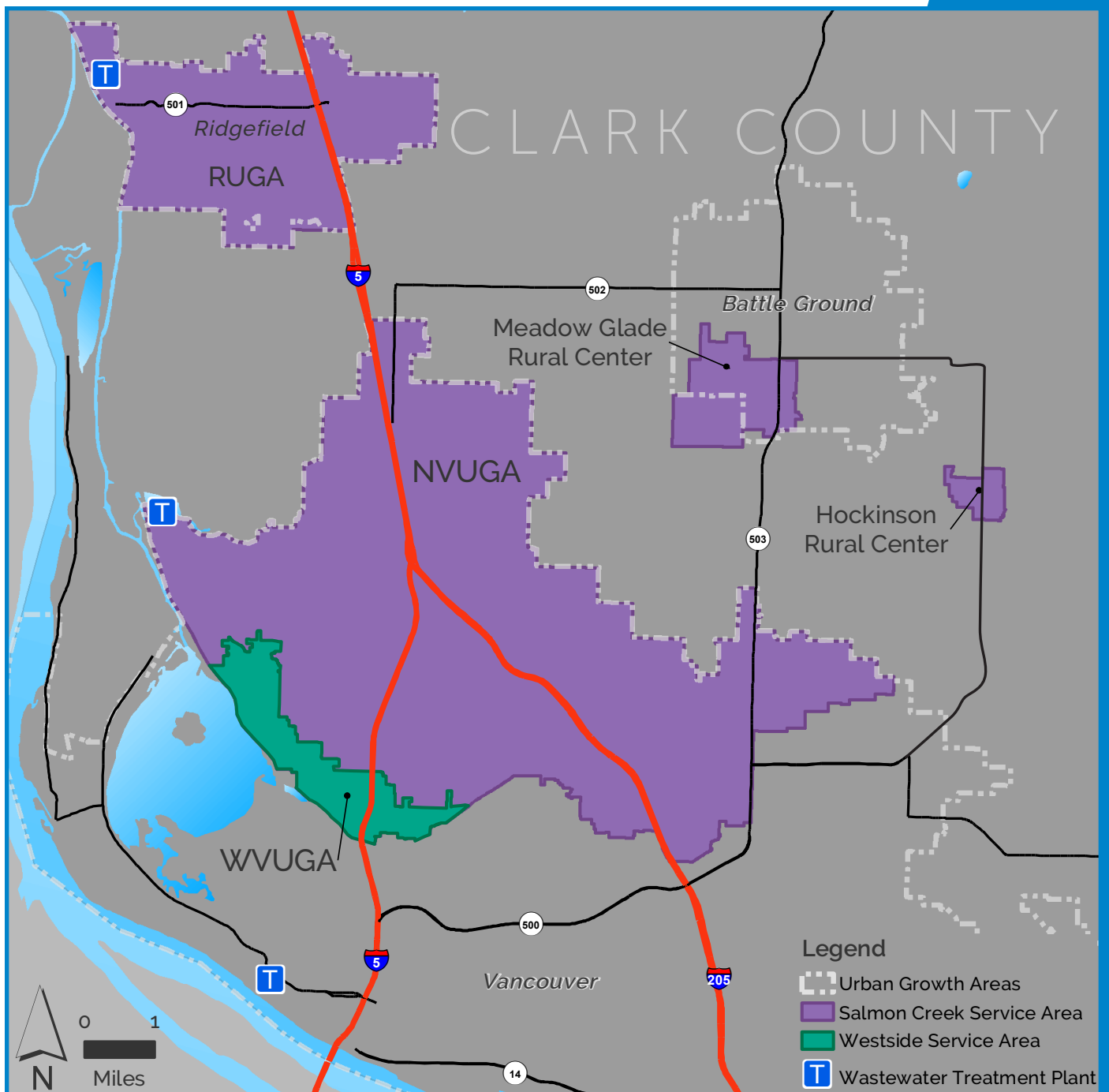


FIGURE 3.1
Service Area Boundaries

3.2 Vicinity Characteristics

3.2.1 Water Features, Sensitive Areas, and Flood Hazard Areas

A majority of the District lies in the Salmon Creek Watershed. Other notable drainages include Burnt Bridge Creek, Whipple Creek and Gee Creek in the Ridgefield area. All of the creeks and tributaries ultimately discharge to the Columbia River. The presence of sensitive lands in the service area limits the development potential of some lands. In some cases, restrictions contained in local, state, and federal regulations may cause parcels to be unbuildable. Other parcels limited by the presence of sensitive lands could potentially be developed if additional infrastructure were provided or other measures were taken. The water features, sensitive areas and Federal Emergency Management Agency (FEMA) flood hazard areas within and near the District are shown in Figures 3.2 and 3.3.

3.2.2 Geology

Soils in the District's service area are generally characterized as 1 of 3 soil types as defined by the National Earthquake Hazard Reduction Program. The 3 soil types are:

- » Type C - very dense soil or soft rock
- » Type D - stiff soil
- » Type E - soft soils

A soils map is presented in Figure 3.4. Figure 3.4 was prepared based on data and information from Clark County and the US Geological Survey (USGS).

3.2.3 Landslide Hazard and Ground Acceleration

Landslide hazard areas and peak ground acceleration are presented in Figures 3.5 and 3.6, respectively. These conditions may affect the integrity of infrastructure constructed in these areas. Local zoning and land use restrictions may affect the design measures required if construction is located within these hazard areas.

3.2.4 Water Resources

Water supply within the District is provided by the following agencies, presented in descending order based on the number of District customers served. A map of water systems and purveyors in and near the District's service area is presented in Figure 3.7.

CLARK PUBLIC UTILITIES (CPU)

All water produced and delivered from CPU originates from underground aquifers and is delivered through a series of wells that are located throughout the District's service area and Clark County. The average well depth is 250 feet.

CITY OF RIDGEFIELD

The City of Ridgefield has 5 active wells, 1 intertie with CPU and 3 water reservoirs.

CITY OF VANCOUVER

The City of Vancouver has 40 wells, 11 reservoirs and 2 interties with CPU.

CITY OF BATTLE GROUND

The City of Battle Grounds has 8 wells, 6 reservoirs, 2 booster pump stations and 1 intertie with CPU.

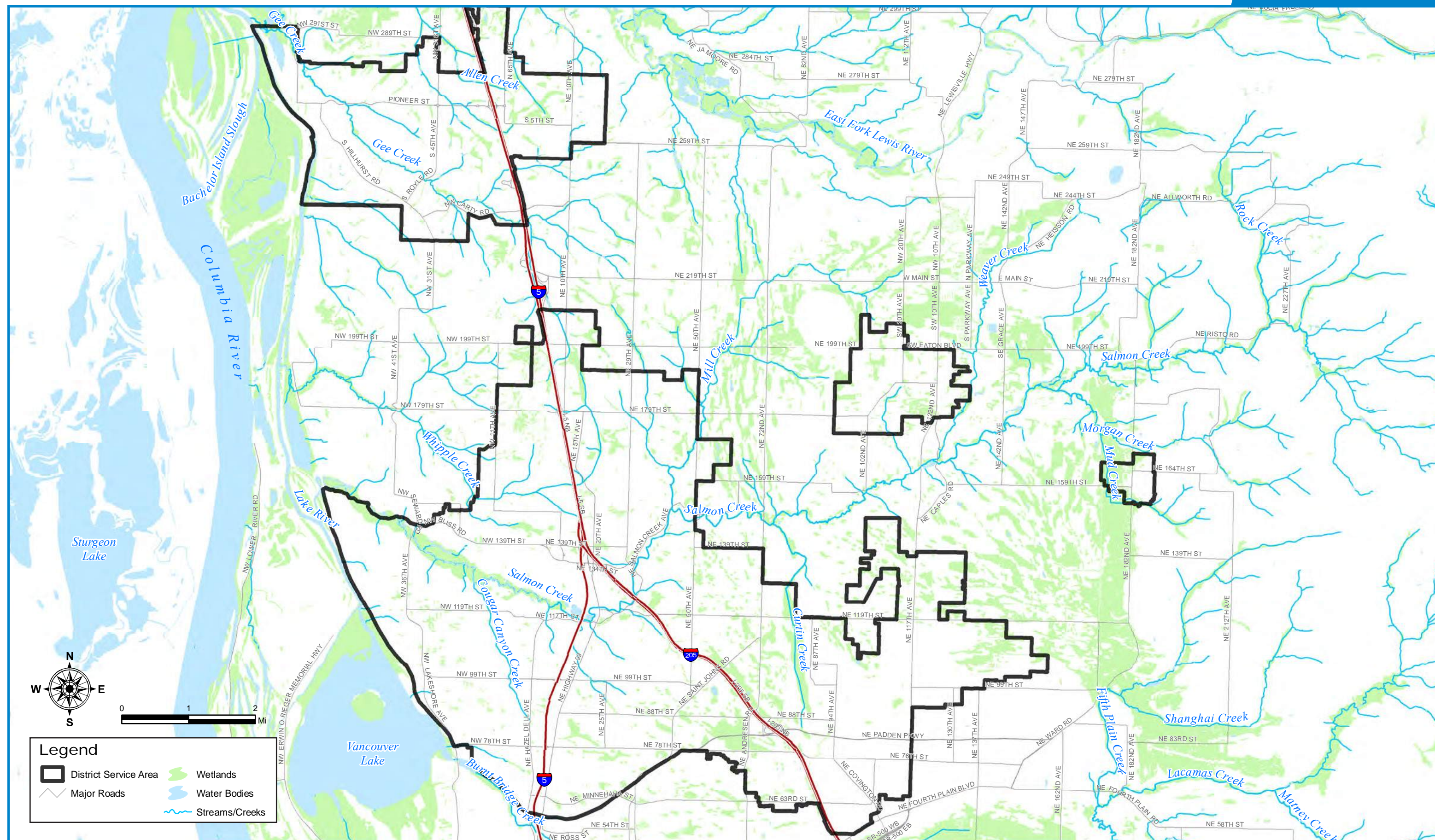


FIGURE 3.2

Water Features

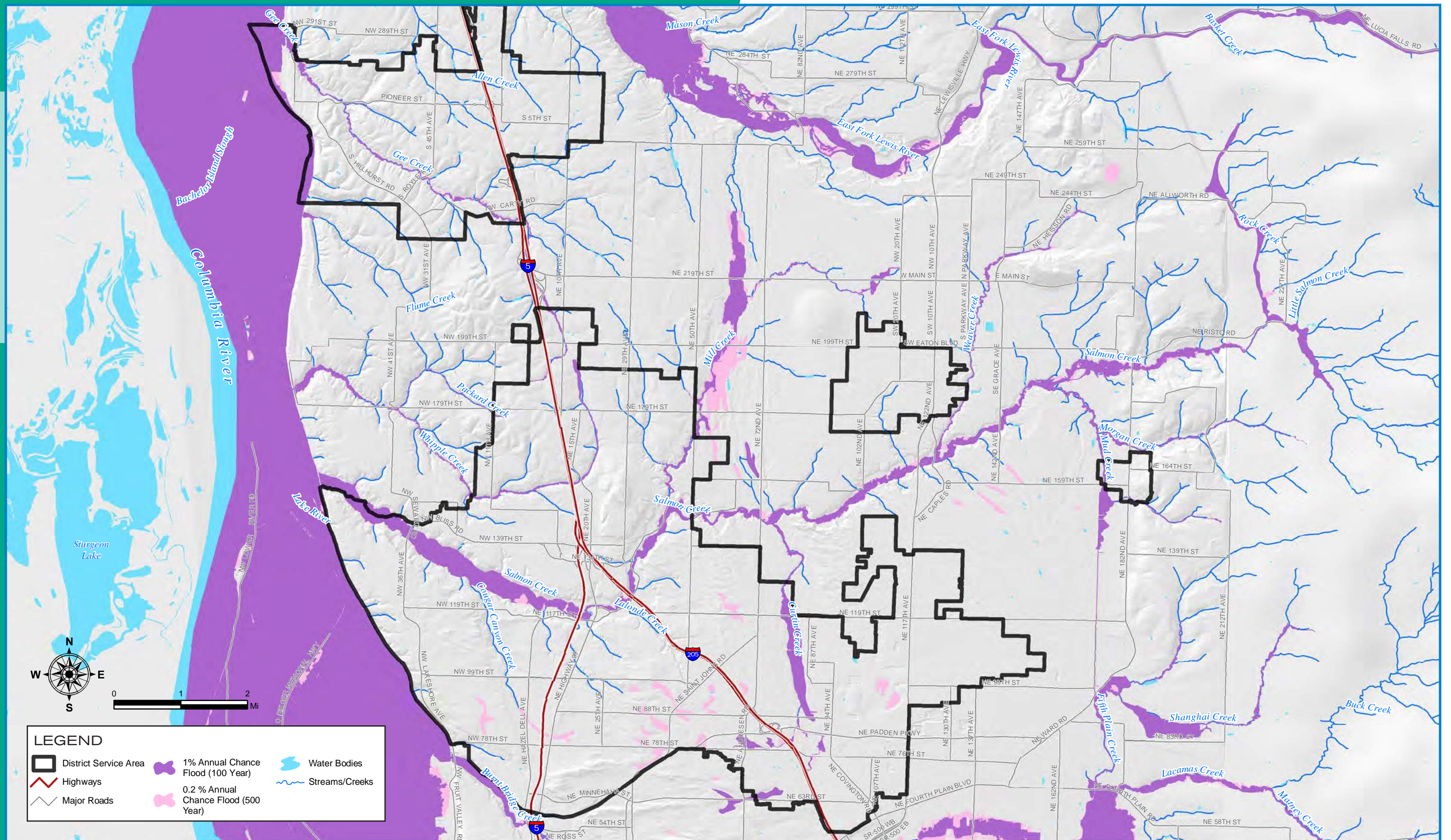


FIGURE 3.3
FEMA Flood Hazard Areas

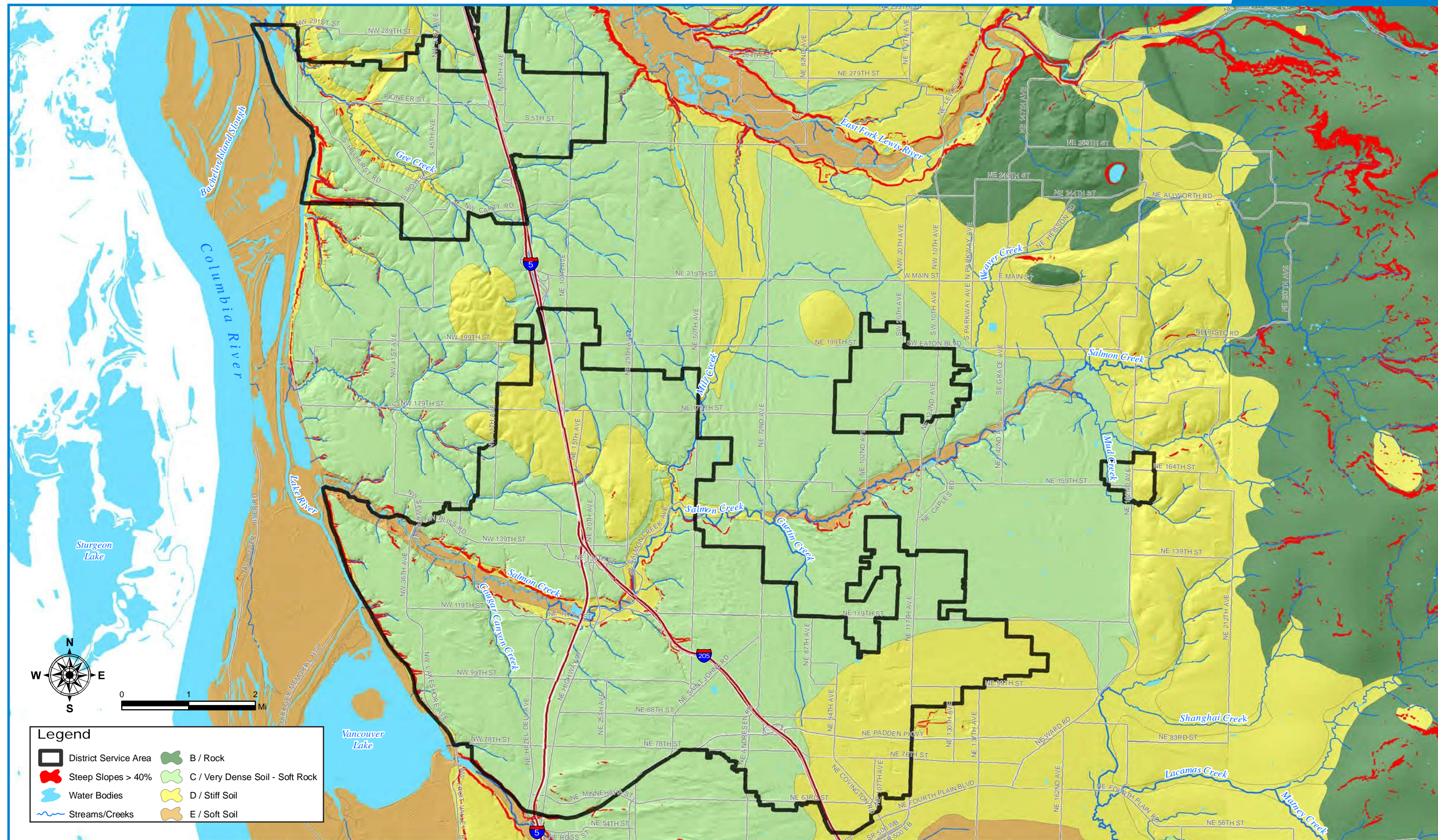


FIGURE 3.4

Soils and Steep Slope Areas

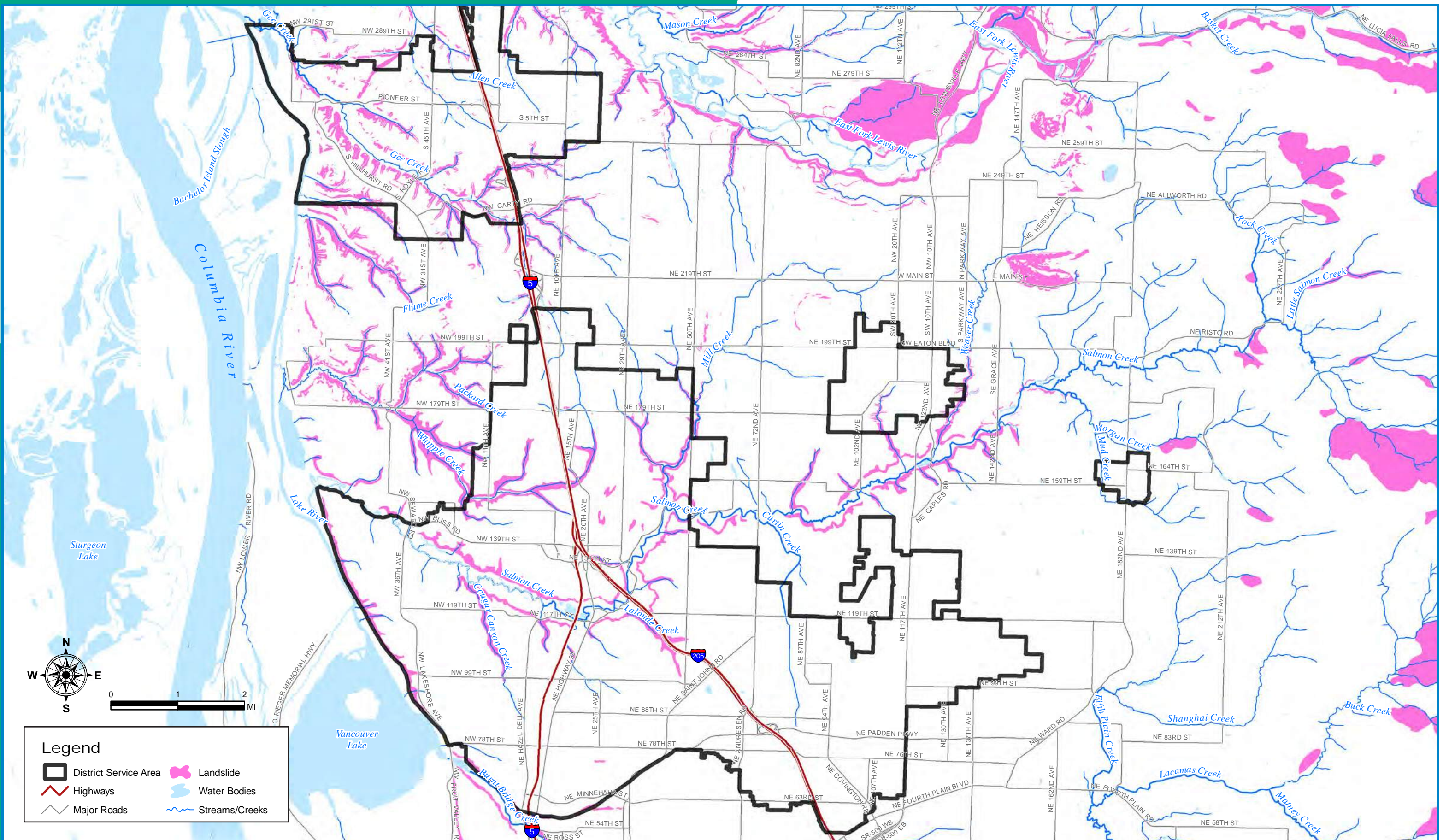


FIGURE 3.5
Landslide Hazard Areas

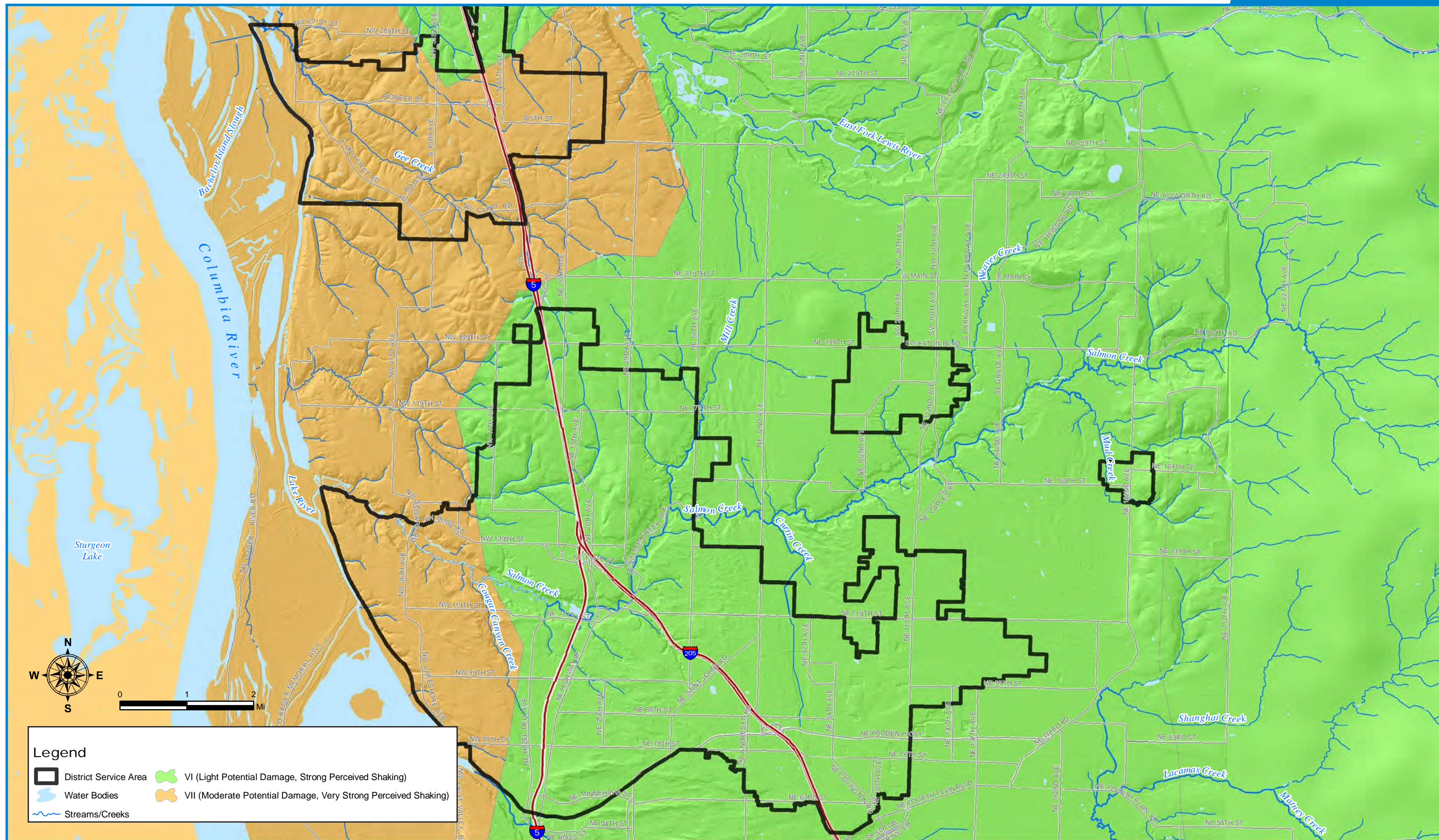


FIGURE 3.6
Cascadia M9.0 Scenario Peak Ground Acceleration



3.3 Land Use

3.3.1 Growth Management Act

The State of Washington adopted the Growth Management Act (GMA), Chapter 36.70A RCW, with the intent of concentrating most new development and population gains within designated urban areas of counties. These counties are required to define a UGA within which urban services such as sewers are provided. Any development outside the urban boundary, within the rural area, may only be provided with rural services, such as water and transportation, which excludes public sewer.

With a few exceptions described below, the District's service area boundaries coincide with the UGA boundary and include only incorporated lands in the Cities of Ridgefield and Battle Ground and unincorporated lands in the UGAs of Battle Ground, Ridgefield, and Vancouver. The service area is not anticipated to expand until such time as the UGA boundaries also expand in the future. In general, sewer service extensions anticipated in this Plan are within the District's service area except for the special circumstances discussed below.

RURAL AREAS INCLUDED IN SERVICE AREA

The designated rural centers of Hockinson and Meadow Glade, which are located outside of the UGA, are within the District's service area. Section 40.370.010 Unified Development Code (UDC) of Clark County allows designated rural centers to be served by public sewers.

CURRENTLY SERVED OUTSIDE OF SERVICE AREA

The extension of sewer service has been provided to the following properties (see Appendix K) that are located outside the UGA. In most cases, public sewer was permitted in accordance with those exceptions granted in Chapter 40.370 UDC, to protect public health and serve public facilities such as schools. Continuation of service to these facilities is anticipated in this Plan.

- » The District serves multiple schools that are located outside of its service area and UGA. These include South Ridge Elementary School, Hockinson Heights Elementary School, Hockinson High School and Tukes Valley Schools.
- » Tri-Mountain Golf Course (District acquired in 2014).
- » I-5 Gee Creek Rest Areas & Weigh Station (Washington State Department of Transportation/ Washington State Patrol)

STUDY AREAS

The District has studied the following areas as part of this Plan (Study Areas), consistent with the requirements of RCW 57.16.010(2), which requires the District to consider “present and reasonably foreseeable future needs” of the sewer system. (See Maps 2-1712A, B & 3-602A, B). This Plan establishes that the District sewer system has adequate capacity for the Study Areas and that sewer service is feasible for the Study Areas. Because Clark County has not yet approved sewer service for the Study Areas, the District cannot currently extend sewer service to the Study Areas. If Clark County (or the local government with jurisdiction if applicable) approves sewer service for a Study Area, the District then will have authority to extend sewer service to the Study Area. Clark County’s or the local government’s approval must be consistent with the requirements of RCW 36.70A.110 and RCW 57.16.010(7), which states in part that: “The general comprehensive plan [of the District] shall not provide for the extension or location of facilities that are inconsistent with RCW 36.70A.110.”

- » **Rural Industrial Land Bank adjacent to the Vancouver UGA.** This area has been designated as a future industrial hub by Clark County and an Industrial Urban Reserve. In 1996, the GMA was amended to allow major industrial developments to be sited outside of urban growth areas where there is a specific development application.

Section 36.70A.367 RCW allows counties to establish up to 2 rural industrial land banks with the intent that they develop as industrial properties.

- » **Freight Rail Dependent Uses Overlay.**

In accordance with 3ESB 5517, this area has been designated for freight rail-dependent uses, which are buildings and other infrastructure used in the fabrication, processing, storage and transport of goods where the use is dependent on and makes use of an adjacent short line railroad.

- » **Allen Creek West Expansion Study Area adjacent to the Ridgefield UGA.** This area has been annexed by the City of Ridgefield.

3.3.2 Zoning

Zoning within the District service area is presented in Figure 3.8. Zoning is determined by the local government with land use jurisdiction over that portion of the service area, which includes the cities as well as Clark County. The zoning is generally classified as commercial, office, industrial, single-family and multi-family residential, public facilities, and undeveloped lands such as public right of ways, parks, and open space. Low-density multi-family zoning allows a variety of low-density multi-family housing including townhouses, multi-family structures and attached or detached homes on small lots.



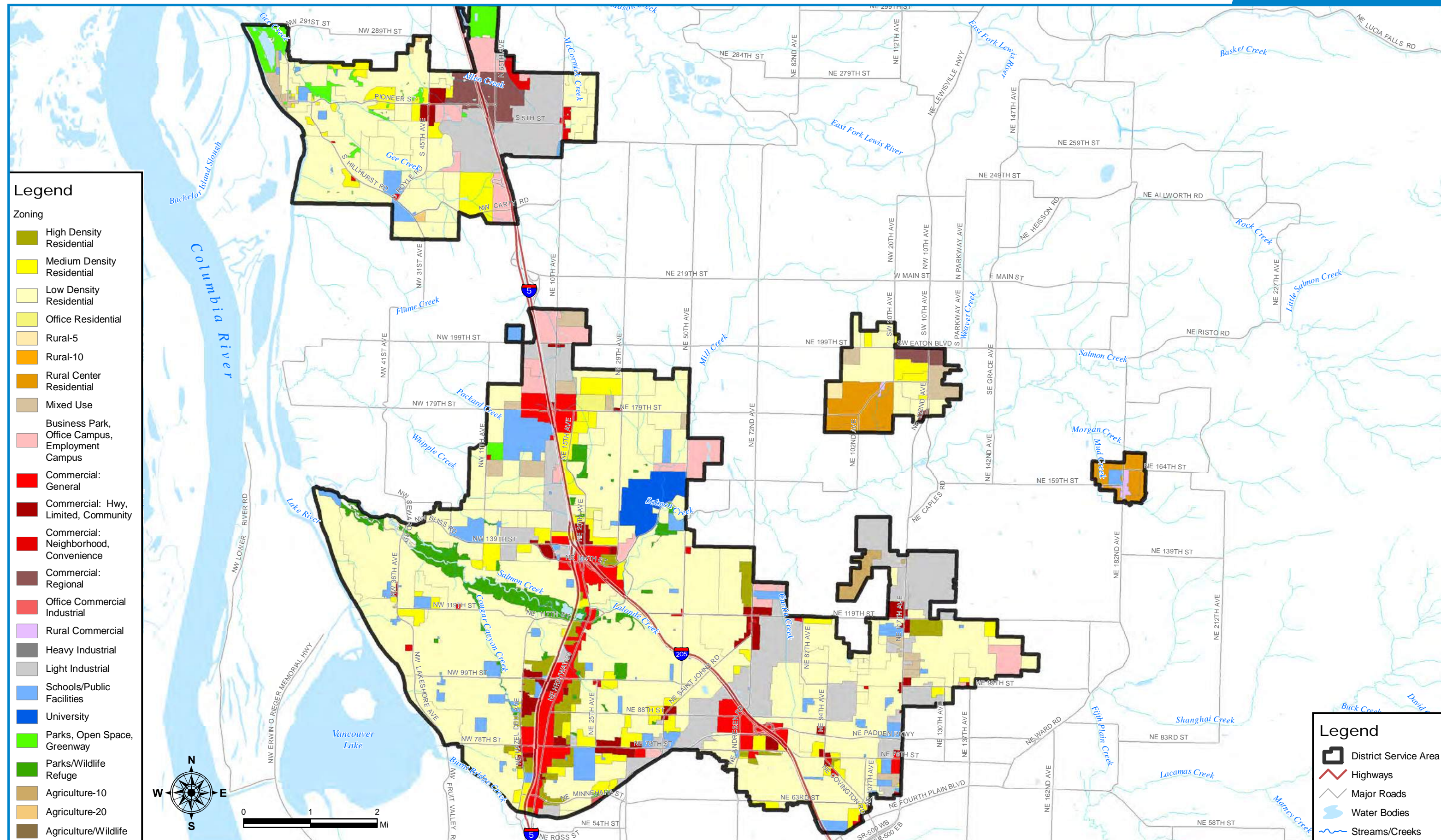
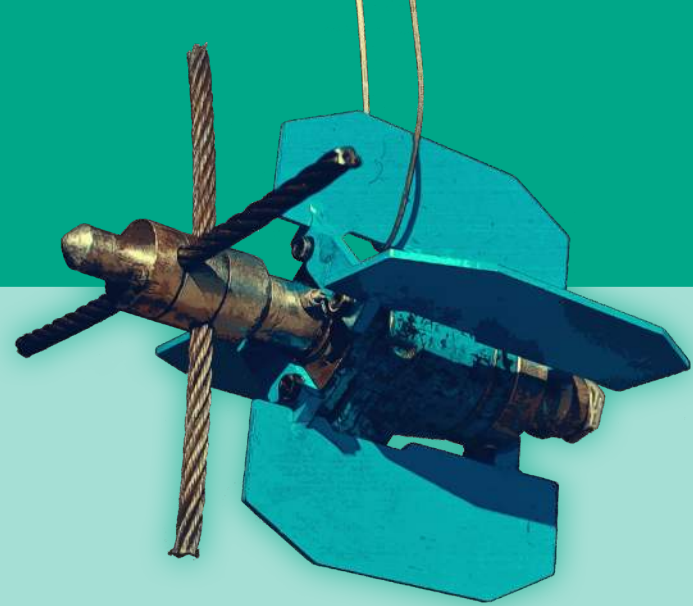


FIGURE 3.8
Zoning Map



Service Area & Land Use



3.4 Local Partnerships and Plans

Efficient provision of wastewater services in fast-growing Clark County, Washington requires local coordination and cooperation. This section summarizes the most important local coordination efforts and describes those regional plans that impact the District's assumptions and forecasts in this Plan. Agreements formalizing these local arrangements are presented in Appendix F.

3.4.1 Wastewater Treatment

Treatment and discharge of District customers' wastewater is provided through partnerships with the Discovery Clean Water Alliance (Alliance) at the RTP and the SCTP and with City of Vancouver at the VWTP. The capacity of the SCTP is owned by the District and the City of Battle Ground. See Chapter 8 for a general discussion of treatment plants, which are not otherwise included in the Plan.

3.4.2 Agreements

DISCOVERY CLEAN WATER ALLIANCE

The Alliance was legally formed on January 4, 2013, after several years of evaluation, to jointly provide for the cost-effective delivery of regional wastewater transmission and treatment services. The District is an original member of the Alliance, whose members also include the City of Battle Ground, Clark County and the City of Ridgefield.

The Alliance assumed full operational responsibility for the regional assets on January 1, 2015. The Alliance owns the wastewater transmission and treatment system known as the Salmon Creek Wastewater Management System (SCWMS), which includes the SCTP and the primary east-west infrastructure serving the facility. The Alliance also owns the RTP. Alliance assets are operated by designated sewer service providers as established in the Alliance's formation documents and agreements with participating providers. For example, Clark County currently operates the SCTP while the District currently operates the regional biofilter. The District's conveyances connect to Alliance systems for transmission of flows to the SCTP. The District's conveyances connect directly to RTP.

CITY OF BATTLE GROUND

The City of Battle Ground's sewer collection system connects to the Alliance's regional transmission system, and its flows are conveyed to SCTP.

The City of Battle Ground and the District have agreed that the City has the first right of refusal for new sewer connections within its UGA, specifically within the Meadow Glade area that is currently served by the District. If the City is unable or unwilling to serve the new connections, then the District will provide service within the design parameters of the STEP system, if it is mutually agreeable to both parties.

The District is responsible for providing pretreatment services within the City of Battle Ground to prevent fats, oils, and grease and other pollutants from entering the sewer system as described in an agreement with the City.





CITY OF RIDGEFIELD

The District's conveyances connect to RTP. The City of Ridgefield previously operated its own wastewater collection and treatment system. On January 1, 2014, Ridgefield transferred ownership and operational responsibility of its wastewater collection systems to the District. On January 1, 2015 the City transferred ownership of its treatment plant to the Alliance and continues to operate the plant under agreement.

CITY OF VANCOUVER

Wastewater collected in the District's Westside Service Area is discharged into the City's conveyance system and is ultimately discharged to VWTP. Vancouver has provided treatment for portions of District's wastewater originating in the City's vicinity since 1969. A 2010 wholesale wastewater treatment agreement describes the current terms of this arrangement.

The City and the District also have agreements allowing the District to continue providing wastewater collection services when parcels in the District's service area annex into Vancouver until a minimum threshold of annexations has been reached. A 2010 coordination of services agreement and its 2015 amendment describe this arrangement.

The District is responsible for managing an industrial pretreatment program within the Westside Service Area, in accordance with City standards, as described in a 2013 agreement.

3.4.3 Regional Plans

The RTP has limited capacity available and will not accommodate flows from high rates of expected growth in Ridgefield. See Chapter 6 for a detailed discussion of population projections. An assumption of this Plan is that the RTP will be decommissioned and all RUGA flows will be directed to the SCTP within 20 years. In addition to adjusting the system to handle expected growth, the plan for the Ridgefield flow diversion, presented in Chapter 10, results in operating cost savings by consolidating operations at SCTP and environmental benefits by removing the discharge to Lake River.



Design Standards & Policies





This hydraulic cleaning nozzle is designed to quickly travel down large diameter sewer mains

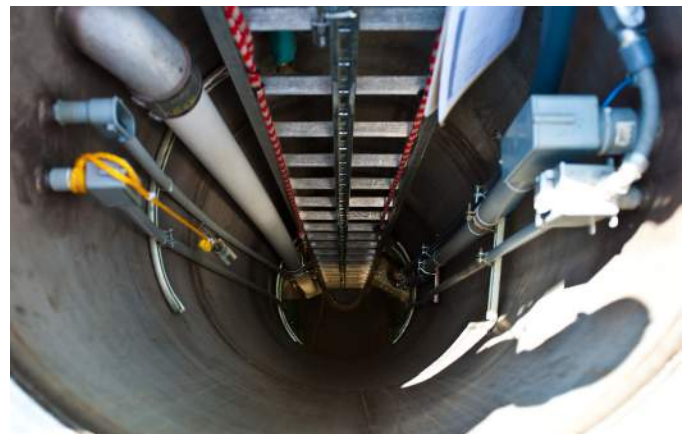
Design Standards & Policies



4.1 Performance and Design Criteria

Sewer system design criteria and standards facilitate planning, design, and construction of sewer system projects. They have been developed to maintain a consistent level of service throughout the District while allowing for the extension of sewers, both publicly and privately, to meet the increased need for sewer service in response to development and population growth. The *Clark Regional Wastewater District Design Manual 2010* (Design Manual) is presented in Appendix J.

The Design Manual consists of 3 components: design criteria, construction specifications and standard drawings. Plans and designs shall conform to design criteria set forth in the *Criteria for Sewage Works Design*, prepared by the Washington State Department of Ecology (Ecology), revised August 2008, as amended and supplemented by the District. The following is a brief summary of the pertinent criteria that affect sizing and siting of District facilities.



4.1.2 Manholes

- » Manholes shall be placed at a maximum of every 400 feet and at each grade and direction change.
- » All sewers 8-in diameter or larger shall terminate in a manhole.
- » All pipes shall be aligned with the center of the manhole.
- » All manholes shall be externally sealed.
- » Manholes shall not be placed within 3 feet of the curb and gutter, and inflow dishes shall be installed when required.
- » Manholes shall be precast concrete locking type, a minimum 48-in interior diameter, and placed a minimum of 4 feet deep.
- » Manhole channels shall be constructed at the full depth and diameter of the sewer main, with a 0.20-ft drop, and shaped to allow placement and use of the District's television inspection equipment.

4.1.1 Sewer Main

- » Sewer main extensions shall be designed and constructed to provide gravity service for all adjacent lots. Where gravity service is not feasible, the District may allow the use of individual pressure systems for a limited number of connections.
- » Minimum grade for 8-in diameter sewer mains shall be 0.45%.
- » Materials for gravity sewers and force mains may vary depending on depth and location.
- » Force mains shall be designed for a system's maximum operating pressure plus 50 pounds per square inch (psi).

4.1.3 Side Sewers

- » Side sewers shall be a minimum of 4-in diameter SDR-35 PVC.
- » The grade for side sewer stubs shall be a minimum of 2%.
- » Cleanouts shall be used and placed over every side sewer at the property line.
- » A side sewer stub shall be provided for each parcel on all new sewer extensions.
- » Side sewers shall have a minimum of 5 feet of cover at the right-of-way line.

4.1.4 Pump Stations

Developers/owners that may require a pump station to provide sewer service shall contact the District regarding the design requirements of the station and current policies. Design criteria are contained in chapter C2 of the Design Manual. Design of a pump station shall be provided with a firm pumping capacity equal to or greater than the peak hourly design flow. With the largest pump out of service, the remaining pump(s) must have the capacity to pump the peak hour design flows. Pump station design may be determined on a case-by-case basis. The following is a brief summary of some of the pertinent criteria that typically affect sizing and siting of pump stations:

- » **SYSTEM DESIGN**
 - ♦ 8-ft minimum diameter wetwell
 - ♦ Non-clog, solids handling pumps
 - ♦ Redundant pump installed
- » **RELIABILITY**
 - ♦ Emergency generator
 - ♦ Bypass capability (e.g. Pig launch)
 - ♦ Overflow storage (2 hours)
 - ♦ Telemetry and alarms
- » **STATION COMPONENTS**
 - ♦ Valve vault, pressure gauge and flow meter
 - ♦ Canopy over control panel(s) for rain protection
- » **SECURITY**
 - ♦ Area lighting
 - ♦ Perimeter chain link fence

4.1.5 STEP Systems

The use of STEP systems is permitted within the designated rural centers of Meadow Glade and Hockinson. Outside of the rural centers, The District Engineer shall determine which connections qualify for service by a STEP system after it has been determined a gravity alternative is not feasible. STEP systems for residential connections shall be designed in accordance with section C1-10 of the Design Manual. When permitted, STEP systems shall meet the following standards:

1. Systems shall be owned and maintained by the District.
2. No minimum velocity for STEP force mains is mandated.
3. The pump selected shall be able to discharge the peak influent flows without exceeding the working volume within the pump holding vessel using a minimum of 400% of the average daily flows.
4. The system shall provide a minimum of 24 hours of storage volume, without emergency and back-up power (e.g. 950 gallons minimum for single-family homes).
5. STEP service lines shall be a minimum of 1.25-in diameter schedule 40 PVC.





4.2 Easements

The District requires easements to provide for the construction, maintenance, and operation of sewer mains or any other related District owned facilities that lie outside of public right-of-way. Easement requirements vary depending on the size, depth, location and type of asset contained. Reference section C1-1.3.5B(19) of the Design Manual. The District requires easement documents to be drawn up on its standard

forms and to include drawings and legal descriptions signed and stamped by a Professional Land Surveyor, currently registered in the State of Washington. A separate easement is required for each lot the sewer crosses. Easements shall be a minimum of 15-ft width, with the sewer located in the center of the easement. Easements must be approved and received by the District Engineer prior to side sewer connection.

4.3 Standard Details and General Notes

The District's Sample Plans, General Notes and Standard Drawings are presented in Appendix J. The Sample Plans and Standard Drawings must be considered during design and followed during construction. At a minimum,

a copy of all applicable standard drawings, including manhole detail(s), the side sewer detail and the typical trench detail must be included on all plans sets approved by the District for the construction of sewers.

4.4 District Policies

Policies that govern the District collection system can be categorized into 2 groups: 1) the method and authority to extend sewers to unserved areas within the UGA, and 2) policies of implementation.

4.4.1 Extension Policies

The District's policy for extending sewer service recognizes that its function is not to plan land uses but to respond to land uses as established through the County's and cities' planning processes.

This Plan includes assumptions for extensions of sewers to provide service to unsewered parcels in the District's service area. Generally, the District expects sewer extensions to be privately funded by developers. There are exceptions to this rule as described in Section 4.4.2.

Currently, the public sewer system in the District may be extended by any of the following methods:

- » **Developer extension agreement:** a developer, property owner or a group of property owners request and construct a sewer under the terms and conditions of a developer extension agreement. Most extensions use this method.
- » **Utility Local Improvement District (ULID) process following Chapter 57.16 RCW:** Using this method, a group of property owners may petition the District to extend sanitary sewers and then agree to an assessment for the sewer improvements on each property served.
- » **District funded project:** project funded by the District through either a capital program or local facility program (e.g. septic elimination program).



It is the District's policy that the property owners/developers desiring sewer service initiate the process by applying for a request for utility review (RUR). Engineering plans are then prepared in accordance with the service requirements stated in the RUR. The proposed sewer design is submitted to and reviewed by the District to ensure compliance with standards and design criteria. Prior to construction, the owner/developer must enter into a developer extension agreement with the District. The District's inspection and testing program ensures that the improvements have been constructed in accordance with established standards. After construction acceptance, ownership and maintenance responsibility of the sewers is transferred to the District by the owner/developer submitting a bill of sale and the donated capital form.

Similarly, a property owner may request the District to fund or participate in the extension of a local sewer to a parcel that is not currently served. This usually occurs when a septic system is being abandoned and connection is made to the public sewer system. The District's cost to implement such a request by building local facilities is assessed as a Local Facility Charge against the property.

The District may also choose to take a more proactive approach to extending sewers. For example, the District may allocate sewer funds for sewer extension projects with the objective of participating in a local transportation project, expanding the customer base, reducing environmental impacts of failed septic systems, and expanding the wastewater system for future development.



4.4.2 Current Implementation Policies

The purpose of this section is to analyze some of the current implementation policies and to present new policies that form the foundation of this Plan. A brief overview of the current policies is presented below. A copy of the District's policies is provided in Appendix H.

GENERAL FACILITIES

The District defines 'General Facilities' as those gravity sewer lines that are larger than 8-in diameter (trunk sewers) and permanent pump stations and their associated force mains. Included in this definition are permanent siphons (and motor operated valves), odor control facilities and flow monitoring stations. This term is important in the determination of cost sharing and the financial obligations of the District. The District's definition is similar to that which is used by the majority of other wastewater districts in Washington.

The District pays 100% of permanent pump stations and force mains shown in the Plan. The policy regarding District participation in constructing trunk sewers is discussed in more detail below. There are no changes to the General Facilities definition and policy in this Plan.

REIMBURSEMENT FOR OVER-SIZE AND OVER-DEPTH TRUNK SEWERS

The District's policy is to share in the cost of trunk sewers if such sewers provide a benefit beyond the proposed development. District Code section 5.36.050 describes the policy. In general, the District pays for the incremental cost increase associated with installing a larger diameter pipe, compared to the cost of a local 8-in diameter sewer.

The District's current approach to determining the incremental costs is to prepare 2 cost estimates. The first estimates the cost of the proposed over-sized and over-depth trunk sewer, and the other estimates the cost of an 8-in sewer line at depths necessary to serve only the development. The District's participation, which generally comes in the form of a reimbursement to the developer, is the difference between the estimates. This approach is commonly used by other special purpose districts.

There are no changes to the Over-Size and Over-Depth definition and policy in this Plan.

INTERIM PUMP STATION

It is understood that the ultimate service scheme may not be feasible to implement at the time sewer service is desired. The progression of development in a basin may not support extension of sewers, in accordance with this Plan, in the time desired by a property owner/developer. In that situation, this policy allows the District to evaluate and approve an interim pump station, under certain conditions, in lieu of the planned permanent sewers. A brief summary of this policy follows. There are no changes to the Interim Pump Station definition and policy in this Plan.

An interim pump station may be allowed if the following conditions are met:

- » If the improvements require the construction of a 1,500-lineal foot or longer sewer extension within the paved roadway; or
- » If the permanent sewer requires 3 or more easements from separate property owners; and
- » The interim pump station is constructed at the developer's expense; and
- » The developer pays the District \$30,000 toward operations and future decommissioning; and
- » The Board of Commissioners approves the interim pump station.

A developer reimbursement agreement may be executed for constructing the permanent gravity sewer alignment.

EXTENDING SEWERS "TO AND THROUGH"

When sewer lines are extended to provide sewer service to previously unserved parcels, the property owner/developer is obligated to extend the sewer line across the entire length of the abutting right-of-way to accommodate future extensions. There are provisions for cost sharing amongst the properties which benefit if the sewer extension is serving the last parcels and further extension of the line is not anticipated.

There are no changes to the Extending Sewers "To and Through" definition and policy in this Plan.

4.4.3 Recommended Policies

Over time, the District has improved its knowledge of its own wastewater system through tracking and flow monitoring technologies. Industry standards for modeling assumptions and risk assessment have also changed over the years. Considering these factors, the District has adopted several new policies for planning and design. The level of service provided for by the policies discussed below results in an appropriately conservative yet practical and affordable CIP compared to previous District approaches.

The proposed recommended policies are summarized below and are presented in detail in Appendix H.

DESIGN STORM

The District's current policy is to apply a peaking factor, in accordance with Ecology standards, to account for increased flows due to storm events. The peaking factor is typically 3.0 and has been the historical basis for sizing infrastructure. The factor is conservative, so its use often results in additional expense for constructing infrastructure with excess capacity.

The hydraulic analysis presented in Chapter 7 indicates that the existing infrastructure has been conservatively sized as evidenced by the adequate system capacity predicted by the models of future scenarios. Research into other western Washington wastewater districts' sizing criteria shows that a hydraulic model that utilizes a design storm recurrence interval of 20 to 25 years is common. In 2015, the District and Alliance captured flow data corresponding to a major wet weather storm event, which was later determined to be a 25-year storm. The availability of rainfall and wastewater flow data for the event, which captured the actual response of the system, promoted the use of a design storm in this Plan and for future sizing of the collection system infrastructure.

This Plan was developed based upon a 25-year design storm event, as defined.

ALLOWABLE SURCHARGING IN TRUNKS AND INTERCEPTOR SEWERS

The District's current policy is that a piping system is at full capacity when flow reaches the crown of the pipe. This policy has resulted in a conservatively designed and constructed infrastructure and in reserved capacity that is seldom, if ever, used. In recent years, many

of the larger sewer agencies have investigated and implemented a storm-based hydraulic model with a surcharging allowance.

By allowing surcharging during high flow events, the previously unused capacity in the trunks is recaptured. Allowing surcharging also recognizes the infrequent nature of storms large enough to cause high flows. Assumptions used in determining the policy include: all finished floor elevations of served parcels are at least 1 pipe diameter higher than the sewer mains and lateral and side sewer lines have a minimum 2% slope. In addition, considering the depth needed for making the side sewer connection, design elevations will easily exceed the surcharge allowance.

This Plan was developed using the following for Allowable Surcharging in Trunks and Interceptor Sewers:

- » For pipes less than 10-ft below grade, 1-ft above crown of pipe.
- » For pipes greater than 10-ft below grade, 3-ft above the crown of the pipe.

INDUSTRIAL LOADINGS

The flows associated with industrial users vary widely depending on the industry and use. A water-intensive user and a “dry industry” have very different flow profiles. The District’s 2013 GSP used an average annual flow rate of 1,800 gallons per acre per day (gpac). This value seems to be in line with, or slightly higher than, other Washington sewer agencies. Because of the variability in flows, a prudent approach would be to establish an allocation for future industrial users and to test system capacity using the hydraulic model when a wet industrial user proposes to exceed the allocation. The industrial loading is applied in the Plan, above and beyond domestic use, at 3 industrial hubs identified by Clark County and local economic development partners. The 3 locations are the I-5/Fairgrounds area, I-5/Ridgefield Junction, and Rural Industrial Land Bank (see Section 3.3.1 regarding service assumptions for the land bank).

This Plan was developed using an average annual wastewater discharge allocation of 1,500 gpac to project future wet industrial wastewater flows at the three locations listed above. Domestic use from employees of any industry is captured separately with the employment population projections.



FLOW PER CAPITA

The District’s current policy is to estimate flows at 100 gallons per capita per day (gpcd). The origin of this value can be traced to guidelines from the mid-1900’s. Ecology restates the standard in *Criteria for Sewage Works Design* with the added clause that the value is a default in the absence of better and localized data.

Observations throughout the industry indicate that flow conservation measures and water-efficient plumbing fixtures have steadily lowered this value. The District’s records confirm that the 100 gpcd estimate is very conservative and that actual per capita values are approximately 75 gpcd. This value is consistent with per capita values from other western Washington sewer agencies.

This Plan was developed implementing an average day flow contribution of 75 gpcd. With a residential density of 2.66 people-per-household, the average day flow for a single-family residence is 200 gallons per day.

FLOW TRIGGERS FOR PUMP STATIONS

Ecology’s *Criteria for Sewage Works Design* states that pump stations are to be designed to meet the peak hour flows with the largest single pump out of service. This means that Ecology’s policy would be violated if the redundant pump is called to run while the other duty pump(s) are running. To proactively anticipate when the redundant pump is needed, it is prudent to have a policy that identifies a flow triggering event that would alert the District to investigate and, when warranted, initiate capital planning.

This Plan was developed based on the following flow trigger: the run time for the lead pump approaches 45 minutes per hour when peak flow conditions are occurring.



Existing Facilities





A multi-jet high-velocity hydraulic cleaning nozzle is commonly used to hydro-clean local sewer mains

Existing Facilities



5

5.1 Introduction

The District owns and operates a modern collection and conveyance system consisting of a network of gravity sewers, pump stations with associated force mains, STEP systems and other appurtenances. The collection system currently totals more than 370 miles of gravity sewers, more than 67 pump stations with 78 miles of force main and approximately 800 STEP systems.

The inventory of existing facilities forms the basis of analysis for anticipating future needs. Existing facilities are described below by drainage basin and by type.

5.2 Drainage Basins

As described in Chapter 3, the District's service area is ultimately divided into 3 drainage basins: WVUGA, NVUGA, and RUGA.

The WVUGA currently has approximately 11% of the gravity sewers 8-in diameter and larger, or roughly 42 miles (223,078 linear feet (lf)). Wastewater from this basin flows through a metered Parshall flume, located at the intersection of NW Lakeshore Avenue and Burnt Bridge Creek, to the City of Vancouver's VWTP.

The NVUGA currently has approximately 80% of the gravity sewers, or roughly 299 miles (1,576,993 lf). Flows from this basin are collected and conveyed to the SCTP.

The RUGA currently has approximately 9% of the gravity sewers, or roughly 32 miles (171,670 lf). Flows from this basin are collected and conveyed either to the SCTP or to the RTP. A key assumption of this Plan is that all flows from this basin will eventually be directed to the SCTP.

A detailed summary of the lengths and sizes of the piping systems in each basin is presented in Appendix E.

5.2.1 Mini-basin Delineation

The 3 drainage basins are sub-divided into 82 mini-basins to evaluate the existing system's capacity to serve current demand and future growth (see Chapter 7).

Basins are divided into mini-basins as follows:

- » The WVUGA includes 5 mini-basins adjacent to the City of Vancouver.
- » The NVUGA includes 52 mini-basins:
 - ♦ 49 in Vancouver's unincorporated UGA
 - ♦ 1 from the Rural Industrial Land Bank adjacent to Vancouver
 - ♦ 1 for the Hockinson Rural Center and nearby schools
 - ♦ 1 basin that includes the Meadow Glade Rural Center and parts of the City of Battle Ground and its UGA
- » The RUGA includes 25 mini-basins encompassing the entire city and its UGA, including the expansion area.

The delineation of mini-basins is driven by topographic constraints, pump station catchments and the logical confluence of interceptor lines. Boundaries follow right-of-way and parcel lines. The main feature of each mini-basin is a single defined outlet, usually a manhole or pump station. This allows calibrations and flow estimates for specific points in the system (see Chapter 7).

Comprehensive planning efforts have generally suggested that mini-basins should be large enough to avoid excessive flow monitoring and to prevent minor abnormalities in flow and peaking factors from skewing true flow characteristics. Mini-basins should also be small enough to allow the identification of inflow and infiltration sources. Previous experience suggests that a mini-basin should contain between 20,000 to 40,000 lf of mainline sewer pipe. This range is a general target, not an absolute limitation. Where topographic constraints prevent further division, some mini-basins exceed the suggested range. Where there is minimal development, there may be little or no existing sewer pipe. The delineation for undeveloped areas is based on forecast developed conditions. Large undeveloped parcels are included in single mini-basins, even though the development of that parcel may ultimately result in flows split and served into an adjoining mini-basin.

A map showing the 82 mini-basins is presented in Figure 5.1.



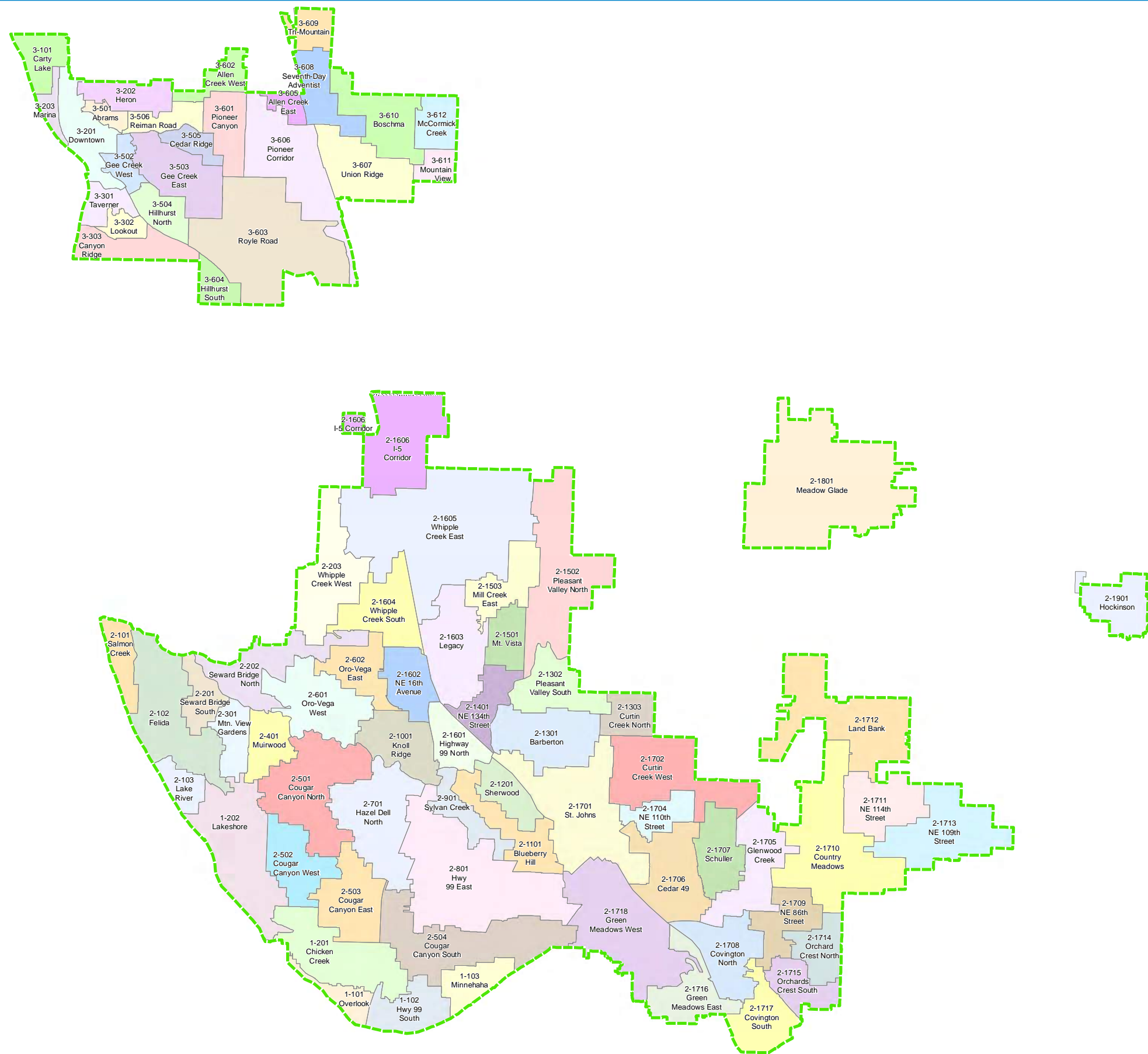


FIGURE 5.1
Mini-Basin Delineation Map



Existing Facilities



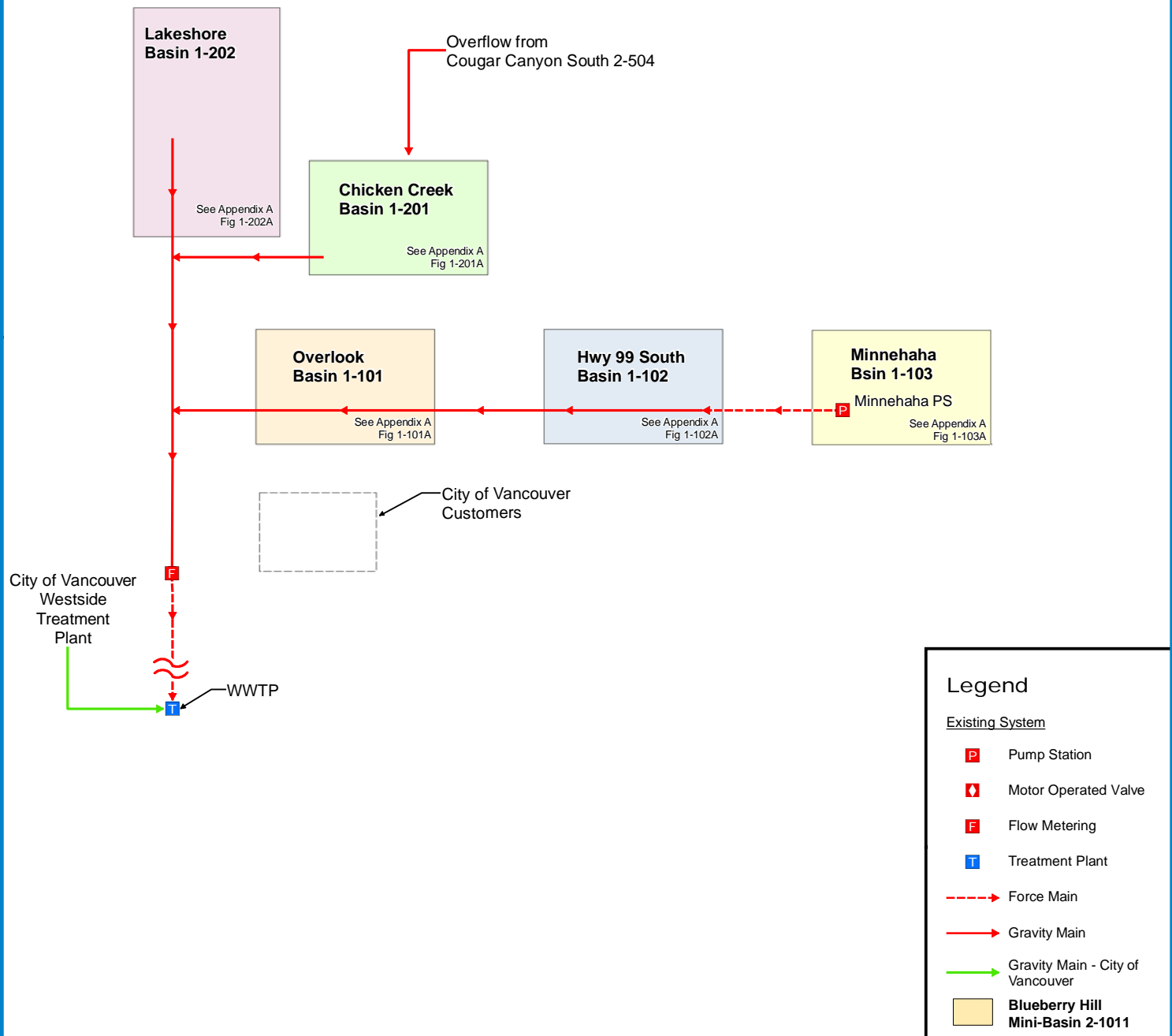
5.3 Inventory

Over the years, the function of some originally installed piping systems has been modified. Because of such modifications, together with nonstandard flow routing between mini-basins, flow schematic diagrams help show the flow patterns throughout the system. Schematic flow diagrams for each of the 3 drainage basins are presented in Figures 5.2, 5.3 and 5.4. An individual map of each mini-basin is presented in Appendix A. The mini-basin maps depict existing

infrastructure that is owned and operated by the District. Private side sewers and laterals are excluded. Maps also depict proposed capital improvements, as described in Chapter 10, and local sewers not included in the CIP. Each of these mini-basin maps is accompanied by a complementary map that depicts characteristics such as the presence of wetlands, water features, steep slopes, zoning and land use designations. The full inventory of existing facilities is presented in Appendix E.

FIGURE 5.2

WVUGA 2016 and 2036 Schematic



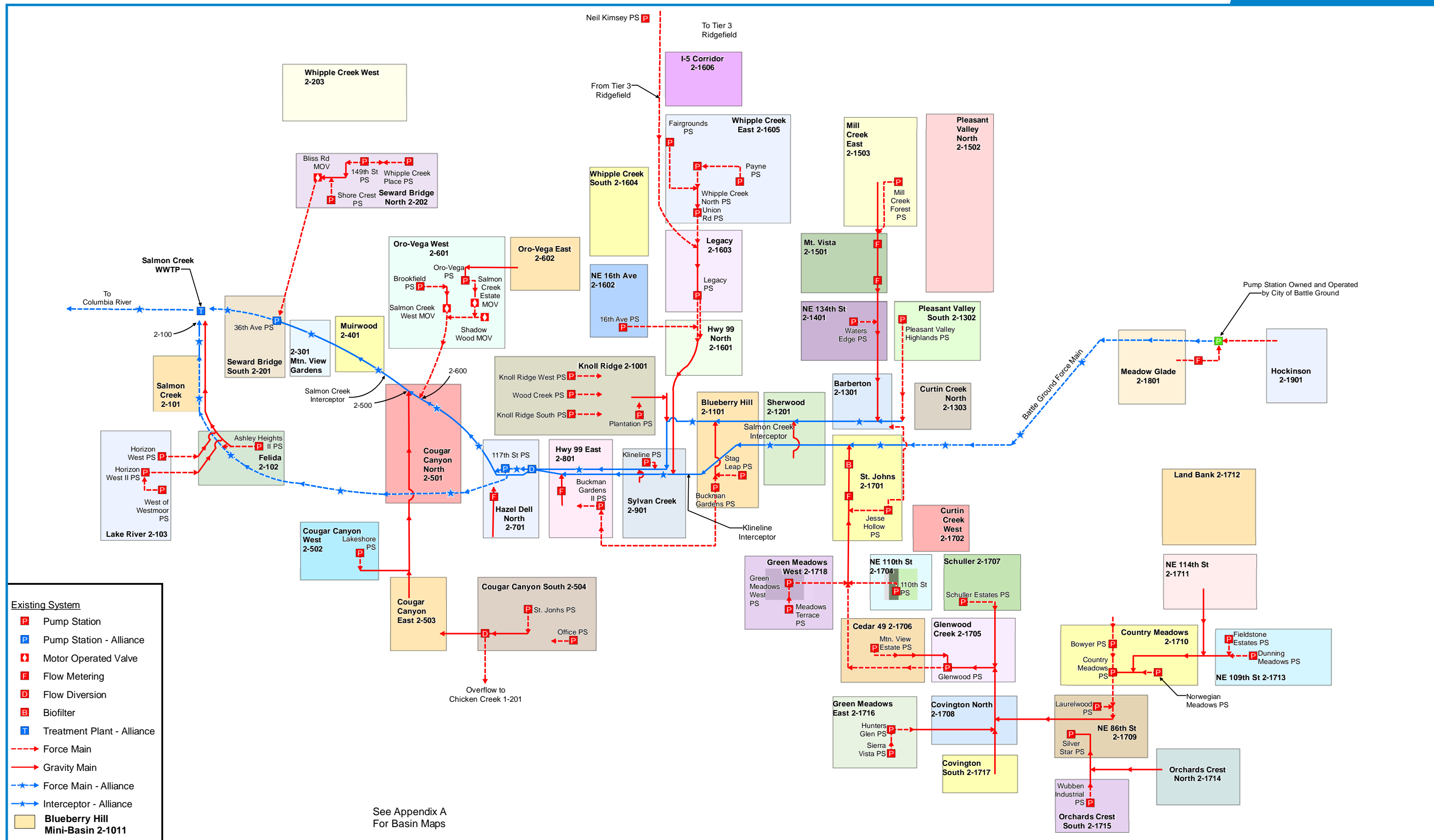


FIGURE 5.3
NVUGA 2016 Schematic

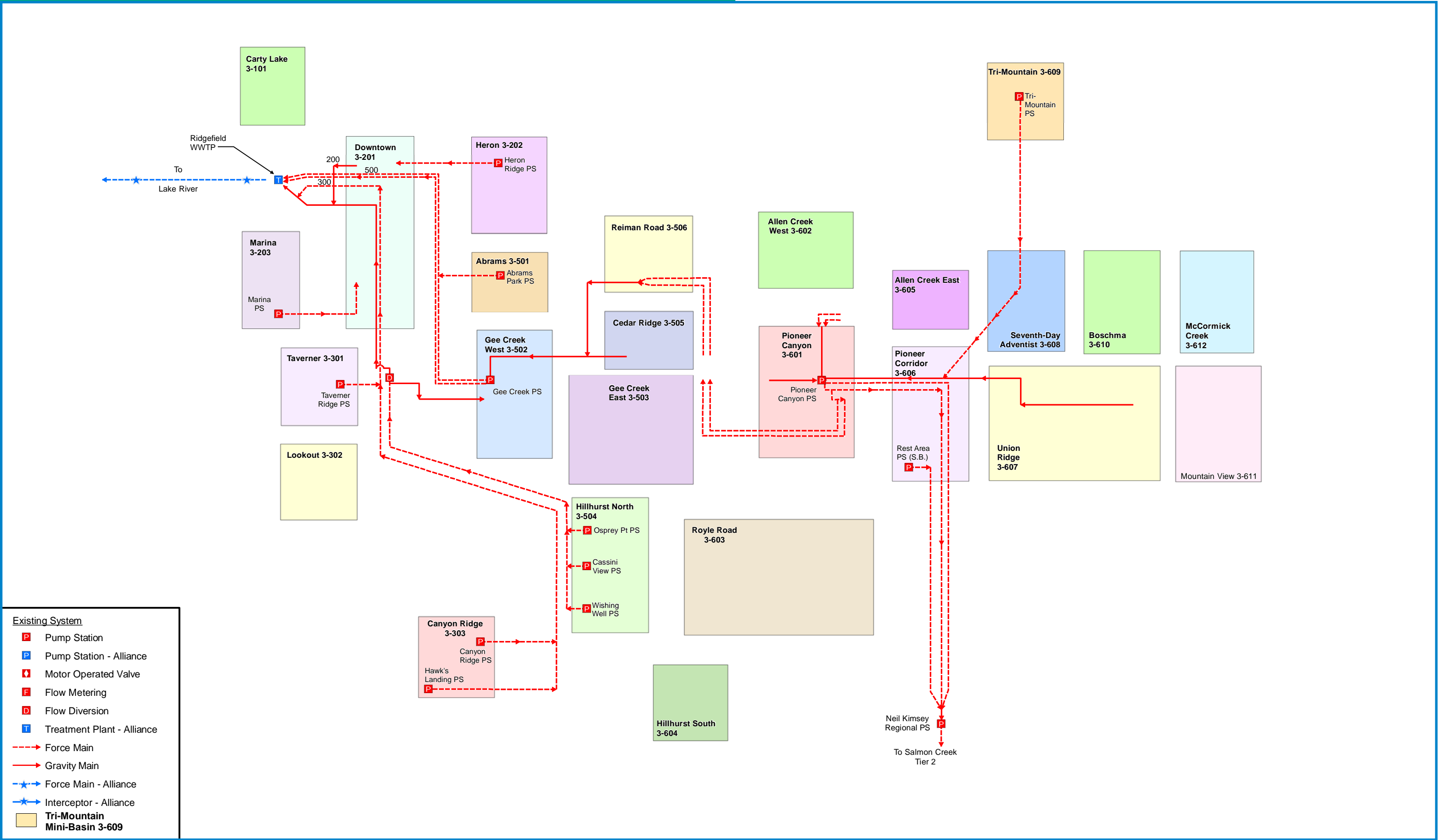


FIGURE 5.4
 RUGA 2016 Schematic

5.3.1 Collection and Conveyance Facilities

As a whole, the collection system is relatively young. Though the first facilities were constructed roughly 60 years ago, the majority of the system has been constructed in the last few decades. The District's inventory of gravity sewer lines totals more than 370 miles, or approximately 1,971,741 lf, of pipes ranging from 8-in to 48-in diameter. More than 50% of the pipe inventory has been installed since 1990. Pipe materials include PVC, concrete, ductile iron and HDPE. The summarized inventory of the publicly-owned piping systems by mini-basin is presented in Appendix E.

The District has more than 78 miles, or approximately 413,806 lf, of force mains ranging from 3-in to 34-in diameter. This linear footage is linked to specific pump stations. In some cases, 2 or more pump stations share a force main (see Appendix E). More than 80% of the force main inventory has been installed since 1990. The aging of the District's gravity pipes and force mains is presented in Figures 5.5 and 5.6.

FIGURE 5.5
Gravity Sewer Pipe Aging

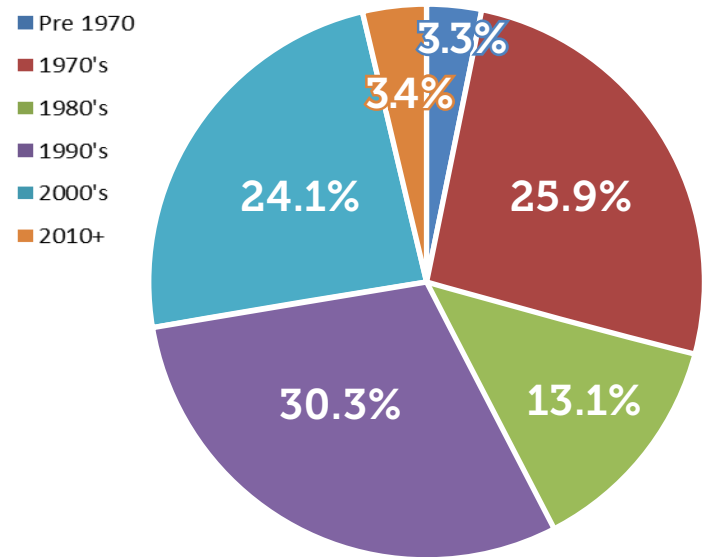


FIGURE 5.6
Force Main Aging

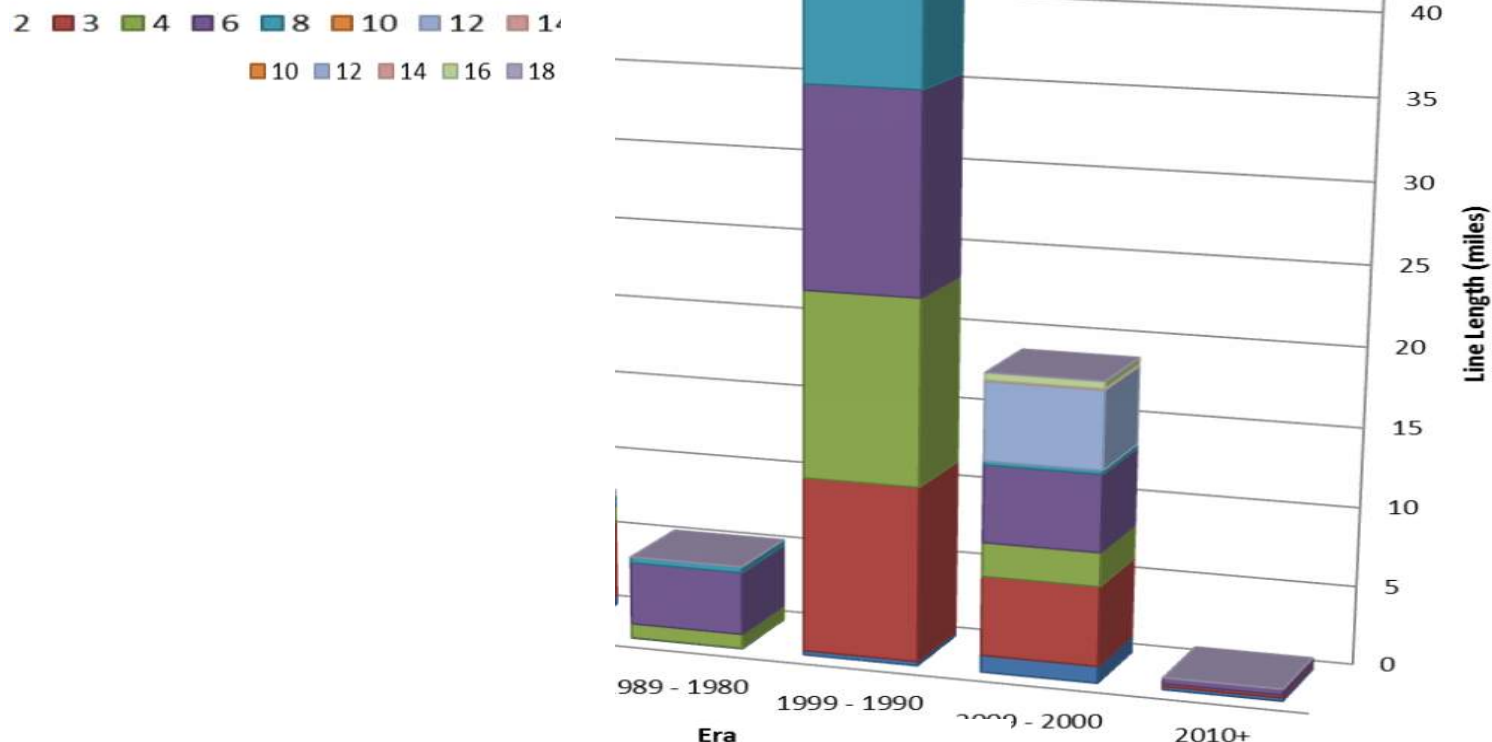


FIGURE 5.7
Pump Size

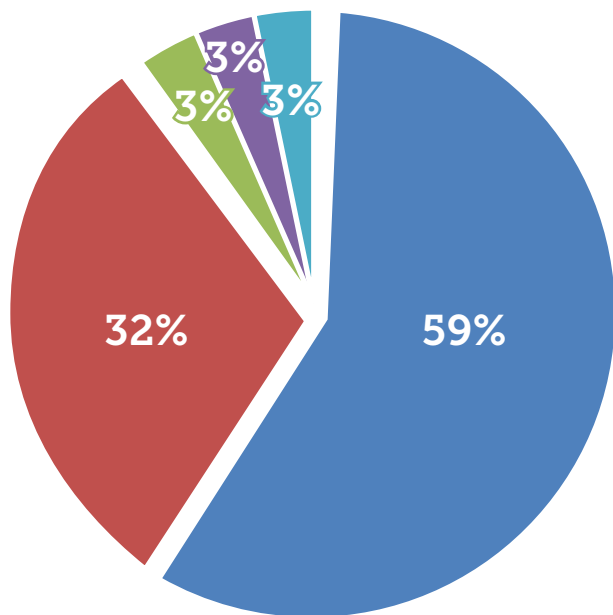
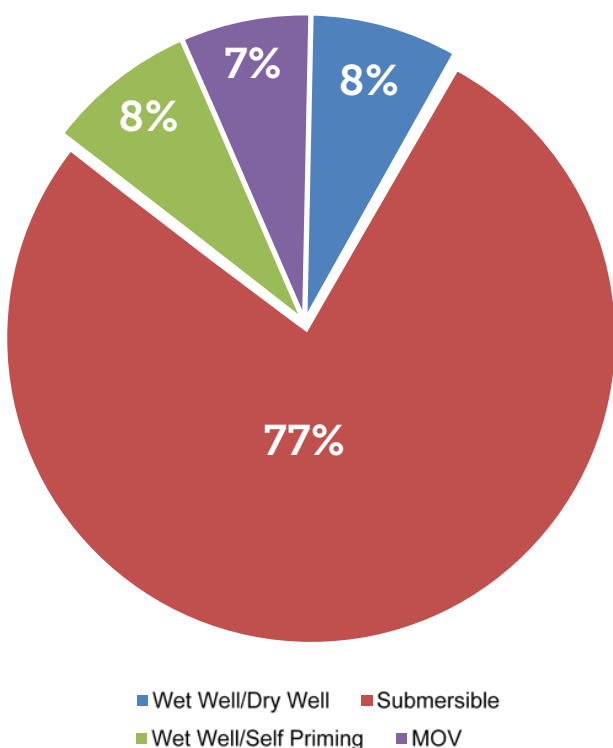


FIGURE 5.8
Pump Station Configuration



5.3.2 Pump Stations

The District currently owns and maintains 67 pump stations. Consistent with the overall aging of the system, the vast majority of the pump stations are less than 30 years old. The period between 1990 and 2000 witnessed the construction of more than 40% of the stations currently in service. The most common pump station is a residential-scale facility consisting of duplex submersible pumps using less than 10 horsepower. These types of facilities represent approximately 60% of existing stations.

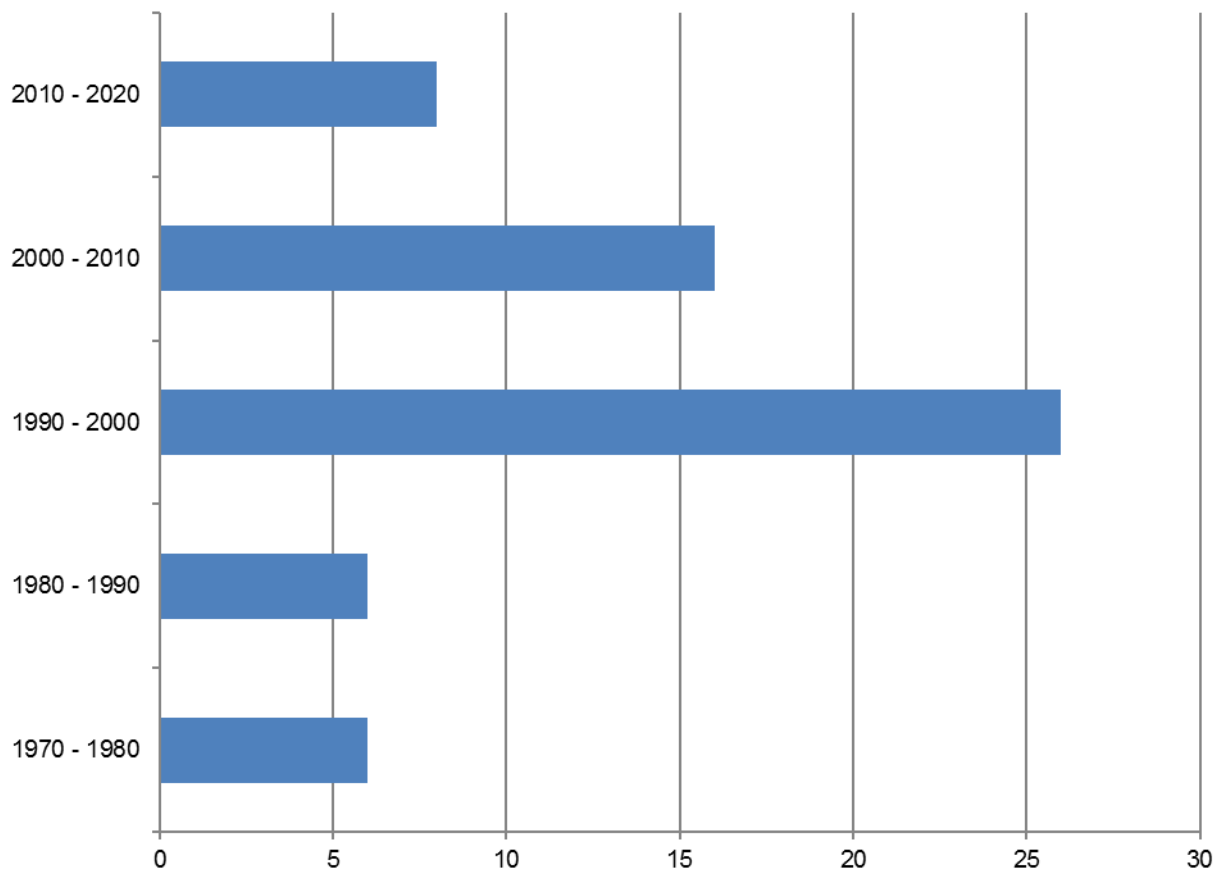
The District's asset management program, discussed in Chapter 9, addresses ongoing operations, maintenance, restoration and replacement of these critical facilities. The pump station inventory and operating conditions are presented in Appendix E. Graphical representations of pump size, station configuration, and pump station installation history are presented in Figures 5.7, 5.8 and 5.9

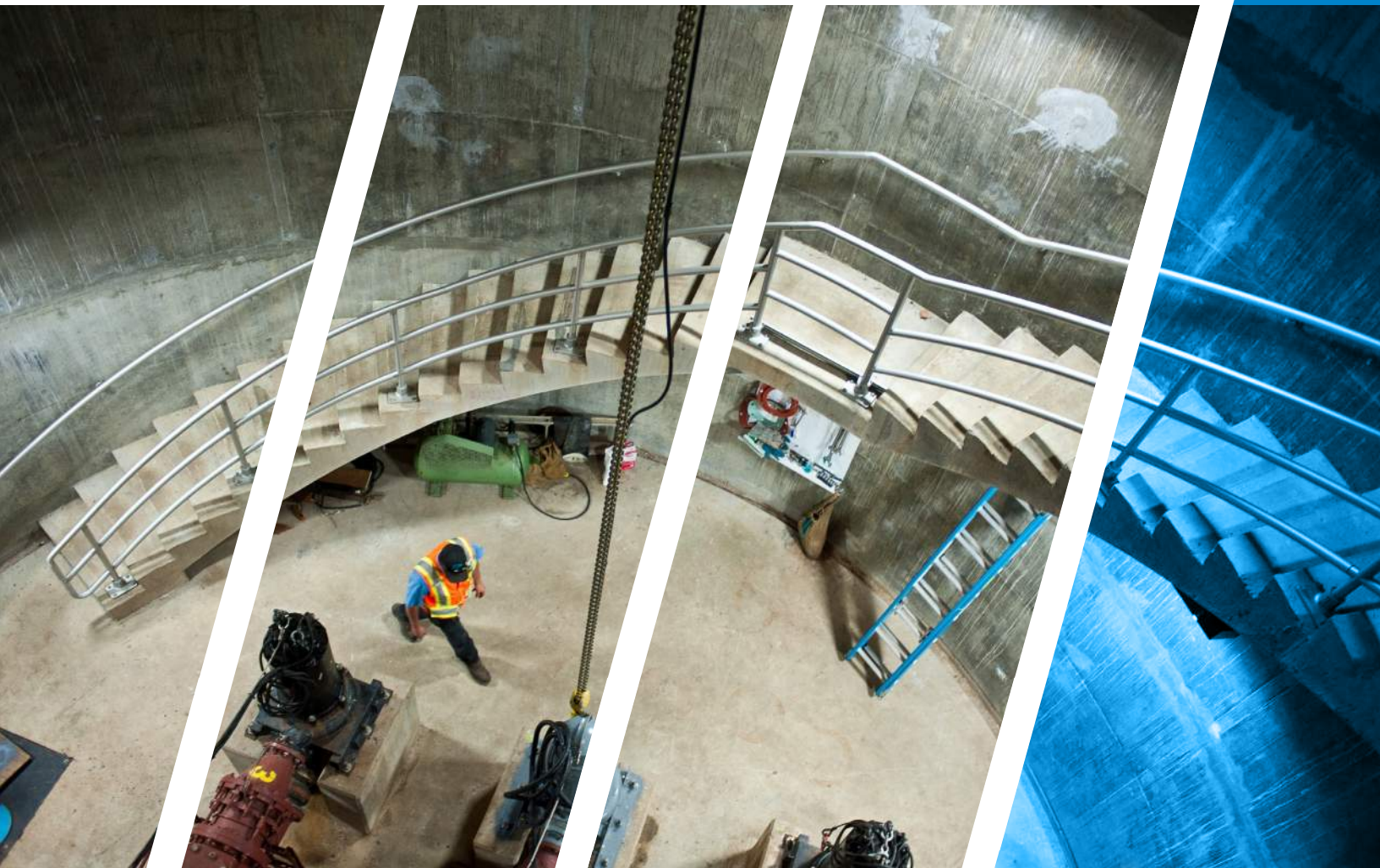


5.3.3 STEP Systems

The District owns and maintains 800 STEP systems. These systems are predominantly located in the rural centers of Meadow Glade and Hockinson. Initially installed beginning in the mid-late 1990's, the STEP systems predominantly serve residential uses. On a more limited basis, "commercial" STEP systems are permitted for public schools and the limited rural center commercial uses that are allowed by local land use regulations. A duplex system with telemetry and alarming is typical for the commercial uses.

FIGURE 5.9
Pump Station Installation History





Existing & Future Population & Flow Projections





The penetrator nozzle's arrow shaped design and water jet is used to blast through obstructions in a sewer main

Existing & Future Population & Flow Projections



6

6.1 Introduction

The District must plan to collect and convey wastewater flows generated from existing and expected future populations within its service area. To support this planning, demographic information and engineering analyses have been used to estimate existing and future flows throughout the system, consistent with local comprehensive plans.

6.2 Approach

Wastewater flows are significantly influenced by the population served. The population segments studied in this Plan included residential, employment, student enrollment and industry. The analysis herein uses available data to estimate the population of each segment and determine the resulting wastewater flow by applying an industry standard unit flow contribution for each segment.

- » **Residential Population:** an analysis that counts the number of people living in each basin based on census and county tax assessor data.
- » **Employment:** an analysis of commercial and industrial employees in each basin based on State Covered Employment estimates.
- » **Student Enrollment:** an analysis of student enrollment based on data from school districts and other sources.
- » **Industrial:** an analysis of heavier sewer flows associated with wet industries, based upon industrial zoning and economic development patterns. This allocation is in addition to the employment values mentioned above.

The methodology used combined various available resources to establish the most accurate population estimates and projections. Previous GSPs relied on projections based on historical connections and traffic analysis data. These projections have historically overestimated population growth and flow rates, leading to an aggressive and expensive CIP. The methodology described in this chapter is in alignment with the comprehensive planning efforts of Clark County and the cities of Vancouver, Battle Ground, and Ridgefield. Baseline residential population for the Plan was calculated by Clark County using the same parcel-based assumptions that were used to calculate baseline residential populations for Clark County's *20 Year Comprehensive Growth Management Plan* (Comprehensive Plan). Additionally, the County's Vacant Buildable Lands Model (VBLM), used in the County's long-range planning process to allocate 20 years of growth to each UGA, was used to allocate 20-year growth forecasts to each mini-basin.

6.2.1 ERU Calculations

For each population segment, population figures are expressed as equivalent residential units (ERUs), a unit of flow measuring the average volume of wastewater discharged by a single family in a day. Population figures are converted into ERU using various equations. Section 6.5 describes the ERU conversion calculations.

6.2.2 Projected Sewered Population

The District's service area includes properties where wastewater disposal was provided on site using individual septic systems. Some of these systems are still in operation and result in an actual population served by the District that is less than total population. The population served by the District is the sewered population, and it is used as the basis in this Plan. Estimates of sewered populations include an assumption regarding the forecasted rate of conversion from septic systems to sewer service. The septic conversion rate used is based on historical data and the assumption that all new populations within the urban growth area and rural centers served connect to sewer; this assumption conforms with Section 40.370.010(C) UDC. The population figures shown in this chapter represent the sewered population. A detailed explanation of the methods and assumptions used in calculating sewered populations is presented in Appendix B.

6.3 Existing Population

TABLE 6-1

2016 Population Summary

SERVICE AREA	BASIN	RESIDENTIAL		EMPLOYMENT		STUDENT		INDUSTRIAL		TOTAL ERU
		Population	ERUs	Jobs	ERUs	Students	ERUs	Acres	ERUs	
SALMON CREEK	RUGA	7,208	2,710	2,786	209	1,818	137	203	1,523	4,579
	NVUGA	81,417	30,610	22,882	1,721	22,053	1,658	89	668	34,657
	SUB-TOTAL	88,625	33,320	25,668	1,930	23,871	1,795	292	2,191	39,236
WESTSIDE	WVUGA	10,112	3,802	2,623	197	1,488	112	-	-	4,111
GRAND TOTAL		98,737	37,122	28,291	2,127	25,359	1,907	292	2,191	43,347

6.3.1 General

The current planning year used in this Plan is 2016. Year 2016 populations are estimated from baselines taken from the most recent year of available data for each segment.

- » The baseline year for the residential population is 2015.
- » The baseline year for the employment population is 2014.
- » The baseline year for the student population is 2016.

Year 2016 population estimates are summarized in Table 6-1. Detailed 2016 population forecasts by mini-basin are presented in Table B-1 in Appendix B.

6.3.2 Baseline Residential Population (2015)

Residential population refers to the number of people living in the service area. Estimates for each mini-basin were reviewed for consistency with local planning activities by County staff and local planners.

The County's demographer used 2015 parcel-based data to calculate population for each mini-basin. The baseline population estimates are a function of 2015 Clark County Tax Assessor data and the 2010 Census average household size for each census block. 2015 Clark County Tax Assessor data includes housing unit counts at the parcel level. Using GIS, population estimates were established by multiplying parcel housing unit counts by the average household size for each census block and aggregating by mini-basin. Once aggregated by mini-basin, the County demographer performed customized adjustments based on local conditions to more accurately reflect recent population counts. Year 2016 population estimates were interpolated between the years 2015 and 2036 and reviewed using local planning knowledge.



6.3.3 Baseline Employment Population (2014)

Employment population refers to the total number of commercial and industrial employees working within the service area. Employment estimates were reviewed for consistency by County staff and local planners.

Clark County provided baseline employment estimates for each basin for the most recent year for which data was available, 2014. Year 2014 Covered Employment estimates were derived from the Washington State Employment Security Department's Quarterly Census of Employment and Wages series. This series consists of employment for firms, organizations and individuals whose employees are covered by the Washington Unemployment Insurance Act. Employment estimates were adjusted by local planners based on current land use activity.

Year 2016 employment population estimates were interpolated between 2014 and 2036 and reviewed using local planning knowledge.

6.3.4 Baseline Student Population (2016)

Baseline student population analysis was influenced by discussions with school district staff. There are 5 school districts within the District service area – Vancouver, Battle Ground, Hockinson, Evergreen, and Ridgefield. See Figure 6.1 for a map of schools in Clark County. Each of these agencies was engaged regarding current enrollment and projected enrollment growth.

Baseline student population enrollment was obtained for each school from the Office of Superintendent of Public Instruction (OSPI) for the 2015-2016 academic year. Current student enrollment for Ridgefield was obtained from OSPI for the 2014-2015 academic year. The grade-span specific annualized growth rate was applied to each school to estimate 2016 student enrollment.

Using prior studies and forecasts from the school districts, enrollment estimates were developed from historical enrollment patterns, birth rate patterns, and the County's adopted growth scenario. These previous analyses provided 20-year baseline enrollment forecasts for the 2015-2035 planning horizon and an annualized growth rate for each grade span. The estimated annualized growth rates are as follows:

- » Elementary School - 4.1%
- » Middle School - 4.2%
- » High School - 3.8%

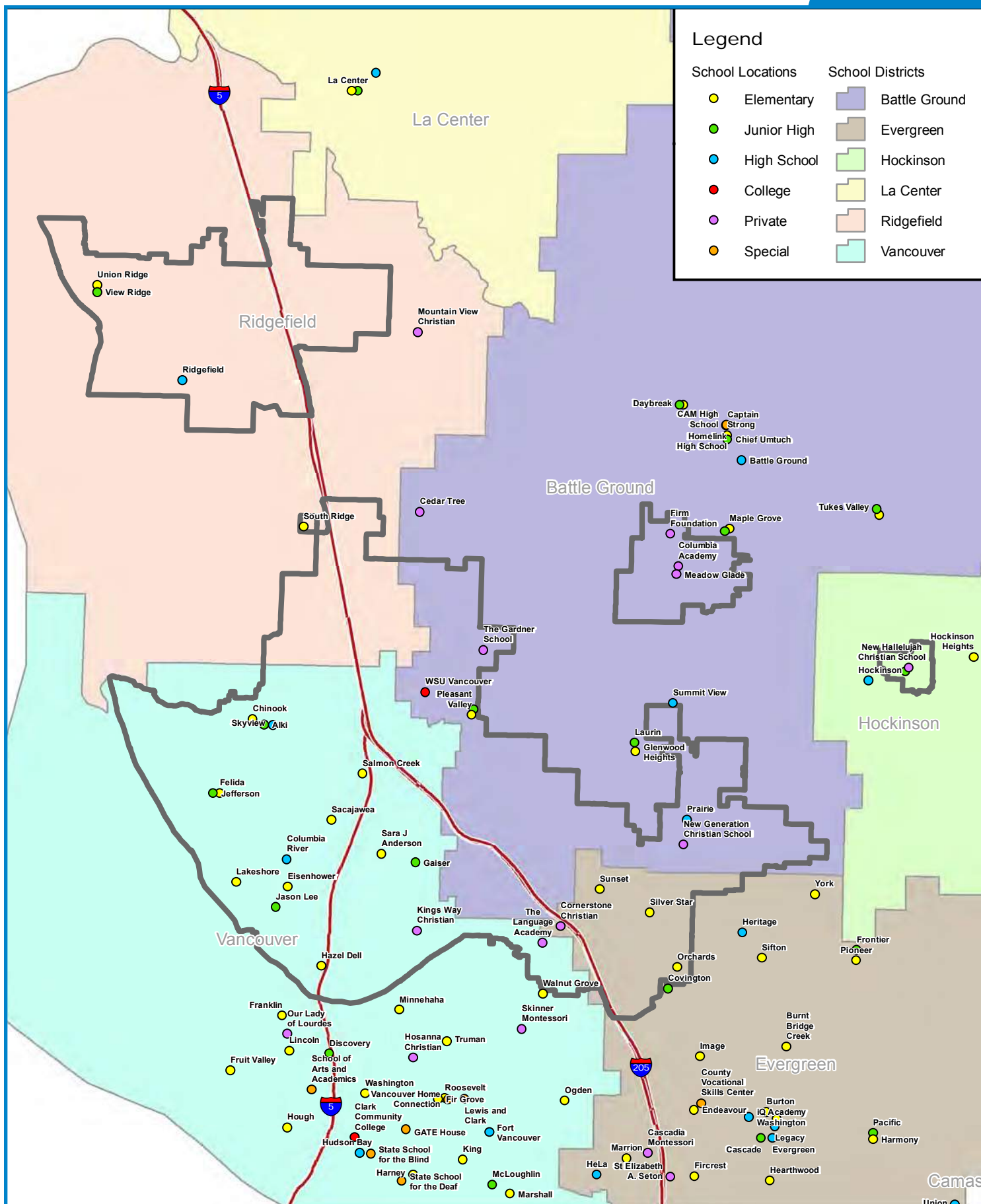


FIGURE 6.1

Schools



6.3.5 Baseline Industrial Acreage

To account for higher flows associated with potential wet industrial uses, an allocation of industrial wastewater flows was added to selected areas designated as industrial hubs. The areas have industrial designations in the Comprehensive Plan and zoning and have been considered for such future development by local economic development interests. Industrial hubs receive an additional allocation of flows, over and above domestic flow captured by employment figures. The hubs are located in 3 areas:

- » I-5 Fairgrounds Interchange area (mini-basins 2-1604, 2-1605 and 2-1606)
- » Rural Land Bank Industrial area (mini-basins 2-1710, 2-1711 and 2-1712)
- » I-5 Ridgefield industrial area (mini-basins 3-603, 6-605, 3-606, 3-607 and 3-610)

These areas are generally undeveloped and unserved. Those few parcels that are served are dry industries, which produce relatively low wastewater flows. However, the zoning allows for wet industrial users, which could contribute significant flows to the collection and conveyance system.

6.3.6 Exceptions

Exceptions to the population estimates and projections herein were made for the rural centers of Meadow Glade and Hockinson. The approach for these areas is described below.

MEADOW GLADE

The Meadow Glade mini-basin consists of the Meadow Glade Rural Center and portions of the City of Battle Ground and its unincorporated UGA. In this Plan, population growth is limited by design capacity of the STEP system to 1 ERU per acre, which fit the rural residential nature of the area when the system was originally constructed. Growth in Meadow Glade beyond the design density of the STEP system will be served by the City of Battle Ground, instead of the District, in accordance with the City's adopted GSP. The City of Battle Ground and the District have an agreement giving the City the first right of refusal for new sewer connections within the UGA. If the City is unable or unwilling to serve the new connections, then the District will provide service if it is mutually agreeable to both parties and complies with STEP system density requirements.

Population calculations for the Meadow Glade mini-basin differ from the methodology used for the mini-basins within the UGA. The District provided the customer (ERU) count and septic count for the end of 2015. The 2016 residential population for the Meadow Glade basin was calculated by subtracting 2016 employment and student ERUs from that total, and then multiplying by an average household size of 2.66.

HOCKINSON

The Hockinson area is designated as a rural center and its flows are captured in the Hockinson mini-basin. This area is largely built-out, but only a small number of the dwellings are connected to the sewer system. Sewer service is provided through STEP systems that convey wastewater to the City of Battle Ground pump station and equalization basin. Hockinson Middle School is the largest connected customer. Baseline sewered population figures for Hockinson were based upon District provided customer (ERU) counts.

6.4 Future Projections

Future population projections were estimated across each population segment for 3 future scenarios: year 2036, 'build-out' and year 2066.

6.4.1 Scenarios

2036 SCENARIO

Projections for the 20-year planning horizon, 2036, are used for the 20-year CIP. The 2036 figures are consistent with the figures presented in Clark County's Comprehensive Plan.

BUILD-OUT

A build-out scenario estimates population based on full development of the current UGA at the densities allowed under zoning rules. There is no specific date assigned to the build-out scenario. The importance of the build-out scenario is to appropriately size future infrastructure improvements. Improvements such as piping and hard structures have an expected life much longer than 20 years. Over the long term, it is likely that each mini-basin will eventually be built to the maximum allowed density. Therefore, certain infrastructure will be sized to serve population at build-out.

2066 SCENARIO

Projections for a 50-year planning horizon, 2066, are used only to avoid under-sizing infrastructure that is likely to have a service life well beyond the 20-year scenario.

6.4.2 VBLM

The VBLM is a parcel-based planning tool developed by the County to analyze development capacity of residential, commercial and industrial lands within UGAs. The result of VBLM is an estimate of growth capacity. It is based on the identification of built, vacant and underutilized parcels. The development potential is based, in general, on land use designations, zoning, critical areas, and infrastructure needs. Parcel-level data is aggregated to express the capacity of each mini-basin to accept growth.

The County's VBLM capacity estimates include assumptions, such as the "never to convert" factor, to realistically capture the likely phasing of residential, commercial, and industrial development over the 20-year planning horizon. The "never to convert" factor withholds certain development percentages. It assumes that 10% of buildable vacant lands and 30% of buildable underutilized lands will not be developed at a higher density in the 20-year horizon. The "never to convert" factor is used in this Plan's 20-year (2036) scenario.

However, it is assumed that the "never to convert" lands will ultimately be developed, after the 20-year planning horizon, to the maximum allowable density. The "never to convert" lands are reintroduced to calculate a basin's maximized growth capacity in the build-out scenario. These 2036 and build-out projections are consistent with current zoning and urban growth boundaries. Use of the VBLM-derived capacity data ensures concurrency with comprehensive planning activities.



6.4.3 Projected Residential Population

The County's 20-year growth allocations and VBLM population capacity data are the foundation for projecting future population growth in this Plan. The growth allocations to each UGA are the result of a process negotiated between the County and local jurisdictions. Population served by the District in the rural centers is assumed to remain largely unchanged over the 20-year planning horizon as discussed above.

WVUGA AND NVUGA

A significant portion of the future population of the District is located in the unincorporated Vancouver UGA (WVUGA and NVUGA). To establish 20-year estimates, population allocations are distributed based on the capacity modeled using the VBLM. The 20-year residential growth estimates in the *Clark County Comprehensive Plan* allocate 56,601 people to the Vancouver UGA. The VBLM estimates that the portion of the District's service area within the Vancouver UGA would capture almost 66% of the growth, or 37,357 people. The VBLM growth capacity for each mini-basin is used to allocate the growth. Allocated growth is added to the baseline estimates to find the 20-year population estimate.

The build-out scenario reintroduces the "never to convert" lands based on a vacant to underutilized ratio of 53:47.

MEADOW GLADE

Future population estimates assume that the Meadow Glade STEP system will reach its design density, 1 ERU-per-acre, by 2036. Employment and student ERUs are subtracted and the balance of the population (ERU) are converted assuming an average household size of 2.66 residents per ERU. The 2036 population estimate is set at the design density of the STEP system.

HOCKINSON

The County does not assign population allocations to rural centers. The Hockinson Rural Center is largely built out, though most properties are not connected to public sewer. The forecast growth for this basin is based on its growth capacity as determined by the VBLM, which estimates population growth of 16 people. The estimated growth is added to the baseline to establish the 2036 population estimate. Since the Hockinson Rural Center is largely built out, the 20-year population estimate is assumed to reflect the ultimate build-out scenario.

RUGA

Population projections in the RUGA are consistent with the adopted comprehensive plan. City of Ridgefield staff met with the District to discuss and review future population projections and to capture the City's expectations of growth. The resultant forecast values include several observations listed below.

- » **Gee Creek East Basin.** A new subarea plan is assumed to encourage additional housing development in this basin.
- » **Pioneer Canyon Basin.** Population forecasts are modified to include in-process developments.
- » **Cedar Ridge Basin.** A subarea planning process is assumed to result in an increase in projected housing densities and new large commercial developments.
- » **7th Day Adventist Basin.** The subarea planning process is assumed to recommend mixed-used development and accommodate the planned Clark College campus.
- » **Hillhurst East Basin.** Forecasts are modified to include in-process residential developments.
- » **Marina Basin.** Adjustments are made to reflect the vested preliminary plat for the Port of Ridgefield mixed-use project.

Subsequent discussion with the City of Ridgefield staff confirm that a higher than normal growth rate is being driven by new development. Subdivision development agreements, pending annexations south of Pioneer Street, District investment in sewer infrastructure, and the accelerated timeline for the 35th & Pioneer roundabout are driving the projected growth rate. The City confirms the short-term goals are to grow Gee Creek East Basin and Hillhurst West Basin before aggressively moving residential growth south along Hillhurst and Carty Roads.

To establish a build-out scenario, the land removed by the "never to convert" factor is reintroduced based on the vacant to underutilized ratio of 40:60 for the RUGA, which is then added to the 2036 population.



6.4.4 Projected Employment Population

The County's VBLM employment capacity data is the foundation for the analysis of future and buildout employment populations. The VBLM capacity data reflects the commercial and industrial development potential of vacant and underutilized land under the *Clark County Comprehensive Plan* land use designations. The County provided custom VBLM capacity estimates per mini-basin. Mini-basin-level capacity estimates are added to the baseline employment to establish the 20-year employment figure. Use of the VBLM-derived employment capacity data ensures concurrency with comprehensive planning activities.

Future employment estimates are also compared to, and found to be consistent with, employment forecasts by transportation analysis zone that were provided by the Southwest Washington Regional Transportation Council (RTC).

The build-out scenario assumes that the planning horizon is extended beyond 20 years and the "never to convert" lands will eventually be built out to the maximum allowed density. These adjustments ensure infrastructure is appropriately sized for the future build-out scenario.

WVUGA AND NVUGA

To establish a build-out scenario in the WVUGA and NVUGA, the land removed by the "never to convert" factor for the 20-year estimate is reintroduced and added to the basin VBLM capacity estimate and baseline employment. The selected "never to convert" factor is based on the vacant to underutilized ratio of 53:47. These adjustments are also applied to the revised Rural Industrial Land Bank (RILB) employment estimates in the Land Bank mini-basin.

Rural Industrial Land Bank (RILB)

Since the RILB was located outside the UGA at the time of this analysis, accurate VBLM employment capacity data is not available. Capacity estimates are established by employing the County methodology and using the revised industrial land use designations and industrial employment densities. The revised capacity estimates are added to the existing RILB employment estimates provided by the County's VBLM. See section 3.3.1 regarding assumptions for serviceability of the RILB.

Rural Centers – Meadow Glade and Hockinson

Since there are no "never to convert" reduction factors applied in the VBLM analysis of rural centers, the 20-year employment estimate is assumed to reflect the ultimate build-out scenario for both the Meadow Glade and Hockinson mini-basins.

RUGA

The discussion presented on page 6-9 reflects the conclusions reached with the City of Ridgefield staff. The modifications are incorporated into the employment projections.

6.4.5 Projected Student Population

Each school district has a 6-year capital facilities plan (CFP) that provides district-wide student enrollment forecasts for each grade level – elementary, junior, and high school. Coordination with each district was required to distribute the 6-year growth to each of the school facilities and to determine 20-year enrollment forecasts. In some instances, the school districts had detailed growth models that provided custom growth estimates for each facility. Other school districts extrapolated growth and adjusted enrollment figures based on facility capacity. Final estimates are calculated by working with data provided by each district followed by review and adjustments proposed by local planners. The school districts recognize that additional facilities will likely be constructed over the 20-year planning horizon, as facility capacities are maximized, but would not comment on the location of potential facilities unless otherwise included in the CFP. For planning purposes, the 2036 projected student enrollment is also used as the build-out projected enrollment. A summary by school district follows.

VANCOUVER SCHOOL DISTRICT

The Facilities Planning and Conservation Office provided custom 6-year and 20-year student enrollment estimates for each school based on the Vancouver School District's student growth model.

BATTLE GROUND SCHOOL DISTRICT

The Assistant Superintendent provided conservative 6-year and 20-year student enrollment estimates for each school based on an existing demographic study and the 6-year CFP.

HOCKINSON SCHOOL DISTRICT

The Business Manager provided 6-year and 20-year student enrollments for each school within the Hockinson School District. The projections are based upon a review of 6-year projections provided by OSPI, 2030 projections prepared by a consultant and 6-year CFP projections. Included in the Hockinson mini-basin projections are 2 rural school facilities served by the District that are located outside its boundaries.

EVERGREEN SCHOOL DISTRICT

The Director of Facilities provided 6-year and 20-year student enrollment estimates. The figures are based on anticipated growth in housing units and a student generation rate of 0.168 students per housing unit.

RIDGEFIELD SCHOOL DISTRICT

Student enrollment estimates are established based on the CFP and the *Student Enrollment Forecast Interim Report*, completed by a consultant in 2015. The report provides 20-year baseline enrollment forecasts and an annualized growth rate for each grade span. The 6-year and 20-year estimates were reviewed by the Superintendent.

Rural Ridgefield School District facility is located within the NVUGA; all other Ridgefield Schools are within the RUGA. Student enrollment figures are allocated to each respective UGA accordingly.

PRIVATE SCHOOLS

There are 9 private schools in the District service area. Current student enrollment was obtained for each private school from the OSPI for the 2015-2016 academic year. Private schools are assumed to have stable enrollment, meaning no growth, for the 20-year planning horizon and build-out scenario.

WASHINGTON STATE UNIVERSITY – VANCOUVER CAMPUS

The Washington State University (WSU) Vancouver Campus is in the Mt. Vista mini-basin. Current student enrollment was obtained from the Vice Chancellor of Student Affairs. Future student enrollment is estimated based on the *WSU Campus Master Plan* and on conversations with campus facilities and operations staff.



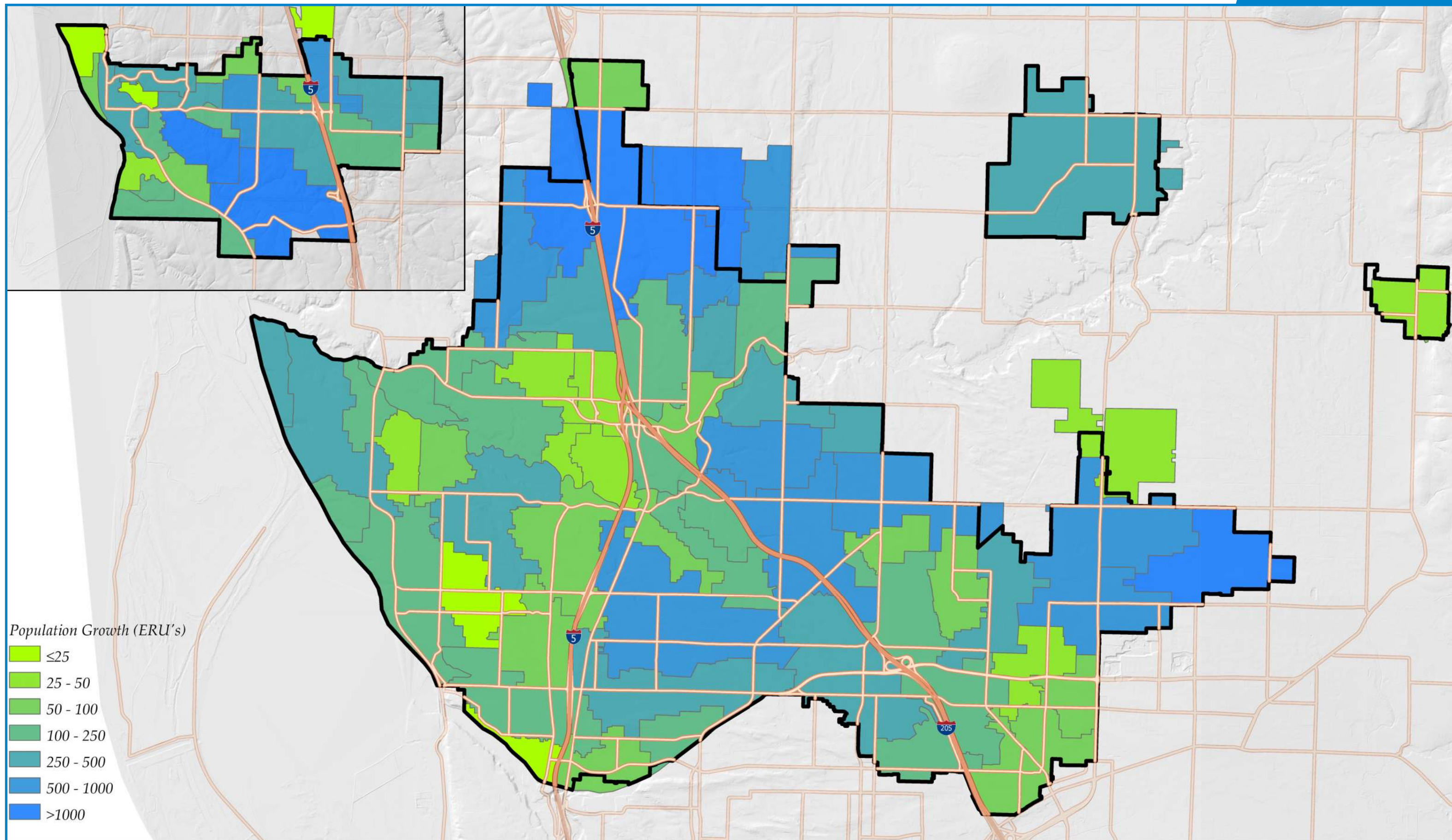


FIGURE 6.2
District Population Growth 2016 - 2036



Existing & Future Population & Flow Projections

6.4.6 Projected Industrial Acreage

Future industrial acreage was established for each of the 3 designated industrial hubs using Clark County VBLM data. The area of parcels within each hub zoned industrial and classified as either vacant or underutilized is assumed to reflect 2036 industrial acreage. The future acreage is aggregated for each mini-basin within the 3 industrial hubs and added to the baseline industrial acreage. Build-out industrial acreage is assumed to equal 2036 industrial acreage. As previously discussed, employment projections for all industrial zoned properties, including the 3 industrial hubs, is included in the employment section of this chapter.

6.4.7 Population Projection Summaries

Tables 6-2 through 6-4 summarize the population and ERU projections for each of the 3 scenarios using the methods described in this chapter. Figure 6.2 illustrates 2036 population growth expressed in ERU.

TABLE 6-2
2036 Scenario Projected ERUs - Summary

SERVICE AREA	BASIN	RESIDENTIAL		EMPLOYMENT		STUDENT		INDUSTRIAL		TOTAL ERU
		Population	ERUs	Jobs	ERUs	Students	ERUs	Acres	ERUs	
SALMON CREEK	RUGA	24,856	9,344	11,895	894	6,908	519	868	6,510	17,267
	NVUGA	119,996	45,111	42,416	3,190	30,400	2,286	1,069	8,018	58,605
	SUB-TOTAL	144,852	54,455	54,311	4,084	37,308	2,805	1,937	14,528	75,872
WESTSIDE	WVUGA	11,495	4,321	2,928	220	1,760	132	-	-	4,673
GRAND TOTAL		156,347	58,776	57,239	4,304	39,068	2,937	1,937	14,528	80,545

TABLE 6-3
Build-Out Scenario Projected ERUs – Summary

SERVICE AREA	BASIN	RESIDENTIAL		EMPLOYMENT		STUDENT		INDUSTRIAL		TOTAL ERU
		Population	ERUs	Jobs	ERUs	Students	ERUs	Acres	ERUs	
SALMON CREEK	RUGA	27,770	10,440	13,864	1,042	10,289	774	868	6,510	18,766
	NVUGA	155,268	58,371	47,500	3,572	30,400	2,286	1,069	8,018	72,247
	SUB-TOTAL	183,038	68,811	61,364	4,614	40,689	3,060	1,937	14,528	91,013
WESTSIDE	WVUGA	13,309	5,003	3,016	227	1,760	132	-	-	5,362
GRAND TOTAL		196,347	73,814	64,380	4,841	42,449	3,192	1,937	14,528	96,375

TABLE 6-4

2066 Scenario Projected ERUs – Summary

SERVICE AREA	BASIN	RESIDENTIAL		EMPLOYMENT		STUDENT		INDUSTRIAL		TOTAL ERU
		Population	ERUs	Jobs	ERUs	Students	ERUs	Acres	ERUs	
SALMON CREEK	RUGA	51,859	19,496	25,560	1,922	14,543	1,093	1,523	11,423	33,934
	NVUGA	186,871	70,252	71,722	5,393	42,921	3,227	1,971	14,783	93,655
	SUB-TOTAL	238,730	89,748	97,282	7,315	57,464	4,320	3,494	26,206	127,589
WESTSIDE	WVUGA	14,350	5,395	3,387	255	2,168	163	-	-	5,813
GRAND TOTAL		253,080	95,143	100,669	7,570	59,632	4,483	3,494	26,206	133,402

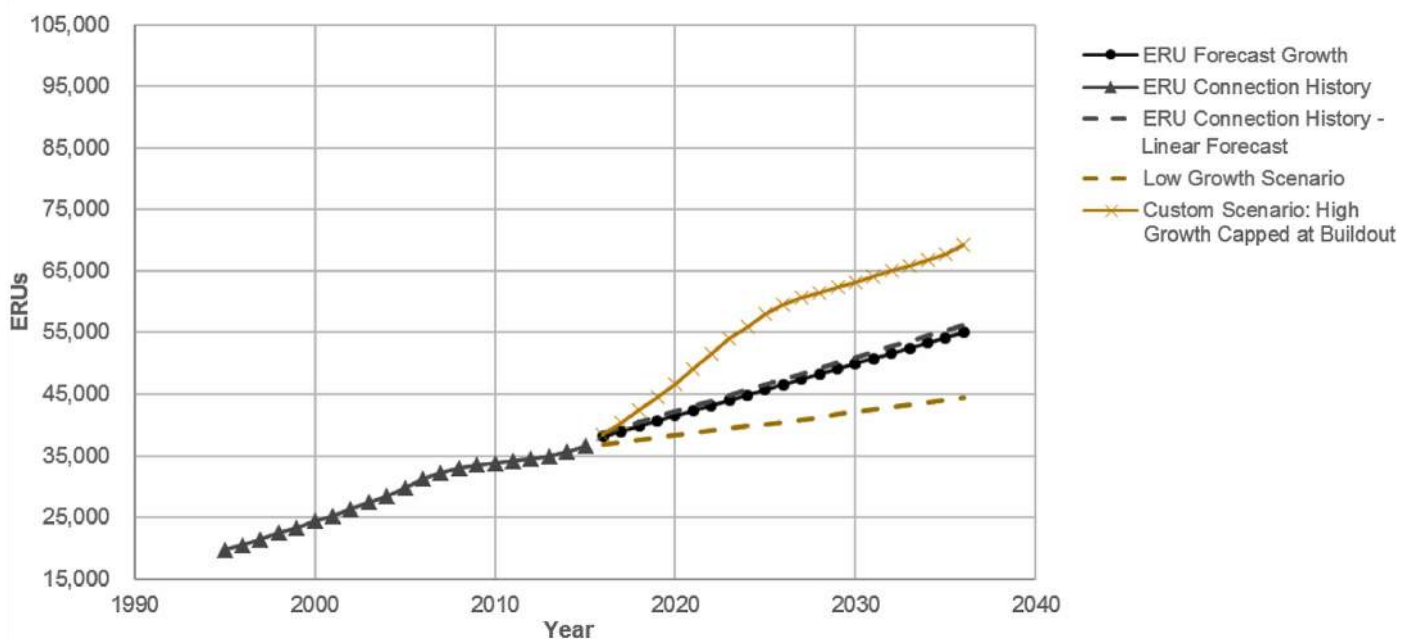
ALTERNATE GROWTH PROJECTIONS

The projections in this chapter result from detailed and location-specific analyses of demographic information. It is also possible to project future ERUs using historical data and generalized growth assumptions. For example, in the NVUGA, either low or high population growth would result in different ERU projections by 2036. The low growth alternative assumes a steady recession-rate growth of 0.94%. The high growth alternative starts with a growth rate of 5.01% and then levels out as the population reaches the build-out capacity.

Figure 6.3 presents alternate growth projections side by side with the projections adopted in this Plan, as detailed above. The graph shows that the projections are reasonable, based upon historic conditions.

FIGURE 6.3

NVUGA ERU Connection History & Forecast



6.5 Flows

This section describes the analyses used to develop flow projections for each of the 4 different population segments and total system flows for each scenario. Population, precipitation and inflow and infiltration (I/I) are the factors that determine the flows in the District's wastewater system. The entry of precipitation into the District's facilities is called inflow. Inflow contribution varies by the intensity and duration of the storm and by location based on topography, system design and system condition. Groundwater infiltration varies primarily by location based on groundwater conditions and system condition. I/I is heavily influenced by rainfall.

6.5.1 Types of Flow Conditions

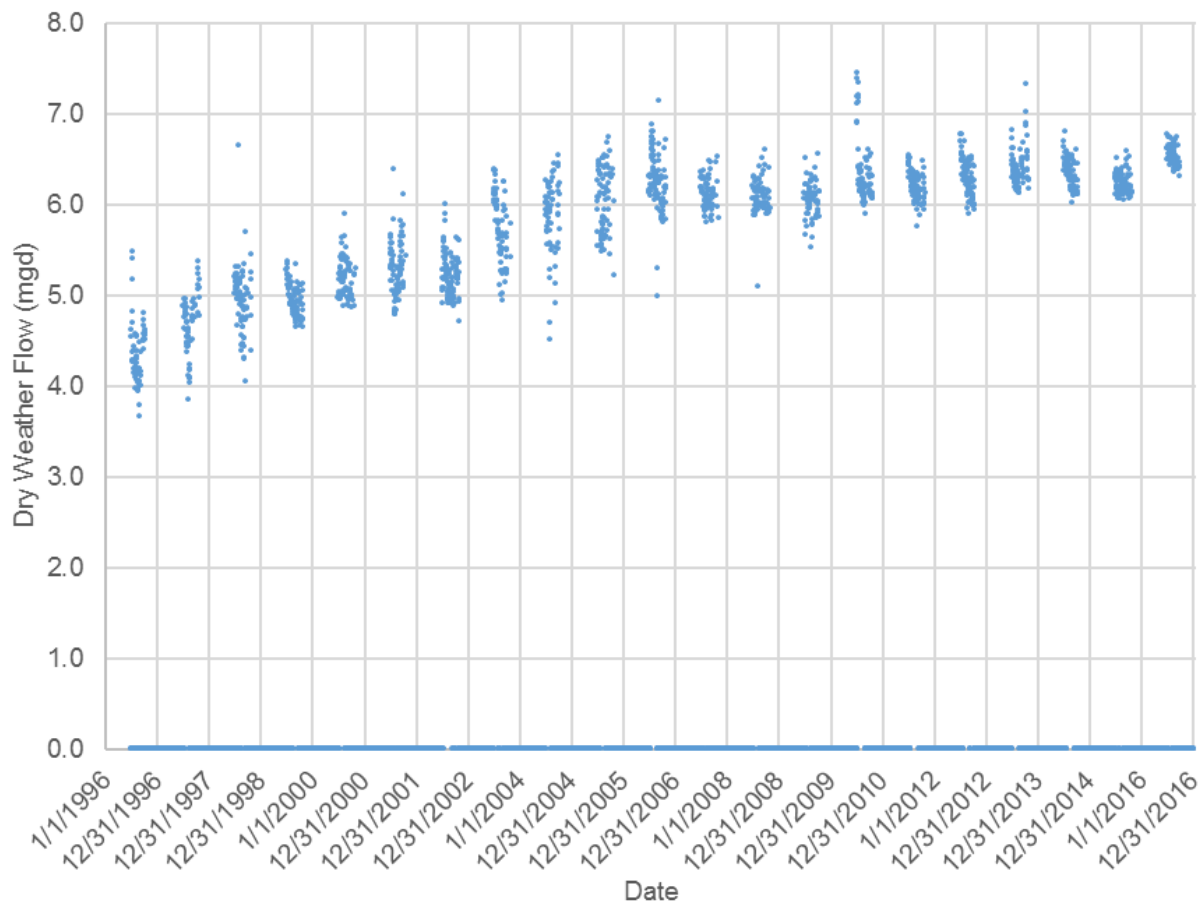
Several flow conditions have been analyzed for this Plan. These include Average Dry Weather, Average Daily, Average Wet Weather, Maximum Month, Peak Day, and Peak Hour. Flow rates are expressed in millions of gallons per day (mgd). Definitions of the 6 flow conditions are provided below.

- » **Average Dry Weather Flow (ADWF):** This flow is the average daily flow for the months of July through October after a period of 3 days when no rainfall was recorded. The ADWF captures the base domestic flow conditions that represent only user-generated flows with some baseline infiltration.
- » **Average Daily Flow (Annual Average Flow, AAF):** This flow is the average of all daily flows during the year. The AAF is also referred to as annual average flow.
- » **Average Wet Weather Flow (AWWF):** This flow is the average daily flow from the months of November through March. All flows during this period were analyzed regardless of the amount of precipitation. The AWWF is used to understand the inflow contribution to the system.
- » **Maximum Month Flow (MMF):** The MMF is the average flow of the maximum month. The determination of this value was based on the highest monthly average flow. Wastewater treatment plants are typically designed based on MMF.
- » **Peak Day Flow (PDF):** The PDF is the maximum total daily flow during a calendar day (24 hours). PDF is valuable in identifying growth and flow trends.
- » **Peak Hour Flow (PHF):** PHF is the peak sustained flow rate occurring during a 1-hour period. It is typically used to design and size the collection system, including interceptor sewers, pump stations, piping, flow meters and certain physical wastewater treatment processes.



FIGURE 6.4

SCTP - Average Dry Weather Flows (mgd)



6.5.2 Historical Flows

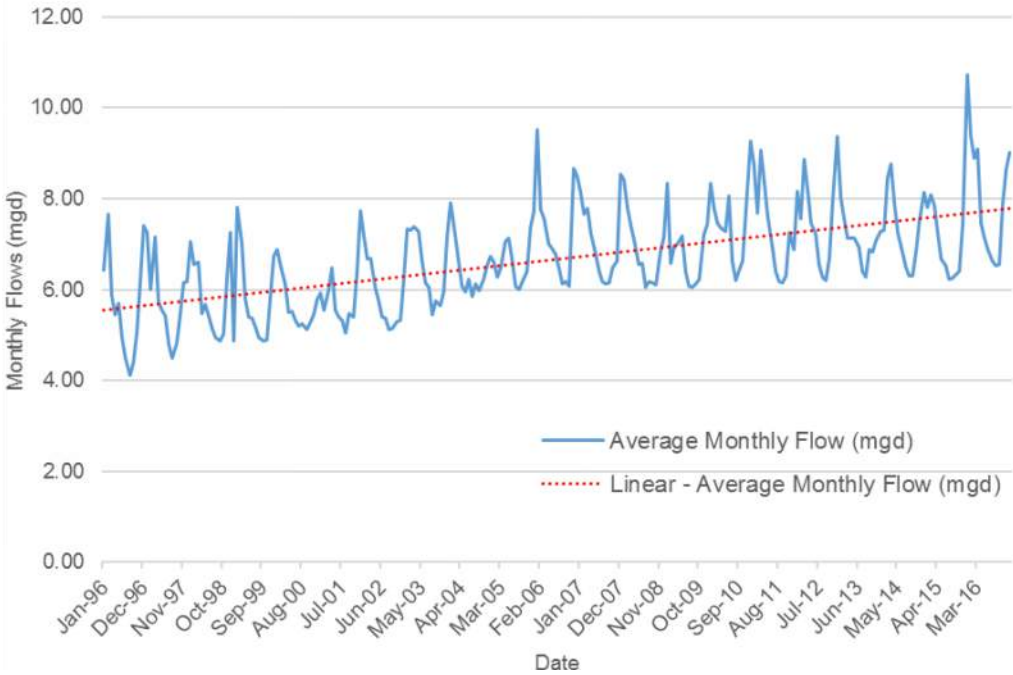
Flow data used in this analysis is gathered from the SCTP and at the Parshall flume monitoring the District's discharge to VWTP. Combined, these represent the vast majority of existing District flows. Both facilities provided reliable data which was useful in the calibration process.

OBSERVED FLOWS

ADWF into the SCTP has been determined to quantify the amount of (predominantly) sanitary flow into the facility. ADWF occurs typically in the summer months and during periods of negligible to no rainfall. Although ADWF usually contains a minor amount of base infiltration, it is considered an effective indicator of base domestic sanitary flow discharging to the collection system from the District's customers. ADWF at the SCTP are presented in Figure 6.4. ADWF increases are gradual compared to population growth over the last decade. This is generally explained by the promulgation of water efficient fixtures and other conservation related measures.

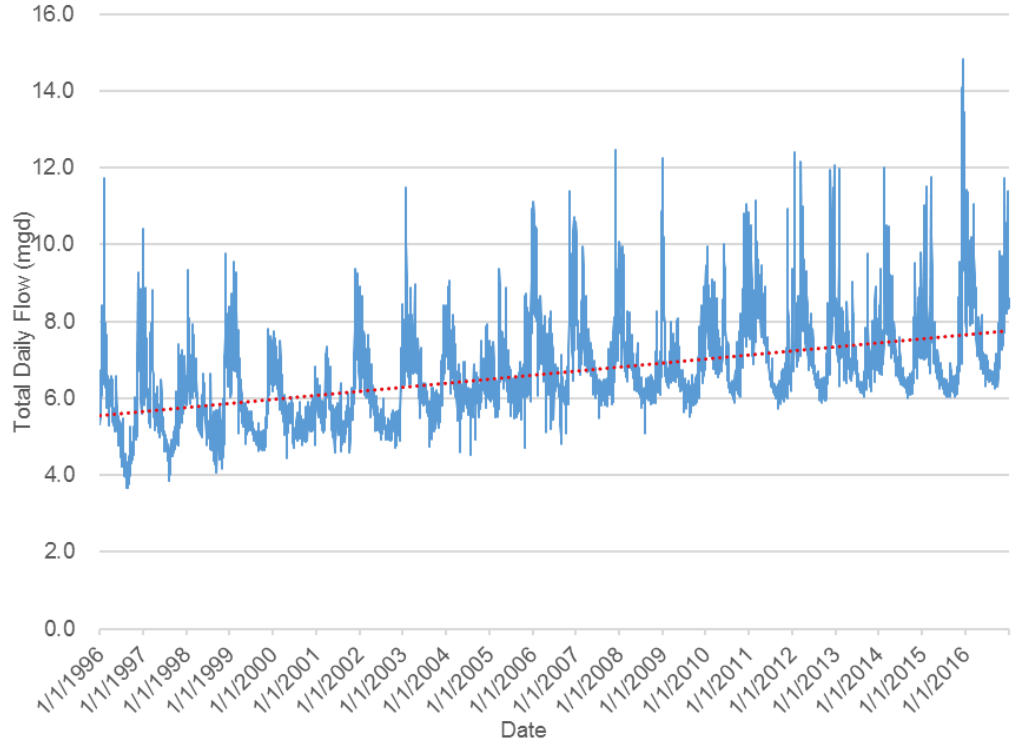
Average monthly flows at the SCTP are presented in Figure 6.5. The MMF value was 10.73 mgd in December 2015.

FIGURE 6.5
Average Monthly Flow at SCTP (mgd)



Total daily flows at the SCTP are presented in Figure 6.6.
 The PDF was 14.81 mgd on December 9, 2015.

FIGURE 6.6
SCTP Total Daily Flow (mgd)





PEAK HOUR FLOW

The peak rainfall event on December 7, 2015 very closely approximates a 25-year, 24-hour storm event. This storm is the calibration event and the criteria used in the hydraulic model. PHF of 18.96 mgd associated with this storm were recorded at the SCTP on December 7 (see Chapter 7).

A summary of existing flows at the SCTP and the Parshall flume discharging to the VWTP is presented in Table 6-5.

TABLE 6-5
SCTP and VWTP Historical Flows

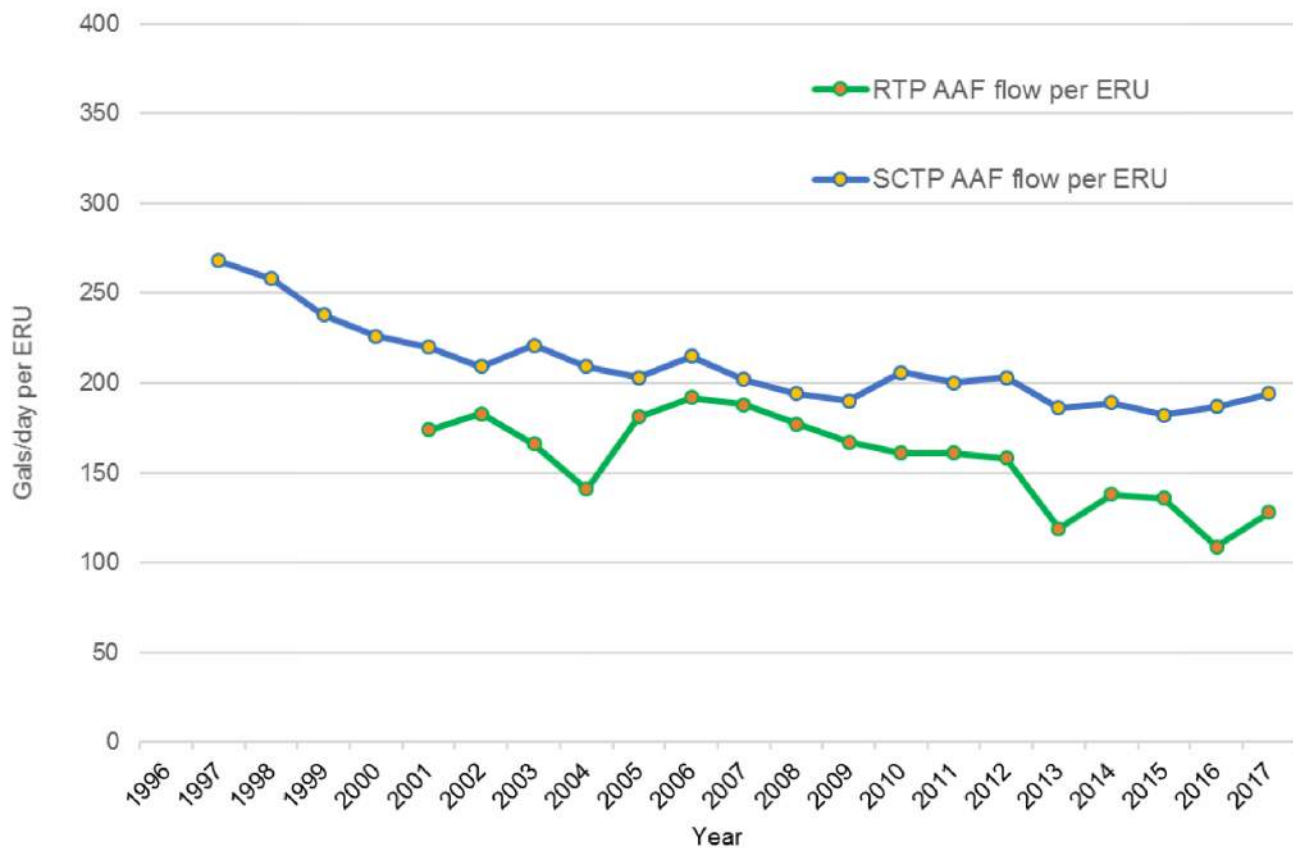
FLOW CONDITION	SCTP ⁽¹⁾ (MGD)	VWTP ⁽¹⁾ (MGD)
ADWF ⁽²⁾	6.36	0.61
AAF	7.49	0.72
AWWF ⁽³⁾	8.48	0.78
MMF ⁽⁴⁾	10.73	0.86
PDF ⁽⁵⁾	14.81	1.75
PHF ⁽⁶⁾	18.96	3.35

NOTES:

1. Values represent flow events from 2014 to 2016.
2. ADWF is defined as the average of the days with 0 rainfall during 4 dry weather months (July through Oct) for years 2014 to 2016 with no rainfall for the preceding 3 days.
3. AWWF is defined as the average of 5 wet weather months (November through March) for years 2014 to 2016.
4. MMF is the average flow for the maximum month, as defined in the current NPDES permit. The MMF is sometimes referred to as peak month flow and is considered the design flow for the WWTP. This event occurred on December 2015.
5. PDF is from wet weather event on 12/07/2015 and recorded on 12/09/2015.
6. PHF recorded at 1:00 pm on 12/07/2015.

FIGURE 6.7

Salmon Creek and Ridgefield Flow per ERU (gallons per day (gpd))



FLOW PER ERU

The average flow per residential unit, flow per ERU, is another way of looking at historical flow trends. The 18-year history of AAF per ERU at the SCTP and a 13-year record at the RTP are presented in Figure 6.7. A clear trend shows a consistent reduction in flow per ERU in the NVUGA and RUGA. This correlates well with the ADWF trends which were also observed.

6.5.3 Forecasted Flows

Forecasted flows are developed by looking at both historical recorded values and by comparing the values against other western Washington sewer systems. As shown in Figure 6.7, the SCTP had 2014 flows of approximately 200 gpd per ERU. The 200 gpd per ERU value is applied throughout the entire District to forecast flows. This value corroborates the planning values previously discussed, which are based upon average density per household of 2.66 persons per single-family unit and 75 gpcd.

As shown in Table 6-6, this value is conservative and similar to planning values used across other western Washington communities.

TABLE 6-6

Comparative Average Annual Unit Flows for other Western Washington Communities

AGENCY	GPCD	PERSON/ERU	GPD PER ERU
Southwest Suburban Sewer District	60	2.45	147
Alderwood Water Wastewater District	66	2.90	191
City of Puyallup	75	2.43	182
City of Monroe	67.4	2.90	195
City of Lynnwood	70	2.50	175
City of Edmonds	63.5	2.36	150
City of Vancouver	90	2.70	243
District	75	2.66	200

The District had previously been using a unit-value of 100 gpcd. This was a common default value when no metered data was available to support actual values. More recently, common planning assumptions use values between 60 and 80 gpcd to account for increasing use of low use water fixtures and general water conservation.

ADWF and AAF are used to project the mini-basin contributions by applying per capita flow rates to residential, employee, student populations and industrial contributions to the system. ADWF represents the sanitary contribution only and the AAF is a representation of user-generated sanitary contributions with baseline I/I. The textbook ratio of wastewater generated from a residential person to that of an employee or student is 5 or 6 to 1. The adjusted employee and student contributions are presented below in Table 6-7.

An industrial flow allocation of 1,500 gpad is in addition to the employment values associated with the industrial use. This value has been applied to industrially zoned parcels within the 3 industrial hubs described in Section 6.3.5. This value is conservatively high to account for wet industries. The term 'wet industry' applies to those industrial users that use higher than average volume of water and produce a higher than average wastewater flow.

These loading values, coupled with the population projections presented in Section 6.3, result in future wastewater flow predictions.

TABLE 6-7

Flow Rates per Population Segment

SEGMENT	ADWF (WITH NO I/I COMPONENT)	PERSON/ERU (WITH BASELINE I/I INCLUDED)
Residential	60 gpcd	75 gpcd
Employment	10 gpd per employee	15 gpd per employee
Student	12 gpd per student	15 gpd per student
Industrial	1,500 gpad	1,500 gpad

Tables 6-8 through 6-11 summarize the flow projections for 2016 and each of the 3 scenarios using the methods described in this chapter. A more detailed analysis of the contribution by mini-basin is presented in Appendix B, Table B-2.

TABLE 6-8
2016 Forecasted Average Annual Flows

SERVICE AREA	BASIN	RESIDENTIAL	EMPLOYMENT	STUDENT	INDUSTRIAL	TOTAL AA (gpd)
		AA (gpd)	AA (gpd)	AA (gpd)	AA (gpd)	
SALMON CREEK	RUGA	540,618	41,783	27,271	-	609,672
	NVUGA	6,106,270	343,228	330,795	94,500	6,874,793
	<i>SUB-TOTAL</i>	<i>6,646,888</i>	<i>385,011</i>	<i>358,066</i>	<i>94,500</i>	<i>7,484,465</i>
WESTSIDE	WVUGA	758,400	39,339	22,320	-	820,059
GRAND TOTAL		7,405,288	424,350	380,386	94,500	8,304,524

TABLE 6-9
2036 Scenario Forecasted Average Annual Flows

SERVICE AREA	BASIN	RESIDENTIAL	EMPLOYMENT	STUDENT	INDUSTRIAL	TOTAL AA (gpd)
		AA (gpd)	AA (gpd)	AA (gpd)	AA (gpd)	
SALMON CREEK	RUGA	1,864,201	178,429	103,619	1,299,450	3,445,699
	NVUGA	8,894,871	636,245	456,001	1,603,500	11,590,617
	<i>SUB-TOTAL</i>	<i>10,759,072</i>	<i>814,674</i>	<i>559,620</i>	<i>2,902,950</i>	<i>15,036,316</i>
WESTSIDE	WVUGA	862,149	43,926	26,400	-	932,475
GRAND TOTAL		11,621,221	858,600	586,020	2,902,950	15,968,791

TABLE 6-10
Build-out Scenario Forecasted Average Annual Flows

SERVICE AREA	BASIN	RESIDENTIAL	EMPLOYMENT	STUDENT	INDUSTRIAL	TOTAL AA (gpd)
		AA (gpd)	AA (gpd)	AA (gpd)	AA (gpd)	
SALMON CREEK	RUGA	2,082,802	207,959	154,334	1,299,450	3,744,545
	NVUGA	11,450,558	712,502	456,001	1,603,500	14,222,561
	<i>SUB-TOTAL</i>	<i>13,533,360</i>	<i>920,461</i>	<i>610,335</i>	<i>2,902,950</i>	<i>17,967,106</i>
WESTSIDE	WVUGA	998,176	45,239	26,400	-	1,069,815
GRAND TOTAL		14,531,536	965,700	636,735	2,902,950	19,036,921

TABLE 6-11**2066 Scenario Forecasted Average Annual Flows**

SERVICE AREA	BASIN	RESIDENTIAL	EMPLOYMENT	STUDENT	INDUSTRIAL	TOTAL AA (gpd)
		AA (gpd)	AA (gpd)	AA (gpd)	AA (gpd)	
SALMON CREEK	RUGA	3,889,430	383,397	218,142	2,284,500	6,775,469
	NVUGA	14,015,324	1,075,828	643,811	2,956,500	18,691,463
	SUB-TOTAL	17,904,754	1,459,225	861,953	5,241,000	25,466,932
WESTSIDE	WVUGA	1,076,264	50,807	32,520	-	1,159,591
GRAND TOTAL		18,981,018	1,510,032	894,473	5,241,000	26,626,523

6.5.4 Inflow and Infiltration

I/I are important factors in evaluating future flows. Depending upon the integrity of the collection system, I/I can have a significant influence on the flows within a wastewater system. Two metrics are considered for assessing I/I of the District's system, observed peaking factors and EPA standards.

Based on observed flows at SCTP, the peaking factor, calculated as the ratio of PHF to AAF, is 3.0, which is not considered to be high. Also, comparing that value against other similarly sized systems in western Washington, the SCTP does not experience high rates of I/I. The peaking factor for the Parshall flume discharge to VWTP is slightly higher, above 4, but is still not considered to be high. Based upon the age and materials used in the system serving the Westside Service Area, compared to the relatively newer collection system in the Salmon Creek Service Area, slightly higher I/I rates are predictable.

Another metric for assessing I/I is a quantitative threshold established by the EPA.

- » **Non-Excessive Infiltration:** ADWF during a period of seasonal high groundwater is less than 120 gpcd.
- » **Non-Excessive Inflow:** AWWF is less than 275 gpcd.

ADWF for SCTP and VWTP were 70 and 56 gpcd, respectively. The AWWF for SCTP and VWTP were 94 and 71 gpcd, respectively. Therefore, using EPA's thresholds, both infiltration and inflow are considered non-excessive.

An I/I analysis is presented in Table 6-12.

TABLE 6-12**EPA/Ecology Excessive I/I Criteria**

PARAMETER	SCTP	VWTP
Sewered Population	90,404 ⁽¹⁾	10,935 ⁽³⁾
ADWF (mgd)	6.36 ⁽²⁾	0.61 ⁽²⁾
ADWF (gpcd)	70	56
AWWF (mgd)	8.48 ⁽²⁾	0.78 ⁽²⁾
AWWF (gpcd)	94	71

NOTES:

1. Residential (not including City of Ridgefield or City of Vancouver): 81,417
Employment in equivalent population: 22,882 / 5 = 4,576
Student in equivalent population: 22,053 / 5 = 4,411
Total equivalent population: 90,404
2. Table 6-5
3. Residential City of Vancouver: 10,112
Employment in equivalent population: 2,623 / 5 = 525
Student in equivalent population: 1,488 / 5 = 298
Total equivalent population: 10,935



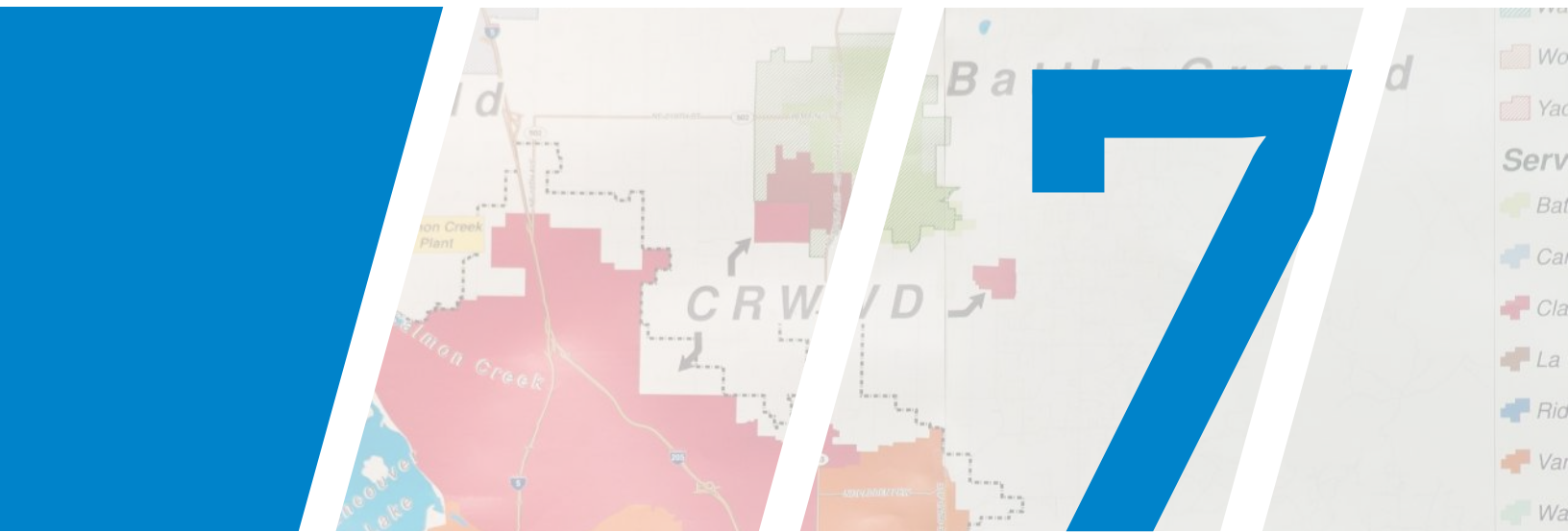
Model Development & Capacity Analysis





A utility locating device can detect underground utilities by detecting RF frequencies from tracer wires and electrical wiring

Model Development & Capacity Analysis



7.1 Introduction

A hydraulic model is used to evaluate the capacity of the District's system to collect and convey wastewater flows. The hydraulic modeling evaluates the collection system for both existing and projected 2036 flow scenarios. The analysis identifies a list of system deficiencies. Each deficiency is reviewed and then used to scope and develop a capital project to alleviate the capacity issue. The resulting CIP is presented in Chapter 10.

7.2 Model Analysis Approach

Future forecasted flows are largely influenced by the growth factors discussed in Chapter 6 and by I/I from storms. A calibrated hydraulic model can accurately represent flows from future populations and storms.



As discussed in Appendix H, the District has selected a 25-year recurrence interval rainfall as the design storm for sizing collection and conveyance facilities. A simulation of the design storm is also used to evaluate system capacity. A long-term rainfall analysis of the December 7, 2015 storm affirms it was a 25-year event. Data for the storm event was captured by District and Alliance flow measurement devices and County rainfall gauges. That storm was therefore selected as the calibration data set. Consequently, the flow data from the storm is used directly in calibrating the model without needing to factor up the data to match a projected 25-year peak day storm.

The analysis uses MIKE Urban modeling software (release 2016, SP1) by DHI. MIKE Urban software solves the complete St. Venant equations for fully-dynamic flow using DHI's proprietary hydraulic engine. The software is developed specifically for modeling urban sanitary and combined sewer systems. It calculates both gravity and pressure flow, surcharging in manholes, backwater effects and reversal of flow. The software operates interactively with ArcGIS software.

7.3 Model Input Parameters

7.3.1 Data Sources

The following information is included in the hydraulic model of the existing collection system:

- » District-provided geographic information system (GIS) collection system data including manholes/points, pipes/links, lift station locations, STEP systems and proposed extensions/improvements previously identified by the District.
- » Additional GIS base data including parcels, streets, zoning, topography, known collection system "hot spots," abandoned facilities and flow monitoring locations.

- » Pump station record drawings, manufacturer's pump data, pump run times and draw-down test data. Pump station data is summarized in Appendix E.
- » Clark County rainfall data. Precipitation data for various locations, including SCTP and RTP, generally at 15-minute intervals.

Projects slated for construction are also included in the model if the project would result in physical changes to the system. For example, the model includes the planned 24-in diameter pipeline bypassing the Country Meadows pump station and NE 78th Street trunk sewer improvements for future flow scenarios.



7.3.2 Modeling of Physical System Features

As described in Chapter 5, the District service area is divided into 82 mini-basins, which are areas of existing or future development discharging to a common sewer outlet. The mini-basins are the basis for loading the model.

Many of the RUGA mini-basins currently discharge to the west into the RTP. These mini-basins will ultimately be diverted to the Pioneer pump station and south to the SCTP. See Figure 5.4 for a schematic diagram.

The model includes a total of 10,214 manholes or “nodes,” which were imported directly from the District’s GIS. A small number of nodes were added manually to represent future extensions of the collection system. Pipes or “links” were then imported from the GIS and connected to associated nodes using their designated upstream and downstream manhole attributes. Additional pipes were manually input, representing future system extensions, and connected to the associated future nodes. From here, built-in model functions and engineering judgement were used to correct and add collection system elements to represent the system accurately.

The resulting modeled system is illustrated in Figure 7.1. It includes proposed future piping and schematic extensions into currently unsewered areas. Green lines identify modeled pipes, brown lines are excluded from the model and the brown “barrels” represent pump station wetwells or motor operated valve (MOV) vaults.

The Meadow Glade and Hockinson STEP systems are not included in the model. However, a separate model of the Meadow Glade system was completed (see Appendix M). That model determined that the STEP system in Meadow Glade is currently operating within design parameters and that it has capacity, as planned, to serve expected growth within design parameters (e.g. 1 ERU/Acre).

The District’s collections system discharges directly to SCWMS, owned by the Alliance, in a number of locations. In order to simulate hydraulic conditions in District infrastructure at these locations, the model includes portions of the SCWMS including the Alliance’s 117th Street and 36th Avenue pump stations and the Salmon Creek and Kline interceptors. The Alliance system is also included to enable comparison of simulated versus recorded inflow to the SCTP during the calibration process. Therefore, the Battle Ground pump station is also included and is simulated as an inflow timeseries. Flow data for the Battle Ground pump station was provided by the City’s consultant and includes District flow from Meadow Glade and Hockinson. However, hydraulic capacity of the Alliance system was not specifically analyzed for this study.

Pump stations were manually input to the model at the locations identified in the GIS using capacities, configurations, operational modes provided by the District.



Of the District's 67 operating pump stations, 63 are included in the model. The Office, Dunning Meadows, and Fieldstone Estates lift stations are not modeled as these pump stations are on the periphery of the collection system and have negligible flows. Sanitary flows tributary to those lift stations are still incorporated into overall model loading.

The future conditions model incorporates planned capital projects to modify several pump stations as described in the CIP (see chapter 10). These modifications are anticipated to accommodate future growth, streamline pumping operations and to complete the Discovery Corridor Wastewater Transmission System (DCWTS). They include the following:

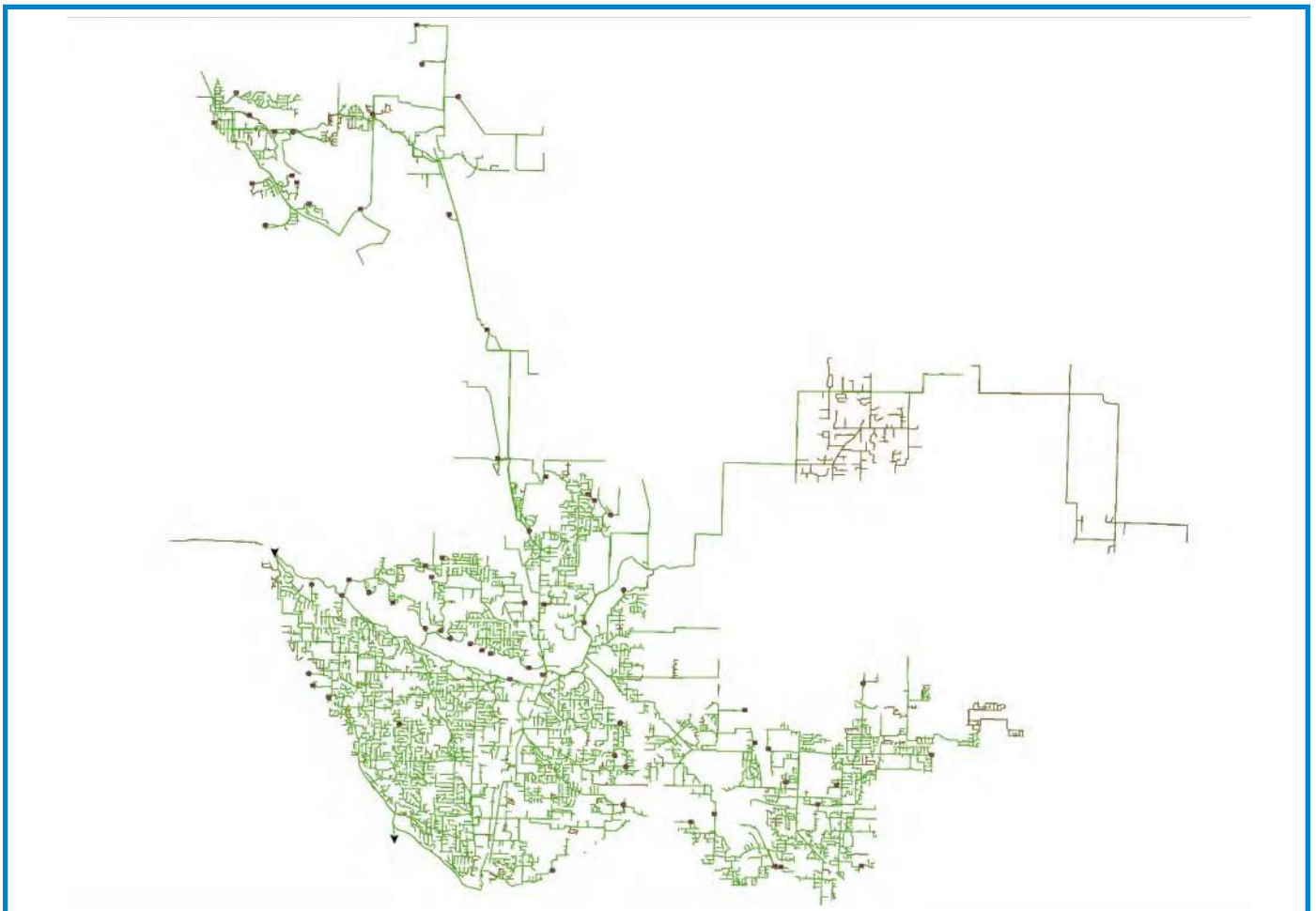
- » Bypass and decommission the N-26 Fairgrounds pump station
- » Bypass and decommission the E-38 Country Meadows pump station
- » Bypass and decommission the E-27 Buckman Gardens pump station
- » Re-direct Payne pump station discharge to the south
- » Increase capacity of the Union Road pump station
- » Increase capacity of the Legacy pump station
- » Increase capacity of the Pioneer Canyon pump station
- » Increase capacity of the Neil Kimsey pump station
- » Re-direct Gee Creek pump station discharge east, to the Pioneer Canyon pump station, via the proposed Midway pump station
- » Upgrade and re-direct Marina pump station discharge to the Gee Creek pump station

Additional pump station improvements identified in the modeling analysis as necessary to accommodate future increases in flow and extend collection system service are not shown above. However, these improvements are identified in the CIP.

EXTENSIONS

Some mini-basins are largely undeveloped or under-developed. Planned growth in these basins will necessitate sewer service extensions where proposed in the CIP. The future conditions model includes schematic representations of these extensions. Sewer extensions are input using several assumptions and procedures as described below. Sewer service extensions to the unserved parcels is provided with gravity service where possible, and with pressure systems if the topography mandates, as depicted in the basin mapping (see Appendix A). The routing and the service schemes are based on the topographic mapping. Where possible, future extensions follow existing rights-of-way. Where large parcels are undeveloped, the sewer line extensions attempt to follow parcel boundaries. When topographic constraints prevent alignments along parcel boundaries, alignment bisect the properties. Development of large parcels is provided with sewer service to the nearest corner.

FIGURE 7.1
Modeled System vs. GIS Comparison



7.3.3 Model Flow Input

After the physical collection system was represented in the model, flow projections identified in Chapter 6 were applied. Flow scenarios were created for 2016 and 2036 PDF. PDF is comprised of 2 primary components: ADWF and I/I. These components are loaded separately and simulated using different model functions, to produce the combined PDF in the collection system.

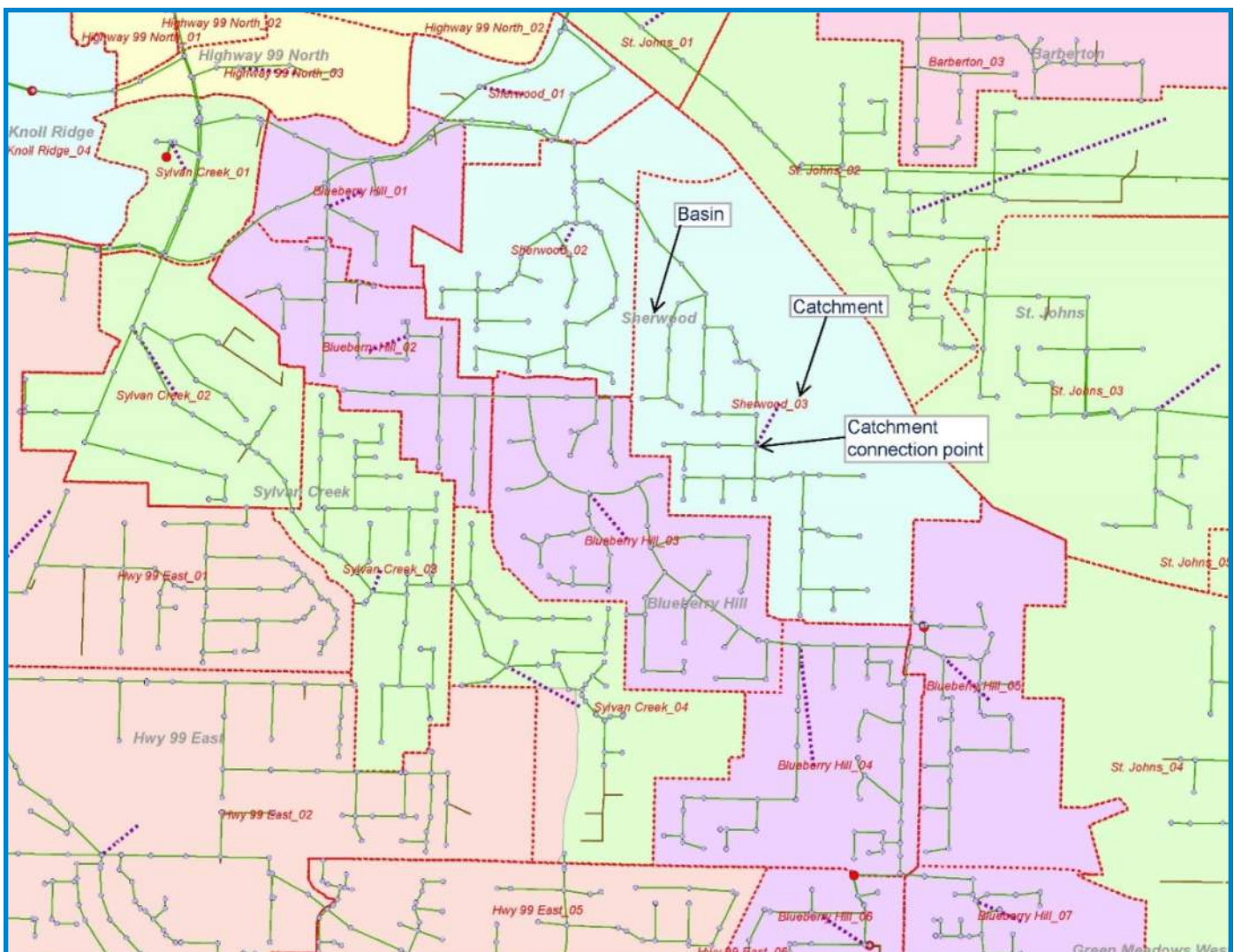
AVERAGE DRY WEATHER FLOW (ADWF)

AAF projections are summarized in Chapter 6 tables 6-8 through 6-11. AAF for each mini-basin is presented in Table B-2 in Appendix B. ADWF for each mini-basin is equitably distributed between the manholes in each mini-basin.

I/I

Two model modules are specifically designed to simulate I/I. Model setup for I/I simulation is accomplished by subdividing the mini-basins into 3 or 4 catchments. Each catchment discharges to a single manhole that is identified in the model. Catchments are then assigned parameter values simulating the response to rainfall. Figure 7.2 illustrates model catchment delineations and connection points for a portion of the overall collection system.

FIGURE 7.2
Model Catchments



7.4 Model Calibration

The model is calibrated to ensure that the modeled collection system is an accurate representation of the physical system. Calibration is an iterative process of adjusting model parameters that control simulated flow. Parameters are adjusted until model output matches measured real world data, within acceptable limits.

7.4.1 Flow Monitoring Locations

The District owns more than a dozen temporary flow meters that are periodically moved throughout the collection system. Flow meters are moved seasonally, with the intention of capturing at least 2 weeks of data at each location during both dry and wet weather conditions. Flow meter data can be used during periods of dry weather to estimate the number of upstream ERUs since primarily sanitary flow is recorded during these periods. The meters are also valuable for characterizing diurnal variations in sanitary flow during wet weather, the I/I response to rainfall, and potential areas of concern. Flow data from both permanent flow meters and the temporary-rotating flow meters was essential in providing data used to calibrate the hydraulic model.

See section 9.5.1 for additional information regarding flow monitoring.



Calibration was performed at the following 3 flow meter locations:

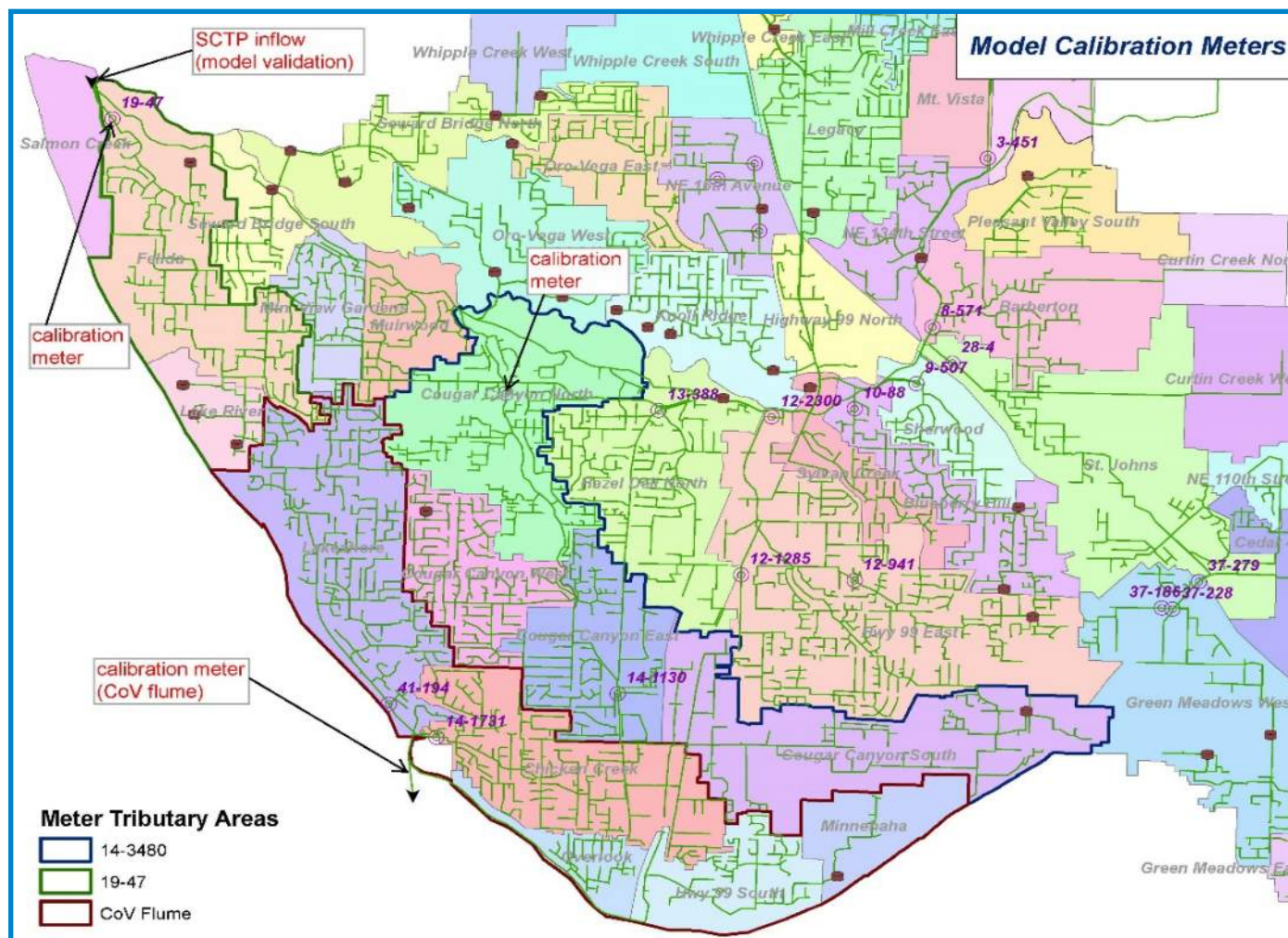
1. MH 14-3480: Cougar Canyon North mini-basin
2. MH 19-47: Felida mini-basin
3. City of Vancouver Parshall flume
 - » Discharge from the Lakeshore, Overlook, Chicken Creek, Highway 99 South and Minnehaha mini-basins is included.
 - » Partial flow from the Cougar Canyon South mini-basin also discharges through the flume via flow diversion manholes.

The meter locations listed above were active during the December 7, 2015 storm event, which was the largest storm on record captured by District flow meters. The storm is both the primary calibration event and the “design storm” event. The SCTP inflow meter was used to validate the model after it was calibrated to the 3 selected flow meters above. Calibration flow meters and their respective contributing areas are shown in Figure 7.3.

Parshall flumes provide very reliable and consistent flow data. Data from the flume available for the December 2015 storm event, plus SCTP inflow data, provided valuable supplemental flow data for model calibration.

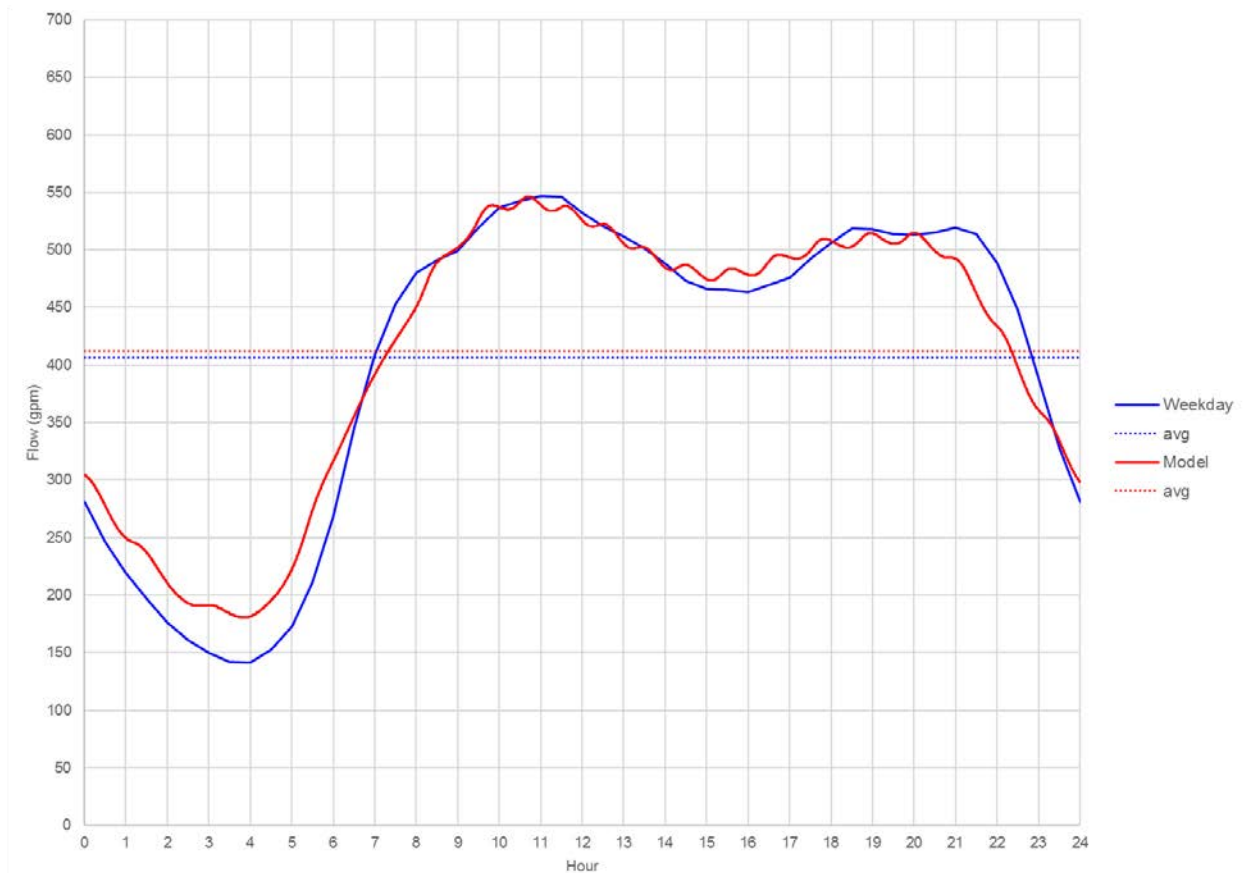
FIGURE 7.3

Calibration Flow Meter Locations



7.4.2 Collection and Conveyance System Calibration

Model calibration was first performed to ADWF to achieve a match between simulated and metered flow. Because ADWFs are contributed only by users (e.g. residences, businesses), the calibration takes into account diurnal flow patterns and flow patterns related to the day of the week. Total volume was also checked to verify that per capita rates derived in Chapter 6 result in an acceptable volume match between simulated and metered flow. ADWF calibration is illustrated for meter 14-3480 in Figure 7.4.

FIGURE 7.4**ADWF Calibration at Meter 14-3480**

An acceptable match was achieved between simulated and metered ADWF. The model was next calibrated to wet weather flow by applying local rainfall data and adjusting parameter values that govern the hydrologic response. Parameter values were adjusted iteratively, until an acceptable volume and peak flow match was achieved at the 3 selected meter locations for the calibration storm event. The primary calibration parameter for wet weather flow is the percentage of basin area that contributes runoff to I/I flow in the pipes. It is representative of the presence of cracks and defects in the pipes and direct inflow to the pipes through manhole lids or other connections to stormwater runoff. Figure 7.5 illustrates wet weather calibration at the Parshall flume.



The time discrepancy between the “previous” and “current” peaks shown is due to an inaccurate time setting on the wheel chart at the Parshall flume. This difference was not observed at any of the other meters. The shape and the timing of the simulated hydrograph compared to the meter hydrograph is an acceptable match. Therefore, the difference in peaks shown in Figure 7.5 is inconsequential and has no bearing on the analysis performed herein. Results of the calibration process at the selected meter locations are summarized in Table 7-1. The comparison of the actual flow data with the hydraulic model results show a close calibration that is within industry standard.

FIGURE 7.5
Wet Weather Flow Calibration at City of Vancouver Flume

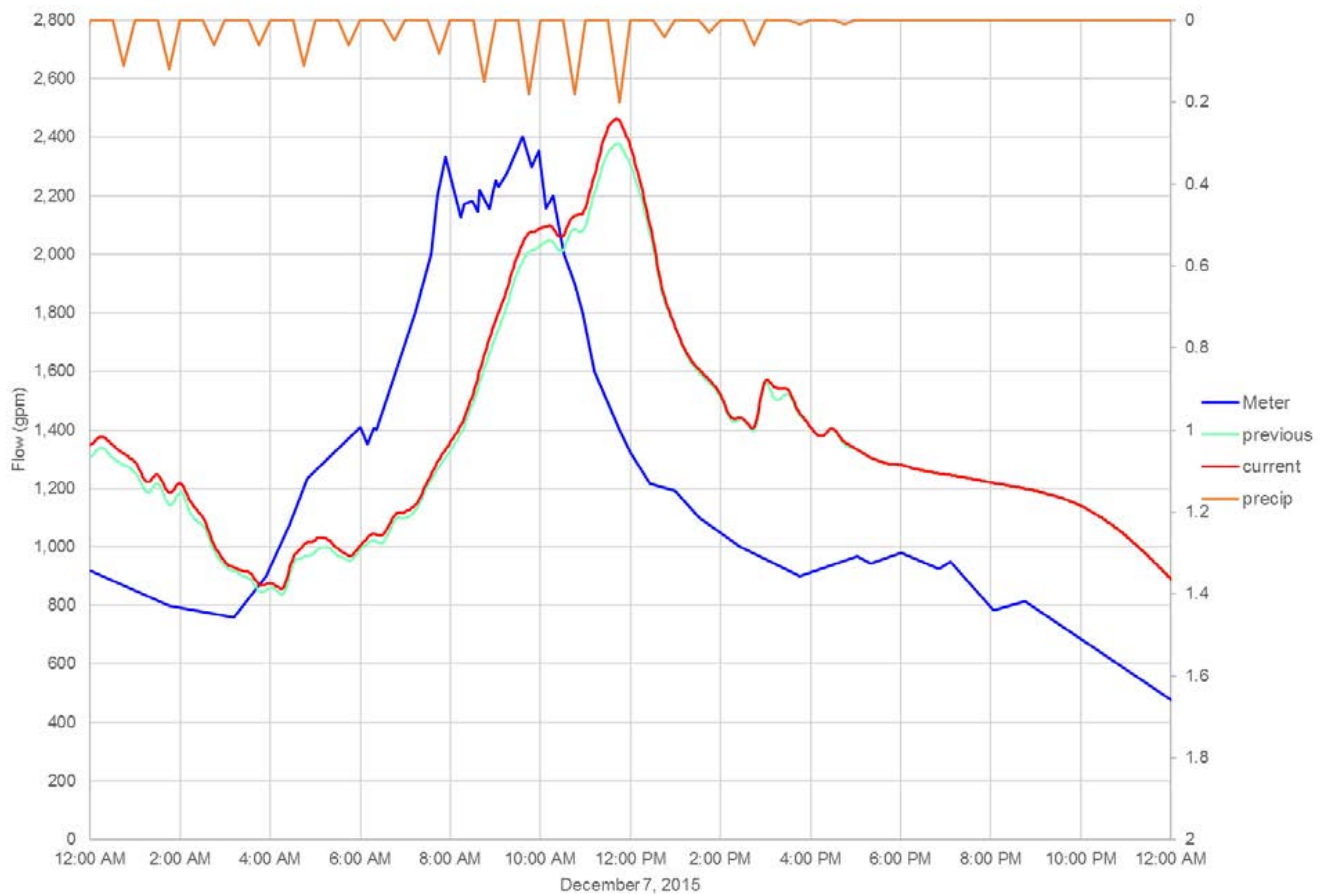


TABLE 7-1

December 7, 2015 Parameter Set Assignments and Peak Flow Comparison with Meter Data

CALIBRATION METER	14-3480 ⁽¹⁾	19-47 ⁽²⁾	VANCOUVER PARSHALL FLUME	SCTP ⁽³⁾	RTP
CALIBRATION SET	14-3480	19-47	City of Vancouver	Composite	Ridgefield
PEAK FLOW %	n/a	-5	3	-2	n/a ⁽⁴⁾
VOLUME %	n/a	9	13	-5	0

NOTES:

1. The 14-3480 calibration is based on splitting the difference between under-simulating the December 12, 2015 peak and over-simulating the November 17, 2015 peak, as discussed with the District. (The model accomplishes this goal.)
2. Flow meter data is not available at this meter for the December 7, 2015 event. Meter data for the December 17, 2015 event was therefore substituted for calibration.
3. SCTP inflow is based on calibration parameter sets developed for the calibration mini-basins and assigned to the model validation event mini-basins, as identified in the first table. A composite parameter set was developed during the calibration process and assigned to the rest of the non-calibration mini-basins. The composite parameter values were adjusted during the calibration process to achieve an overall match with meter data at the treatment plant inflow.
4. Data not available.

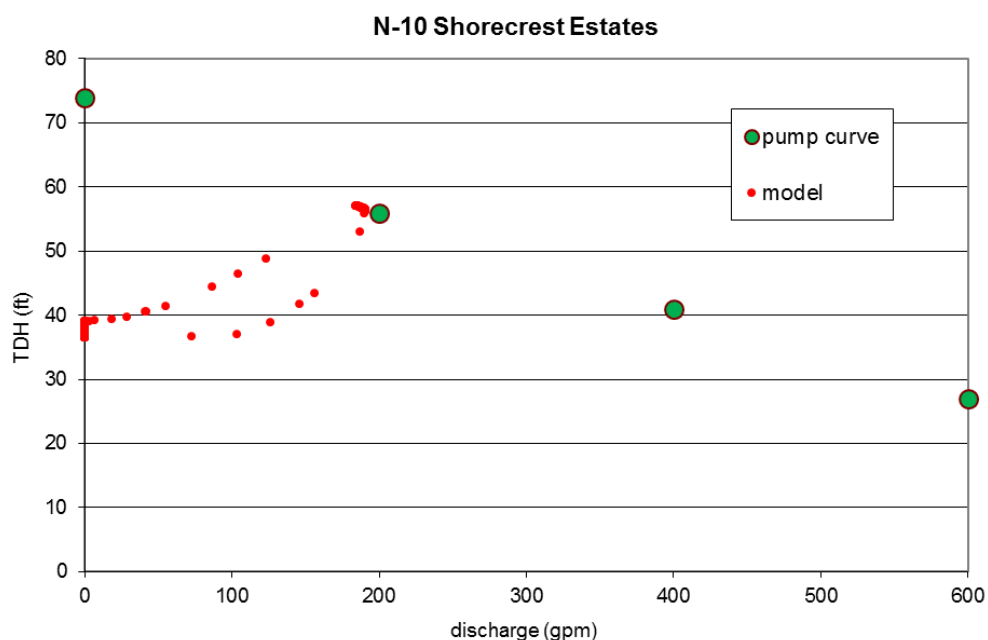


Calibrating the model to match flow and volume at the 3 selected meters results in unique calibration parameter sets for each location. These parameter sets were then applied to mini-basins tributary to other meter locations. The modeled flow for the other locations was compared to actual flow for available storm events. The calibration parameter set resulting in modeled flow most closely matching metered flow data for those events was then selected for each mini-basin.

Peak inflow meter data was not available for the RTP. Therefore, simulated average flow was compared to reported daily flow data. The discharge monitoring report for December 7, 2015 reported 1.03 mgd, which is equivalent to 715 gallons per minute (gpm) average flow over the 24-hour period. The simulated average flow is 713 gpm, closely matching the recorded data.

FIGURE 7.6

Simulated Pump Operation



7.4.3 Pump Station Calibration

Calibration to pump data ensures pump stations are modeled similar to how they operate in the collection system. The simulated pump discharge is compared to the design operating point and/or drawdown test results. Manufacturer's pump curves were input to the model for each pump station, together with operational controls, wet well configurations and force main information. Force main alignments were checked for intermediate high points that might be higher than the receiving manhole. Pump curves were adjusted in the model for consistency with the District's drawdown test results. Simulated pump discharges were plotted versus simulated total dynamic head (TDH) to verify that pumps were operating close to their expected operating points and to check that the model was producing stable pump discharge. An example of how the hydraulic model simulates pump station operation and pump performance is shown in Figure 7.6. As shown, the hydraulic model simulates both the ramp-up and ramp-down of the pump showing that it operates at the pump's duty point.



7.5 Surge Criteria

The hydraulic model analysis simulates flow conditions in the system for the December 7, 2015 storm event for existing and 20-year (2036) scenario. Modeled Hydraulic conditions are measured against surcharge criteria to identify system deficiencies. Improvements to the collection system are developed to resolve the identified deficiencies. Per the District surcharging policy described in Chapter 4, a gravity pipe is considered deficient if:

- » The maximum hydraulic grade line is greater than 1 foot above the crown of the pipe during the design storm, for pipes under less than 10 feet of cover; or
- » The maximum hydraulic grade line is greater than 3 feet above the crown of the pipe during the design storm, for pipes under more than 10 feet of cover.

Force main capacity is based on velocity; a force main having velocities exceeding 8 feet per second (fps) is above capacity. Pump station capacity is based on firm capacity.

7.6 2016 Analysis Results

The capacity analysis of 2016 baseline flows identified 7 system deficiencies in gravity piping and pump stations.

In 3 areas gravity piping is projected to exceed the surcharge criteria during the design storm event.

1. Gravity piping in NE 12th and NE 13th Avenues between NE 169th and NE 173rd Streets. Surcharging in this piping is caused by discharge from the Fairgrounds pump station. The District has identified a CIP project to bypass and decommission the Fairgrounds pump station. The bypass piping will convey flow to the Whipple Creek North pump station and resolve this surcharging deficiency.
2. Gravity piping in NE 78th Street to the east of NE 16th Avenue. Piping improvements have already been designed to resolve this deficiency.
3. Gravity piping in NE Minnehaha Street to the east of NE Highway 99. The District has examined model results at this location and determined that improvements are not necessary to resolve surcharging.

Results from the analysis indicate that 4 pump stations exhibit capacity deficiencies during the design storm event.

1. Union Road pump station. The standby pump runs and cannot keep up with the peak inflow. Phased improvements identified in the DCWTS Engineering Report (Otak, Inc., 2013) (DCWTS Report) will resolve existing and future peak flow deficiencies. The District has placed a portable pump station on site to augment existing capacity while a permanent capital project is implemented.
2. Country Meadows pump station. The standby pump runs and cannot keep up with the peak inflow. The District has identified a pipeline project that will intercept inflow to this pump station and convey it toward the Glenwood pump station. The Country Meadows pump station will then be decommissioned. The District has placed a portable pump station on site to augment existing capacity while a permanent capital project is implement.
3. Schuller Estates pump station. The standby pump runs and cannot keep up with the peak inflow. Additional pump station capacity will be required. The increase in capacity required to pump the peak 20-year flow will result in an estimated peak velocity of 5.8 fps in the existing 4-in diameter force main. An upgrade to the force main is, therefore, not required.
4. Whipple Creek North pump station. The standby pump runs to keep up with peak day inflow. Additional pump station capacity will be required for flow diverted here from the planned decommissioning of the Fairgrounds pump station.

Iterative model runs are then performed to upsize gravity piping and pump station capacities to resolve modeled deficiencies. The system deficiencies and proposed solutions are identified in the CIP in Chapter 10.



7.7 2036 Analysis Results

Applying the 20-year projected flow simulation to the system identified a limited number of system deficiencies for the design storm event. The deficiencies for gravity sewers and pump systems are discussed below. These deficiencies are in addition to those listed above for the baseline model simulation. The system deficiencies and proposed solutions are identified in the CIP in Chapter 10 and listed below.

1. Gravity piping in the Pioneer Corridor mini-basin, west of I-5. Surcharging is resolved by replacing the 8-in piping between the upstream 12-in piping and downstream 18-in piping.
2. Marina gravity piping. New gravity piping will intercept RTP inflow and convey it to the Marina Pump Station.
3. Mt. Vista mini-basin gravity piping. Model results indicate that future flow from the Pleasant Valley North mini-basin will surcharge the existing 10-in piping conveying flow south through the Mt. Vista mini-basin. Phased improvements will first extend the proposed Pleasant Valley North mini-basin force main further south in Mt. Vista mini-basin, bypassing a section of existing 10-in gravity piping, then upsize the 10-in pipe to 15-in where the slope flattens in the southeast portion of the mini-basin.
4. NE 20th Avenue gravity piping to the Legacy pump station. The project will upsize existing piping to 30-in. This system conveys flow from the Whipple Creek East and I-5 mini-basins via the Union Road pump station and from the DCWTS via the Neil Kimsey pump station to the Legacy pump station.
5. NE 20th Avenue gravity piping downstream of the Legacy pump station force main. The project will upsize existing 12-in and 15-in piping to 18-in to resolve surcharging caused by the secondary Legacy force main, which is proposed to be activated and upsized from 8-in to 12-in.



Analysis results also indicate that the following pump stations exhibit capacity deficiencies during the design storm event.

1. **Union Road pump station and force main.** The standby pump runs and cannot keep up with the peak inflow. Phased improvements identified in the DCWTS Report will resolve existing and future peak flow deficiencies by constructing a second 15-in force main parallel to the existing one. Both the existing and the future force main will be needed to provide enough capacity for the upgraded pump station. To provide redundancy, a temporary portable pump as a standby will be provided until the second force main is constructed.
2. **Marina pump station and force main.** Capacity improvements are needed to accommodate diversion of Ridgefield treatment plant inflow and convey it to the Pioneer Canyon pump station via the Gee Creek and Midway pump stations.
3. **Gee Creek pump station and force main.** Capacity improvements identified in the DCWTS study are needed to convey Gee Creek pump station flow to the Midway pump station. A new force main will convey Gee Creek pump station flow to the Midway pump station.
4. **Midway (Gee Creek East) pump station and force main.** The project will construct new pump station and force main to relay Gee Creek pump station discharge to the Pioneer Canyon pump station.
5. **Pioneer Canyon pump station.** The project will implement phased improvements identified in the DCWTS Report to replace the existing pumps with 160 horsepower pumps and connect the pump station to the previously constructed parallel force main.
6. **Glenwood pump station.** Replacement pumps previously identified by the District will increase capacity sufficiently to convey the future peak flow. Force main improvements are not required to convey the increased flow.



7. **Legacy Pump Station force main.** The project will increase the size of the existing (currently inactive) 8-in force main to 12-in. This force main improvement, together with the 16-in force main, will provide enough additional capacity to the Legacy pump station, without upsizing the existing pumps.
8. **Neil Kimsey Regional pump station force main.** The project will construct a new-parallel 22-in force main, identified in the DCWTS Report, to increase Neil Kimsey pump station capacity.

Actual growth and development patterns may vary from future conditions as represented in the model. The District will monitor these portions of the system when the components may be stressed under future high flow events. The proposed capital projects on the 20-year CIP will need to be evaluated again in future years. Refer to Chapter 10 for more information about the CIP.



Wastewater Treatment Facility Capacities





This submersible sewer pump, which lifts raw sewage into a higher-elevation pipe in the collection system, uses a unique impeller to reduce clogging caused by disposable wipes

Wastewater Treatment Facility Capacities



8

8.1 Introduction

Treatment of wastewater in Clark County benefits from local cooperation and regional collaboration. Since the District does not own any wastewater treatment facilities, this Plan focuses only on the collection system. However, the District must include assumptions about wastewater treatment in its planning process. Similarly, the District's local partners have developed their own plans to provide uninterrupted treatment of current and future flows consistent with the projections in this Plan. As briefly described in Chapter 3, treatment and discharge of the District's wastewater flows is provided through partnerships with the Alliance at the RTP and the SCTP and with City of Vancouver at the VWTP. The portion of flow sent to these treatment facilities has varied only slightly over the last 2 years, as shown in Figure 8.1. The percentage of flow sent to each of these facilities over that time frame is:

- » 8.5% to 11.1% (average 10.0%) to the VWTP
- » 84.5 % to 88.6% (average 85.8%) to the SCTP
- » 3.0% to 6.1% (average 4.2%) to the RTP

Flows from the RUGA are collected and treated at either the RTP or the SCTP. Phase 1 of the DCWTS project was brought on-line in 2016, conveying a portion of flow from the RUGA to SCTP. Consistent with the Ridgefield Flow Diversion plan, all flows from Ridgefield will be redirected to the SCTP by 2036. Several capital projects must occur in sequence to ultimately decommission the RTP and redirect all flows to SCTP. This sequence is presented in Chapter 10 as part of the 20-Year CIP. The CIP allows for flows to be managed at RTP, within current permit limits, while segments of the RUGA are incrementally re-routed to SCTP to accommodate growth. Therefore, the RTP is not discussed further in this chapter.

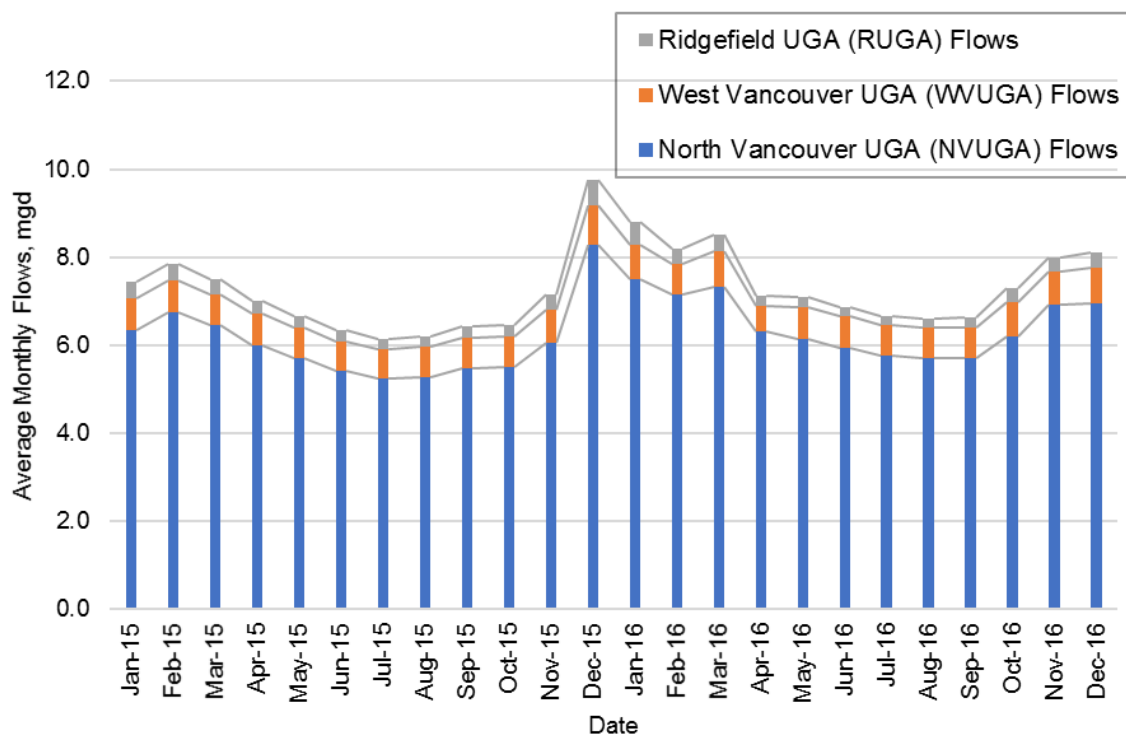
8.2 Salmon Creek Wastewater Treatment Plant



The Alliance contracted with CH2M Hill Engineers to evaluate the capacity of the SCTP and to identify improvements needed to receive future flows. The *2004 Wastewater Facility Plan / General Sewer Plan* was amended in 2013 to address identified expansion projects. The amendment was reviewed and approved by Ecology.

Phases 5 through 9 of a series of phased capacity expansions is planned to provide adequate capacity for the 20-year planning period. The Alliance has sole responsibility to advance these phased projects as needed, which will ultimately provide for MMF capacity of 30.70 mgd. Projects will be implemented and scheduled in concert with Ecology.

FIGURE 8.1
Summary of Distribution of Flows



8.3 Vancouver Westside Wastewater Treatment Plant

The forecasted flows for the VWTP, as shown in the *City of Vancouver General Sewer Plan*, are presented in Table 8-1.

The VWTP was constructed in 1948 and was upgraded to 12.0 mgd in 1974. The facility was improved in 1984 and in 2000. These improvements increased capacity to a MMF of 28.3 mgd. This is well within the projected MMF of 17.04 mgd in the year 2030. Assuming linear growth between 2030 and 2036, projected 2036 MMF would be less than 18.5 mgd, which is far below plant capacity.

The interlocal agreement between the District and the City of Vancouver allows the District to convey up to an annual average of 1.0 mgd (3.0 mgd PHF) to the VWTP. The District's flow allowance can be expanded to 1.5 mgd annual average and 4.5 mgd PHF by mutual consent of management from both agencies.

In evaluating the District's conveyance system capacity (see Chapter 7), consideration was given to diverting additional flows from the District to City. Staff from both agencies met to discuss the idea. If capacity of the District conveyance system leading to SCTP had been inadequate, near the City system, and capital costs could be avoided, a diversion may have been feasible. However, the District's system had adequate capacity, and the diversion was not necessary.

TABLE 8-1

VWTP Future Loadings

YEAR	MMF (MGD)	MAXIMUM MONTH BOD ⁽¹⁾ (MILLIGRAMS PER LITER, (MG/L))	MAXIMUM MONTH TSS ⁽²⁾ (MG/L)
2010	12.82	45,478	38,935
2011	13.03	46,138	39,500
2012	13.24	46,797	40,065
2013	13.45	47,457	40,629
2014	13.67	48,116	41,194
2015	13.88	48,776	41,759
2016	14.09	49,436	42,323
2017	14.30	50,095	42,888
2018	14.51	50,755	43,453
2019	14.72	51,415	44,018
2020	14.93	52,074	44,582
2021	15.14	52,734	45,147
2022	15.35	53,393	45,712
2023	15.57	54,053	46,276
2024	15.78	54,713	46,841
2025	15.99	55,372	47,406
2026	16.20	56,032	47,971
2027	16.41	56,692	48,535
2028	16.62	57,351	49,100
2029	16.83	58,011	49,665
2030	17.04	58,670	50,230

NOTES:

1. BOD is biological oxygen demand
2. TSS is total suspended solids

8.4 Treatment Plant Conclusions and Recommendations

Both the SCTP and the VWTP have adequate capacity to receive and treat the anticipated flows originating from the District's service area over the planning horizon. Using the results of the hydraulic model presented in Chapter 7, the predicted flows to both plants for the 3 scenarios – 2036, build-out and 2066 – are summarized in Table 8-2.



TABLE 8-2

SCTP and VWTP Future Projected Flows

	SCTP (MGD) ⁽¹⁾	VWTP (MGD) ⁽²⁾
2036⁽³⁾		
AAF, 25-year event	20.7	0.9
MMF, 25-year event	24.8	1.1
PDF, 25-year event	30.1	2.2
PHF, 25-year event	38.0 (44 ⁽⁵⁾)	3.9
BUILD-OUT⁽⁴⁾		
AAF, 25-year event	23.7	1.1
MMF, 25-year event	28.4	1.3
PDF, 25-year event	37.6	2.4
PHF, 25-year event	47.4 (55 ⁽⁵⁾)	4.2
2066⁽³⁾		
AAF, 25-year event	31.0	1.2
MMF, 25-year event	37.2	1.4
PDF, 25-year event	49.1	2.7
PHF, 25-year event	62 (72 ⁽⁵⁾)	4.6

NOTES:

1. Total projected flows include all Ridgefield and Battle Ground flows and assume future improvements made to the Alliance's 117th Street pump station.
2. Flows are only District-generated flows at the flume.
3. 2036 and 2066 PDF and PHF were developed with the hydraulic model. AAF and MMF were estimated using historical peaking factors.
4. Build-out values were approximated based on the population forecasts in Chapter 6.
5. Without Battle Ground flow equalization

8.5 Wastewater Reuse

Section 90.48.112 RCW requires consideration of reclaimed water in wastewater plans. Although the law does not specifically require implementation of a reclaimed water alternative, it strongly encourages it. Section 90.46.005 RCW states, in part, that to the extent that reclaimed water is appropriate for beneficial uses, it should be so used to preserve potable water for drinking purposes. This section assesses wastewater reuse regulatory requirements, potential use and demands, reclaimed water conveyance, and a brief economic analysis of reuse.

8.5.1 Regulatory Requirements

Beneficial use of reclaimed water for irrigation of crops, supplemental stream or wetland flow enhancement, groundwater recharge, toilet and urinal flushing, and similar uses requires treatment to reclamation and reuse standards. Reuse standards are more stringent than the conventional secondary standards for surface water disposal. Meeting the standards necessitates additional treatment facilities and requirements that could include effluent coagulation, filtration, additional disinfection, and improved redundancy and reliability.

The use of reclaimed water is permitted in Washington and is jointly regulated by the State Departments of Health (Division of Drinking Water) and Ecology. The specific language that addresses reclaimed water is found in Chapter 173-219 WAC. Under all reuse options, the proposal must demonstrate the beneficial uses being made of the reclaimed water. The rules categorize reclaimed water as Class A or Class B. Class A specifically includes membrane filtration in addition to traditional coagulation and filtration. Class B does not require filtration.

The most logical uses of reclaimed water are irrigation of golf courses and public parks, which are subject to human exposure and require treatment to Class A standards. In addition, the reclaimed water must be reliably generated. Emergency storage or alternative discharge options must be provided for upset conditions. The standards also require automatic alarms, treatment unit redundancy, and qualified operations staffing. Excess flow would continue to be discharged to the nearby surface waters.



8.5.2 Potential Uses and Demands

While wastewater reuse is becoming more common, the demand for year-round reclaimed effluent in the Pacific Northwest is limited. In assessing the potential use of Class A reclaimed water, sites were identified for irrigation and/or industrial, commercial, and public use. Irrigation can include parks, commercial nurseries, golf courses, and cemeteries. Industrial uses of reclaimed water can include boiler feed, cooling, process water, sewer flushing, and processing plant wash down. Though there are areas within the District that are zoned for industrial use, currently there are only 3 significant industrial users (SIUs). None of the SIUs use large volumes of water or would be good candidates for use of reclaimed wastewater. Thus, the main uses of reclaimed water would be irrigation of open access areas. The top 24 irrigation water users for the 2016 water year are presented in Table 8-3.

The volumes presented in Table 8-3 are estimated by taking the difference between the average summer water usage and the average winter water usage.

TABLE 8-3**Top Water Users Sorted by Irrigation Usage**

NO.	PROPERTY USE	2016 AVERAGE WINTER MONTH CONSUMPTION (CUBIC FEET (CF))	2016 AVERAGE SUMMER MONTH CONSUMPTION (CF)	AVERAGE MONTHLY IRRIGATIONAL USAGE (CF)
1	College Campus	28,900	425,367	396,467
2	Park	200	191,333	191,133
3	School	2,700	176,400	173,700
4	Medical Facility	224,233	394,467	170,233
5	Park	0	157,833	157,833
6	Multi-Family Residential	89,333	228,033	138,700
7	Park	1,033	113,600	112,567
8	Church	14,400	124,100	109,700
9	Intertie	3,933	98,733	94,800
10	School	18,767	109,333	90,567
11	Medical Facility	17,967	92,567	74,600
12	Multi-Family Residential	42,000	115,100	73,100
13	Multi-Family Residential	32,767	94,400	61,633
14	Public Facilities	1,300	60,667	59,367
15	Assisted Living Facility	21,200	77,500	56,300
16	Multi-Tenant Retail	267	54,400	54,133
17	Multi-Family Residential	68,733	122,467	53,733
18	School	0	51,767	51,767
19	Church	5,333	56,900	51,567
20	Commercial	26,367	76,967	50,600
21	Schools	6,033	53,667	47,633
22	Multi-Family Residential	11,700	58,800	47,100
23	Church	367	46,200	45,833
24	Public Facilities	9,700	51,767	42,067
TOTAL		627,233	3,032,367	2,405,133

Of the largest irrigation users, 8 are located within a 3-mile radius of the SCTP. Collectively, these users have an estimated monthly irrigation demand of 773,000 cf, or 5.8 million gallons. Assuming the irrigation demand is for a 5-month period from May to September, the total annual demand equals 3,865,000 cf, or 28.9 million

gallons. Experience has shown that reuse is not cost effective at distances greater than 3 miles. Additionally, in the District service area, extending the radius further would require the crossing of I-5, which is situated at or just beyond the 3-mile radius. The locations of the top irrigation water users are presented in Figure 8.2.

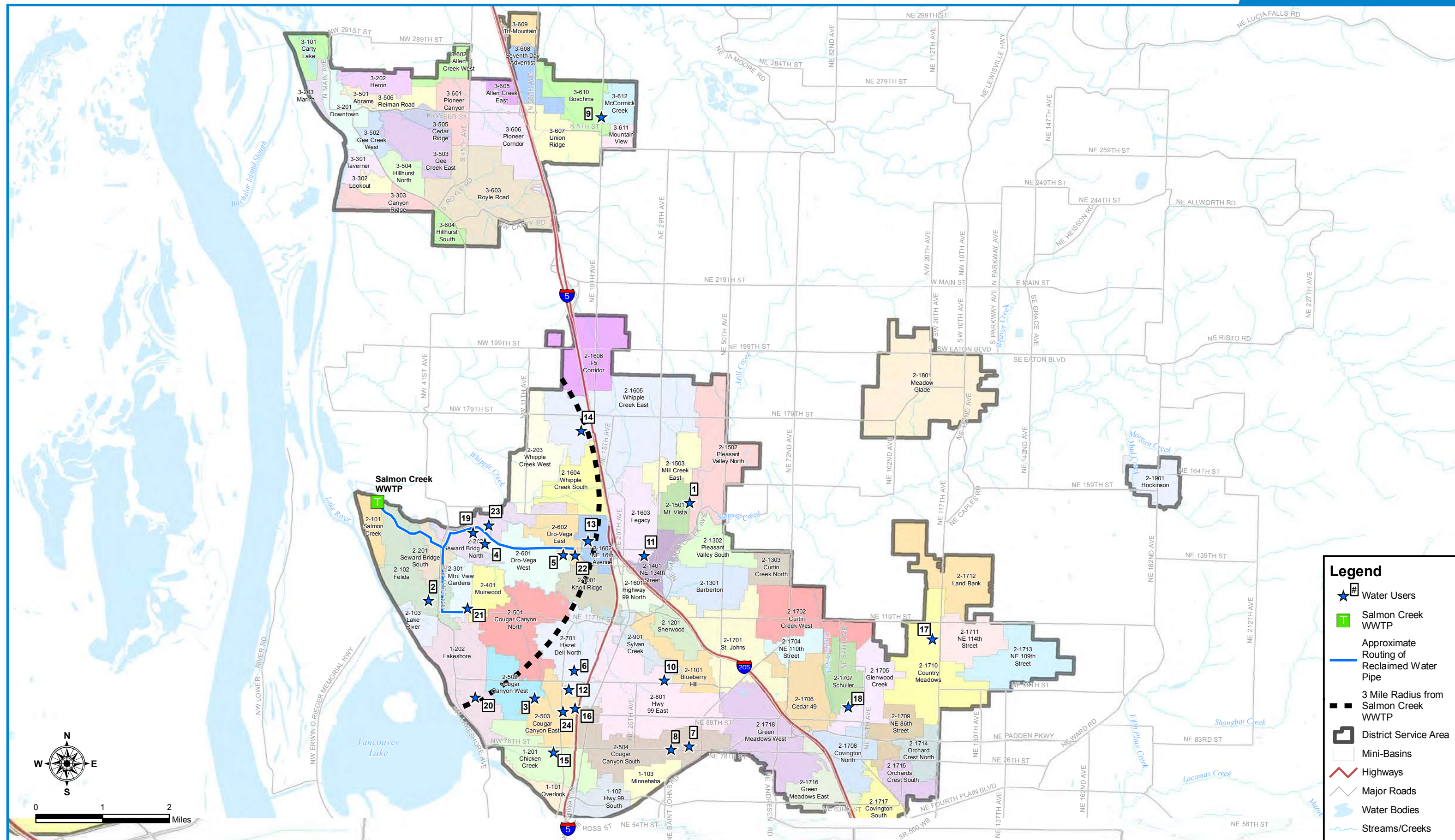


FIGURE 8.2
Potential Reclaim Water Users



Wastewater Treatment Facility Capacities





8.5.3 Reclaimed Water Treatment Facilities at SCTP

The SCTP would require additional facilities to reach the Class A reclaimed effluent standards. These improvements include:

- » Effluent filters
- » Coagulation
- » Flocculation

It is assumed that the reclaimed water would be pumped to off-site irrigation users and that no additional on-site storage would be provided. This information is provided for context only. The improvement projects identified in this Plan are limited to the District's collection and conveyance system and do not address improvements to the SCTP. The District does not own the SCTP, and all capital and operating decisions for SCTP are the responsibility of the Alliance.

8.5.4 Reclaimed Water Conveyance and Distribution

CONVEYANCE ALTERNATIVES

Conveyance of reclaimed water by pumping is the only feasible method. Truck hauling could be considered for other general uses, such as sewer flushing, street washing, dust control, roadside planter watering, and other similar uses, but the expected volume for these activities is small.

CONVEYANCE AND DISTRIBUTION FACILITIES

A clustering of 6 potential reuse customers are located north of Salmon Creek, and 2 potential users are located south of Salmon Creek (see Figure 8.2). A schematic routing of a distribution system from SCTP to the identified users was developed. Distribution to the 8 potential users would require approximately 25,500 feet of pipe, as follows:

- » Approximately 6,500 feet of 8-in diameter pipe from the SCTP to the north and south junction;
- » 12,200 feet of 6-in diameter pipe from the junction to serve the northern potential customers; and
- » 6,800 feet of 4-in diameter pipe to serve the southern customers.

8.5.5 Economic Analysis of Reuse

For economic analysis, a capital recovery factor of 0.0736 was assumed. The factor is based on 4% interest rate and 20-year project life. A summary of the economic analysis and the annual O&M costs associated with reclaimed water are presented in Tables 8-4 and 8-5, respectively.

TABLE 8-4

Reclaimed Water Economic Analysis Summary

Effluent Filters	\$400,000
Flocculation and Coagulation Equipment	500,000
Reclaimed water booster station	400,000
Conveyance (with restoration)	
8-inch: 6,500 lf @ \$120	780,000
6-inch: 12,200 lf @ \$110	1,350,000
4-inch: 6,800 lf @ \$100	680,000
Distribution and connection to irrigation systems	100,000
Subtotal	4,210,000
Contingencies @ 30%	1,260,000
Subtotal	5,470,000
State Sales Tax @ 8.4%	460,000
Total Construction	\$5,930,000
Engineering @ 15%	\$900,000
Construction Management @ 7%	420,000
District Administration @ 3%	180,000
Property/Easement Acquisition @ 5%	300,000
Total Capital	\$7,730,000
Amortized Annual Capital Cost	\$569,000

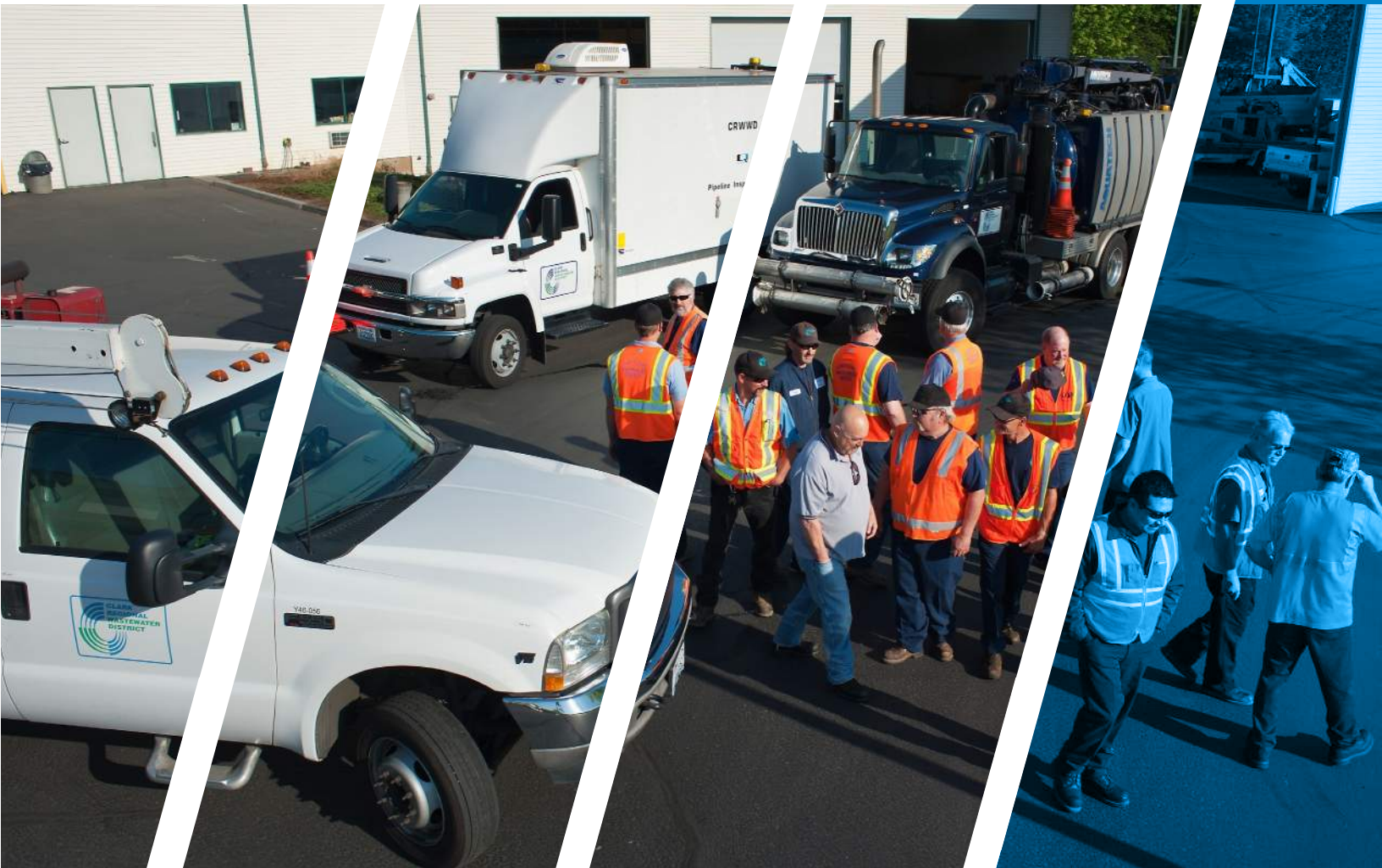
TABLE 8-5

Estimated Annual O&M Cost of Reclaimed Water Treatment and Conveyance

Treatment & Conveyance	
Chemicals	\$10,000
Electricity	3,000
Equipment maintenance and replacement	25,000
Labor	75,000
Total Annual O&M Cost	\$113,000
Annual Capital Cost	\$569,000
Total Annual Cost	\$682,000

The combined capital and operating costs for reclaimed water is estimated to be \$682,000 per year. The cost of purchasing an equivalent amount of potable water from Clark Public Utilities is \$114,000 (3,865,000 cf @ \$0.0295/cf). The cost of treating and conveying reclaimed water for irrigation use is significantly higher and is therefore deemed infeasible.





Operations & Maintenance Program





An operator can remotely inspect the condition of a sewer pipe using this wheeled digital closed-circuit TV inspection unit

Operations & Maintenance Program



9.1 District Management and Personnel

The District's General Manager is supported by an Assistant Manager and 4 department managers. The department managers report to the Assistant General Manager or directly to the General Manager, who is responsible for the overall District management. The General Manager reports to the elected Board of Commissioners, which currently consists of the following individuals:

- » Norm Harker
- » Denny Kiggins
- » Neil Kimsey

The District's 4 departments and associated managers are listed below:

- » Administration under the direction of the Board Clerk/Administrative Services Manager
- » Engineering under the direction of the District Engineer
- » Finance under the direction of the Finance Director/Treasurer
- » Operations and Maintenance under the direction of the Operations Manager

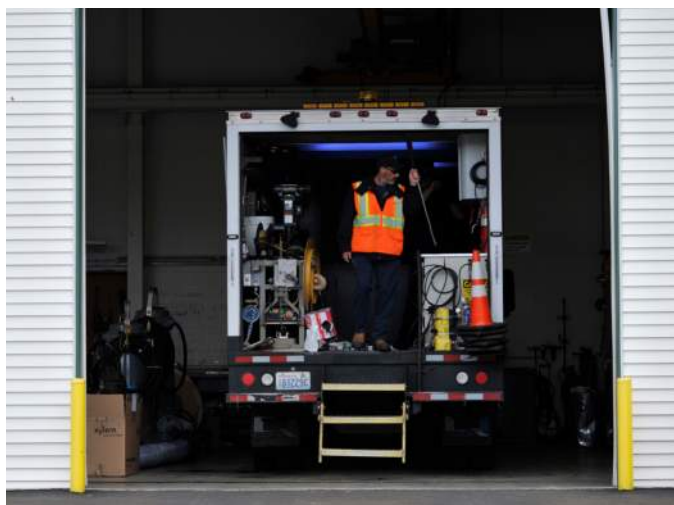
The District's organization chart is presented in Figure 9.1 on page 9-9.



9.1.1 Certification and Training

The District encourages its employees to obtain certification and training for skills relevant to operating and maintaining the sewer system. At a minimum, the District's Operations staff must have the following credentials:

- » A high school diploma or GED
- » A driver's license, if applicable
- » Washington Wastewater Collection Personnel Association – Level 1 certification



The District provides employees with opportunities for training and certification related to their job duties. Each employee receives training in his or her areas of expertise on an annual basis. Depending on the employee's function, training may include, but is not limited to, safety, record keeping, pump station electrical and instrumentation, pump station operation, public relations, fleet and equipment operations and emergency response. Training may be provided by any of the following methods:

- » Manufacturer training by various equipment suppliers and representatives
- » On-the-job training in the field, the shop, or in the office
- » Class room training, in-house or at regional training centers
- » Industry-wide training at conferences and seminars away from the District

To promote the career development of its employees, the District may elect to pay for annual certification fees, employee time and tuition for certification training courses, and tuition reimbursement for post-secondary education. The District also provides staff opportunities to receive the continuing education necessary to maintain certification.

9.2 O&M Activities and Programs

The District's operations and maintenance activities include preventive and corrective routines, procedures and wastewater related programs. District Resolution No. 1586 adopted a Level of Service Plan that was jointly developed with the City of Vancouver. The plan was subsequently incorporated into the interlocal agreement with the City of Ridgefield. The District has generally adopted the plan throughout its service area. The service plan identifies the minimum standards and schedules for the management, operation and maintenance of the collection system. The District regularly reviews actual performance against adopted standards. The O&M elements (categories 1, 2, and 3) are generally compliant or substantially compliant. Those few items that are in non-compliant status have been incorporated into the CIP (see Chapter 10).

9.2.1 Collection System Maintenance – Pump Stations

The District has a crew (2-FTE) that is responsible for pump station maintenance and incident response. The crew visits each station at least once a week. Those stations that have a higher consequence of failure are visited more frequently. Staff also conducts a virtual pump run test every weekday morning. All stations are equipped with supervisory control and data acquisition (SCADA) systems and telemetry to aid in status monitoring. All pump stations have either permanent onsite generators or portable fleet units. The onsite emergency generators are exercised, with load, at least once a week. Typically, the generators are exercised a minimum of 30 minutes. Wet wells that have frequent grease accumulation, which represents approximately half of the inventory, are washed down every month. The remaining wet wells are washed down as needed. Wet wells are observed and assessed weekly, and floating and settled materials are removed as needed.

9.2.2 Collection System Maintenance – Sanitary Sewers

The District regularly inspects mainline gravity sewers using closed circuit television (CCTV). In accordance with the Level of Service Plan, pipes installed after 1975 are on an 8-year CCTV inspection cycle. Therefore, approximately 12% of the system is inspected each year. Pipes installed prior to 1975 are cleaned on a 3 to 5-year cycle, which accounts for a small portion of the existing sewers. District staff review digital records of the inspections and prepare condition reports to record any deficiencies. The Engineering Department reviews condition reports and identifies corrective measures (e.g. repair, slip lining or replacement) where necessary. Deficient lines are logged and tracked in the District's O&M tracking software. Some pipes require more frequent maintenance and are generally referred to as a "hot spot." The hot spot pipes require flushing either quarterly or annually. Where possible, these chronic sewer collection problems will be resolved by identifying the solution as a potential project in the CIP. Until the pipes are repaired, they will remain on the hot spot list, receiving more frequent cleaning.

District staff is also alert to the potential for odor concerns, though odor complaints in the collection system are infrequent. Systematic monitoring of hydrogen sulfide (H₂S) and remote monitoring/dosing using calcium nitrate have been implemented across the District as needed. The District reviews odor complaints on a quarterly basis. As needed, manhole dishes/canisters are installed.

9.3 Pretreatment Program

Chapter 5.52 of the District's Code outlines the purpose and scope of its pretreatment program. The pretreatment program is intended to prevent District users from discharging pollutants and inappropriate materials into the collection and conveyance system that may interfere with wastewater treatment operations, reduce quality of treatment and impact disposal of byproducts such as sludge. The District administers the required industrial pretreatment program for SCTP and RTP on behalf of the Alliance. The District's duties include monitoring and surveying industrial waste users and submitting annual reports to Ecology about its pretreatment activities in the NVUGA pursuant to National Pollutant Discharge Elimination System (NPDES) Permit No. WA-002363-9, paragraph S6.A.4, regulating discharges from the SCTP.

The District has an interlocal pretreatment agreement with City of Vancouver. For parcels in the Westside Service Area, the District administers its pretreatment program in accordance with the City's delegated pretreatment program requirements. Copies of the interlocal agreements are presented in Appendix F.

9.3.1 Fats, Oils, Grease and Grit (FOGG)

The District continues to implement the fats, oils, grease and grit (FOGG) program to control FOGG discharged to the system. Pretreatment staff works diligently with all food service establishments (FSEs) to promote good practices to achieve compliance. FSE survey efforts were continued in 2016, and the District conducted 379 FOGG inspections. That year, 71 re-inspections were required due to failure to meet District standards, an 18.7% re-inspection rate. The rate of re-inspection increased in 2016 compared to prior years. The increase was likely driven by the more frequent use of CCTV to monitor FOGG "hot spots." FSE data, including survey and inspection history, is maintained in a computerized maintenance management system (cMMS).

By interlocal agreement, the District also conducts a FOGG program in the City of Battle Ground.



9.3.2 Pretreatment Program Outreach

The pretreatment program focuses on non-residential users that discharge into the District's system. However, residential outreach associated primarily with the FOGG program is also included. The District participates in multiple public education and outreach campaigns. Public education and outreach efforts include a newsletter, the Freeze the Grease program, online outreach and community events. The newsletter focuses on pollution prevention habits that are formed at home.

9.3.3 Industrial Users

The District performs inspections and monitoring activities on 4 significant industrial users (SIUs) and 4 minor industrial users (MIUs). Continuous surveying of new businesses is conducted throughout the year. During 2016, 4 SIUs discharged to the SCTP: 3 were in the District and 1 within the City of Battle Ground. All 3 SIUs located in the District are categorical industrial users under Title 40 code of federal regulations (CFR):

1. Metal finishing (40 CFR 433)
2. Electrical and electronics components (40 CFR 469)

A list of industrial users is presented in Appendix L.

9.4 Sewage Spill Response Plan

Emergency responses to reported sewage spills in the collection system are reported immediately to the Operations Manager. The District's on-call roster responds to incidents 24 hours a day, 7 days per week.

Sanitary Sewer Overflows (SSOs) caused by blockages or malfunction of District-owned infrastructure that result in a discharge to waters of United States are reported to the EPA within 24 hours, and a written report is submitted to EPA and Ecology within 5 days.



9.5 Capacity, Management, Operations and Maintenance (CMOM)

The EPA has issued draft regulations associated with the CMOM program. In accordance with CMOM the District develops facility maintenance plans, tracks asset condition and establishes goals for level of service and performance. The District conducts regular self-assessments against the CMOM standards to assure compliance. Four key components are outlined below:

3. CAPACITY ASSURANCE PLAN

- » Evaluate existing system
- » Identify capacity deficiencies
- » Establish short and long-term remedies to capacity deficiencies

4. MANAGEMENT PROGRAM

- » Specify program goals
- » Establish organizational structure
- » Legal authority (e.g. service agreements) to manage flow

- » Establish program measures and ranking of O&M activities based on current capacity and structural deficiencies
- » Audit documentation of changes in system condition and performance
- » Establish standards and requirements for new construction as well as rehabilitation and repair

5. OVERFLOW RESPONSE PLAN

- » Steps to respond to SSOs and to implement response plan

6. AUDIT OPERATIONS AND MAINTENANCE PERFORMANCE

- » Initial assessment of O&M activities
- » Establish performance goals, measures and priorities
- » Perform periodic audits to identify progress and required revisions to the program

The District uses an asset management software, Lucy, to manage its sewer assets and to schedule maintenance activities.

9.5.1 Flow Monitoring

The District owns more than a dozen temporary flow meters. The meters are periodically moved to 23 separate locations throughout the collection system. Flow meters are typically installed at between 3 to 8 locations at any time, and they remain in place for periods ranging from 3 weeks to 32 months. Meters are moved seasonally, with the intention of capturing at least 2 weeks of data at each location during both dry and wet weather conditions. By rotating the meters periodically through key locations in the collection system, the District can characterize increases over time in upstream sanitary flow and related ERUs. The meters are also valuable for characterizing diurnal variations in sanitary flow during wet weather, the I/I response to rainfall, and potential areas of concern.

The Alliance maintains permanent flow meters at the SCTP and headworks. The District maintains permanent meters at the Parshall flume discharge to City of Vancouver and at both Meadow Glade and Hockinson discharges into City of Battle Ground. Permanent meters are monitored using SCADA. Select pump stations also have meters on the discharge line.

Flow data from the December 2015 design storm event was limited to the selected meters. This was due to either unreliable or missing data, or because flow meters were not in place to capture the storm event since they were in the process of being moved to new locations. Considering these and other factors, recommendations to enhance the program are as follows:

- » Maintain a minimum of 6 flow meters in place at a time.
- » Meters should remain in place for longer periods of time (4-8 weeks).
- » Place meters at same location for both periods of dry weather and wet weather.
- » Check flow meter calibration at regular intervals as recommended by manufacturer.
- » Install Parshall flumes at several locations in the collection systems (see Figure 9.2). If Parshall flumes are not feasible, install permanent flow meters.





9.6 Water Quality Management Plan

The Clean Water Act established a program for maintaining the quality of the waters of the United States. When a water body in Washington State is impaired by pollutants, a limitation on identified pollutants, called a Total Maximum Daily Load (TMDL), is prepared by Ecology. A TMDL includes a requirement

for a Water Quality Management Plan. The District does not own or operate any facilities that discharge to the Columbia River; therefore, the District does not specifically address water quality. However, this Plan is consistent with the intended objectives of maintaining water quality in the Columbia River.

9.7 Management System / Record Keeping

The District maintains an ongoing record of collection system assets, including as-built data. A GIS database includes records of pipe age, size and material, invert and rim elevations, slopes, and manhole identifiers. O&M activities are tracked using Lucity, allowing the

District to chronicle maintenance measures, evaluate performance and track real time tasks and data. The GIS data and the Lucity interface provide maintenance history, incident reports, records of sewer backup events and records of surcharging manholes.

9.8 Sewer Collection Department Staffing Needs

The District employs 55.5 full-time equivalent (FTE) employees. Of these, 14 FTE are dedicated to operation and maintenance of the system, including 7 assigned to the collection and conveyance system and 7 assigned to pump station/force main facilities. To evaluate the District's staffing level relative to programs of similar scale in western Washington, O&M staffing was compared to the City of Lacey; Southwest Suburban Sewer District (SSWD) in Burien, WA; and the Alderwood Water and Wastewater District (AWWD) in Lynnwood, WA. The comparison is presented in Table 9-1.

The District has comparable or slightly higher staffing levels than the other wastewater service providers. Economy of scale normally suggests that agencies with smaller systems and fewer linear feet of pipe typically would have a higher ratio of personnel to pipe length. Other variables, however, can have a substantive impact on staffing needs. These include the numbers of pump stations and STEP systems, both of which increase staffing needs. This is evidenced clearly with the data.



TABLE 9-1
O&M Staffing Comparison

AGENCY	PUMP STATIONS	CURRENT STAFF	LENGTH PIPE (LF)	FTE / 100,000 LF
CITY OF LACEY*	47	6	898,000	0.67
SOUTHWEST SUBURBAN SEWER DISTRICT	11	6	1,219,000	0.49
ALDERWOOD WATER AND WASTEWATER DISTRICT	14	10	1,942,900	0.50
DISTRICT*	67	14	1,971,700	0.71

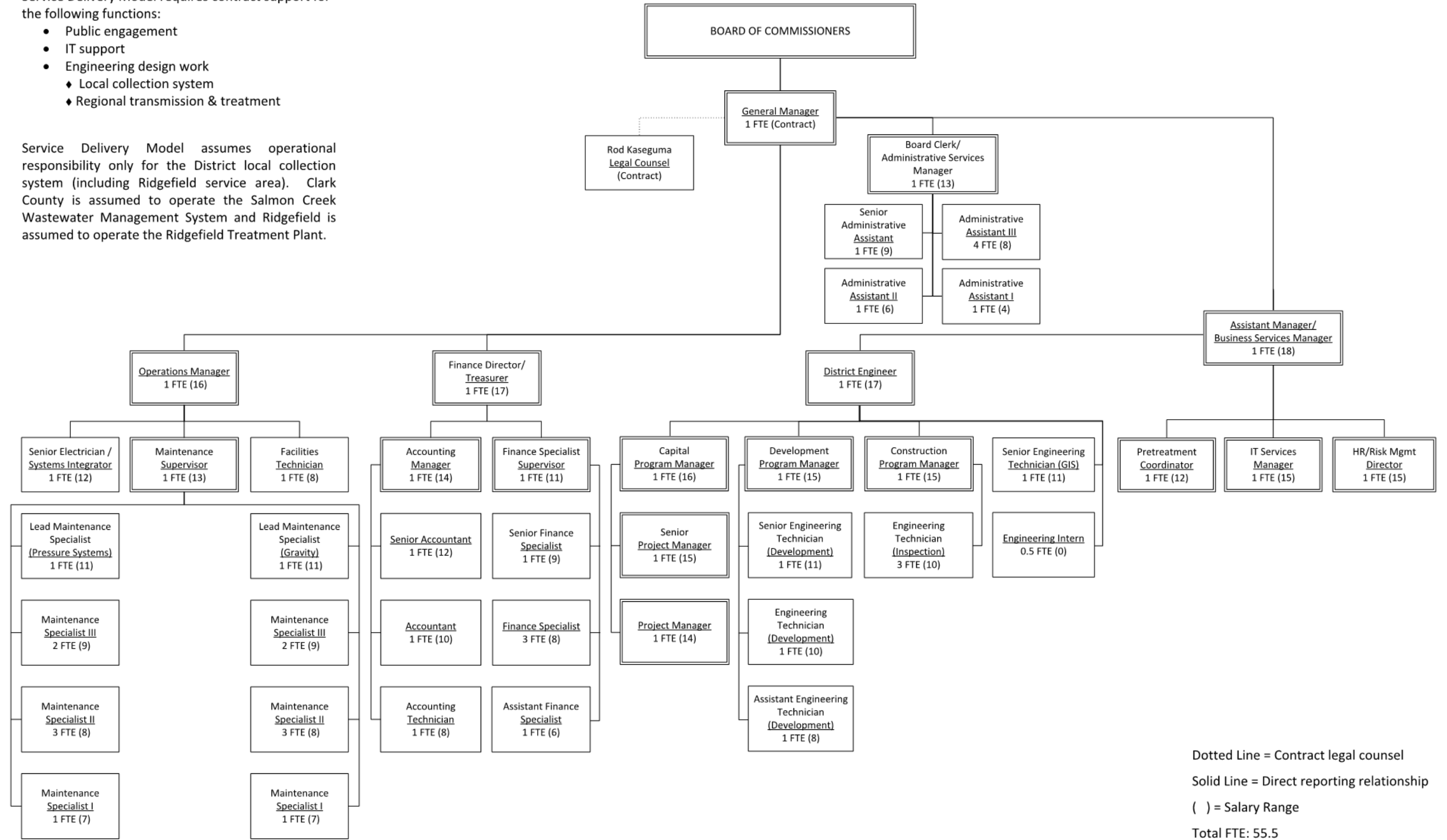
*Substantial STEP systems

CLARK REGIONAL WASTEWATER DISTRICT
ORGANIZATION CHART:
ADOPTED BY RESOLUTION #1713

Service Delivery Model requires contract support for the following functions:

- Public engagement
- IT support
- Engineering design work
 - ◆ Local collection system
 - ◆ Regional transmission & treatment

Service Delivery Model assumes operational responsibility only for the District local collection system (including Ridgefield service area). Clark County is assumed to operate the Salmon Creek Wastewater Management System and Ridgefield is assumed to operate the Ridgefield Treatment Plant.



Dotted Line = Contract legal counsel
Solid Line = Direct reporting relationship
() = Salary Range
Total FTE: 55.5

FIGURE 9.1
Organization Chart



Comprehensive Plan & Capital Improvements





The fog machine introduces smoke into underground conveyance systems to help investigators identify leaks, damage and cross-connections to other pipe systems

Comprehensive Plan & Capital Improvements



10

10.1 Introduction

This chapter presents the District’s anticipated capital improvements for the twenty-year planning horizon. The Capital Improvement Program (CIP) is compiled from specific projects, capital improvements, and programs the District has or will implement to maintain its ability to serve current and future customers.

Proposed projects are derived primarily from the system capacity analysis, construction projects already planned and scheduled, extensions of service to undeveloped areas and projects suggested by District operations and engineering staff based on system knowledge.

Other non-project recommendations can be found throughout the preceding chapters. Projects in the CIP are categorized as either restoration and replacement (R&R) projects or as capital projects. These categories are explained further below.

The project profile of each capital and R&R project is included in Appendix O. The ultimate service plan for the collection system is shown on the mini-basin maps in Appendix A. The mapping identifies each proposed capital and R&R project and schematically shows future local extensions of sewer. The local sewer extensions are funded solely by private development and are not included in the CIP. A CIP summary table is presented in Appendix C.



10.1.1 Restoration and Replacement (R&R)

R&R projects are those construction projects that address improvements to the existing collection system. These are commonly related to operations and maintenance (O&M), poor condition or obsolescence of existing infrastructure. These project categories are described further below.

OPERATIONS & MAINTENANCE (O&M)

An O&M project addresses a recurring maintenance issue that can be solved with a construction project. For example, a pipe segment that is chronically occluded by grease build up might be rectified by improving the flow characteristics, improving the slope of the pipe or changing the pipe material from concrete to PVC. Staff identify facilities that have unacceptably high maintenance requirements, both in terms of frequency and in magnitude. It is understood that some O&M problems cannot be solved with a capital project and simply require continued vigilance.

CONDITION

Condition projects address infrastructure that has a known deficiency or an integrity issue. The District has very good working knowledge of its collection system. Routine maintenance and assessment of sewers provides an ongoing process to identify and document any deficiencies, which forms the basis for this element of R&R. Known areas of root intrusion, damaged and cracked piping systems, protruding taps and localized bellies are included in this category.

OBSOLESCENCE

Obsolescence projects address mechanical and electrical infrastructure that is approaching the end of its expected life. Modern pipes are expected to have a typical usable life of 100 years. Useful life for pump systems, however, can be considerably less. Consistent with the Pump Station Condition/Criticality Assessments, the following usable life spans have been assigned to various pump station components:

- » Control elements – 10 years
- » Electrical and odor control – 15 years
- » Mechanical – 20 years
- » Structures and site improvements – 75 years

As infrastructure components approach their useful lives, the District plans to replace them.



10.1.2 Capital Projects

Capital projects are those construction projects that, in general, address the system improvements which are necessary to accommodate growth. Capital projects can be further categorized as capacity or expansion related projects, as described further below.

CAPACITY

Capacity projects address infrastructure that needs to be upsized as a result of population growth and the associated increase in flow. Capacity improvements are proposed when infrastructure cannot effectively convey the incoming flow, consistent with the District's policies (see Appendix H). Any forecasted capacity deficiencies are identified as part of the hydraulic modeling analysis discussed in Chapter 7.

Given the expected 75-year to 100-year lifespans of structures and pipes, proposed capacity improvement projects are sized using flows forecasted to occur in 2036 and 2066. Following identification of system deficiencies, the computer model is used to evaluate and select system improvements to alleviate system deficiencies.

EXPANSION

Expansion projects address the need for new infrastructure to extend service to undeveloped areas. A significant portion of the forecasted population growth (see Chapter 6) will be accommodated by development of otherwise undeveloped areas, mostly in the outer basins of the District service area. In order for population to expand into currently unserved locations, the collection system must be extended. As shown on the maps in Appendix A, extension of the system will consist of local sewers and general facilities (e.g. trunk sewers and permanent pump stations). Expansion projects are identified whenever a general facility is necessary to extend sewer service to those undeveloped areas. Cost-sharing for general facilities is administered consistent with the policy presented in Chapter 4. The estimated cost for each general facilities project and the allocation of the costs between private developers and the District are shown in the CIP summary table presented in Appendix C.

The majority of sewer extensions into unserved areas are carried out and paid for privately, concurrent with new development. This is consistent with the philosophy of growth paying its own way. With approximately 4,000 lf of main line gravity sewers constructed for every 100 ERUs, most of the investment in the expansion of the collection system will ultimately be funded privately. A portion of the local extensions of sewer is shown in Appendix A as necessary to support the capacity analysis (see Chapter 7) and to assure the feasibility of service within each mini-basin. These extensions should be considered preliminary and are not part of the CIP.

10.1.3 Ridgefield Flow Diversion Plan

As described in Chapter 2, the District and the Alliance are planning to direct all RUGA flows to the SCTP by 2036. The plan for doing so drives several key projects in the RUGA over the 20-year period. The ultimate decommissioning of the RTP relies on several interdependent sequential projects. The plan for redirecting flows is incremental with growth, such that RTP capacity is adequate within current permit limits without the need for expansion. The Ridgefield Flow Diversion Plan projects are only a portion of the CIP in the RUGA. Some of these projects are not critically dependent on the completion of earlier of projects, but all are ultimately needed to complete the flow redirection.

The general sequencing of critical Ridgefield Flow Diversion projects is as follows:

1. Royle Road pump station and force main (constructed in 2017). Capacity upgrades will be necessary to accommodate subsequent development.
2. Royle Road trunk
3. Redirection of the pump stations from the Hillhurst area to the Royle Road pump station
4. Modification to the Pioneer Canyon pump station to accommodate additional flows
5. Construction of the Gee Creek East (aka Midway) pump station and force main
6. Modifications to the Gee Creek pump station and new force main to Midway
7. Modifications and capacity expansion of the Marina pump station, force main and trunk line extension from RTP

The locations and sequencing of the flow diversion projects are presented in Figure 10.1.

Other downstream improvements necessary to receive and convey flows from the RUGA were originally identified in the DCWTS Report. These improvements were studied as part of the 2036 capacity analysis (see Chapter 7). The timing of the improvements has been modified in the CIP, as warranted based upon population and flow forecasts in this Plan. Some of the projects identified in the original DCWTS Report were not warranted in the 20-year planning horizon. However, those projects that were needed to support planned flows have been incorporated into the CIP.



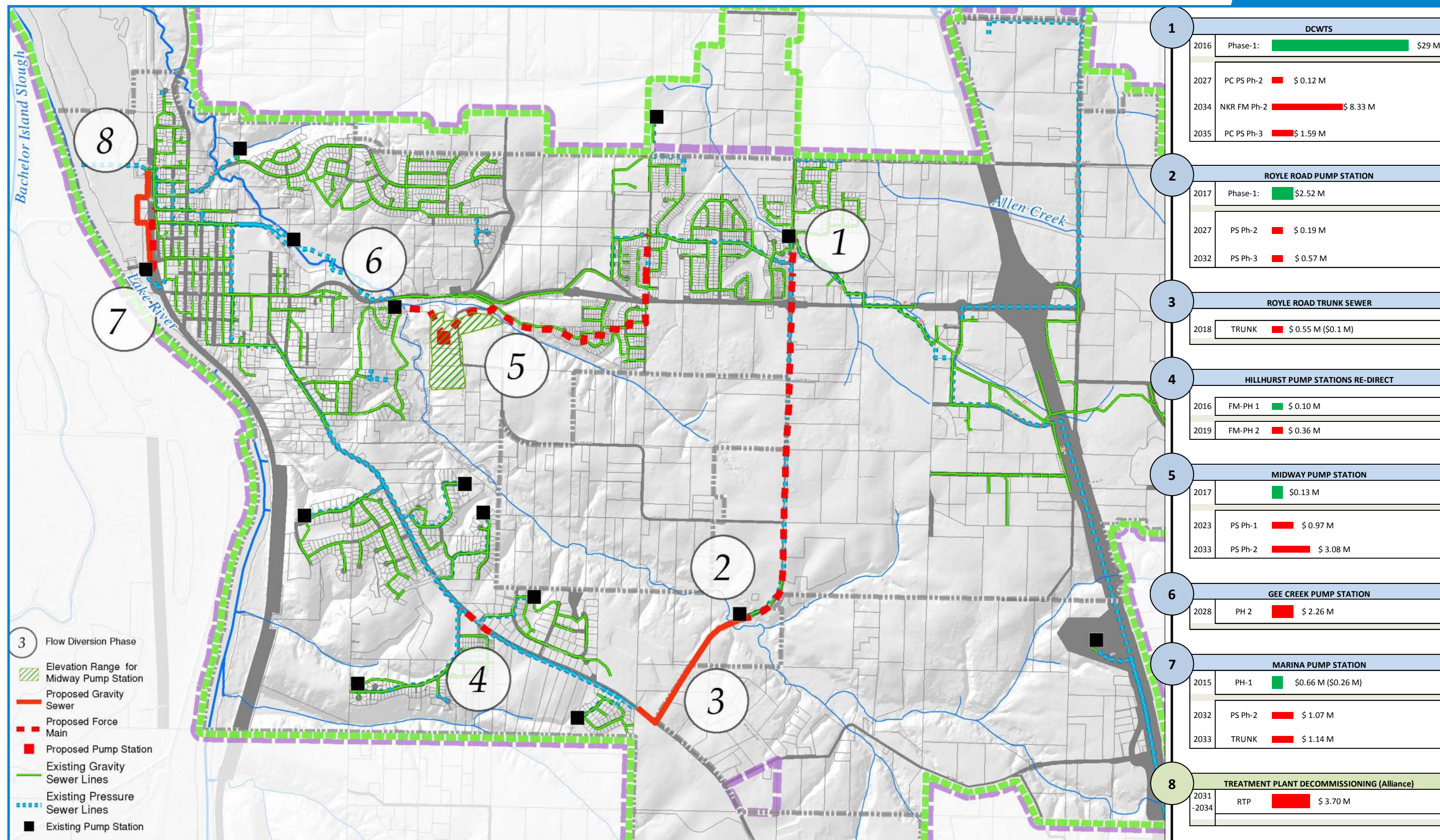


FIGURE 10.1
Ridgfield Flow Diversion

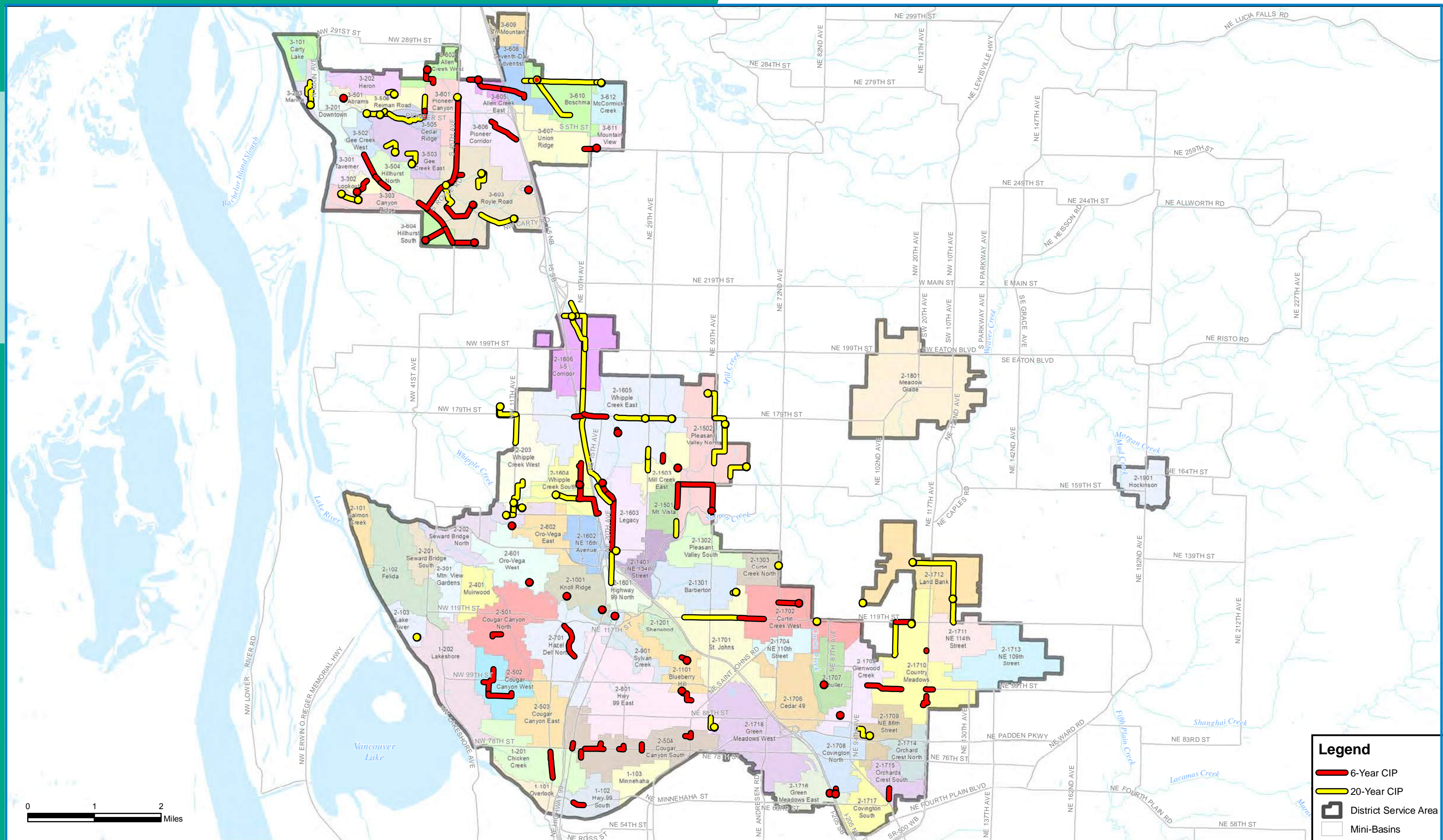


FIGURE 10.2
Capital Improvement Program Map

10.2 CIP Summary

This Plan presents both a 6-year and a 20-year CIP. The District annually adopts a 6-year CIP and performs a 6-year financial analysis (see Chapter 11). The 6-year CIP contains both those projects already identified to resolve current deficiencies and the highest priority projects identified in the 2036 capacity analysis. Projects on the 20-year CIP often will need to be reevaluated as they approach the annual CIP. When possible, projects are coordinated with other utilities to minimize disruption to the public and reduce associated costs such as road and surface restoration. The 6-year and 20-year CIPs each are illustrated in Figure 10.2. Projects in the 6-year CIP are depicted in red and projects in the 20-year CIP are depicted in yellow.

The 6-year CIP for the period of 2017 to 2022 includes a total of approximately \$47.1 million, including both R&R projects and capital projects. Over the 20-year planning horizon, the District has identified an additional \$100.12 million, for a grand total of \$147.22 million of investment by 2036. The 6-year and 20-year CIPs are summarized in Table 10-1 and Figure 10.3. Figure 10.4 shows the distribution of CIP investment over the District's service area by mini-basin. In general, the distribution of investment largely mirrors the allocation of forecasted growth represented in Figure 6.3. The largest investments in capital are related to capacity and expansion of the system and coincide with the highest growth areas, generally near the fairgrounds and in Ridgefield.

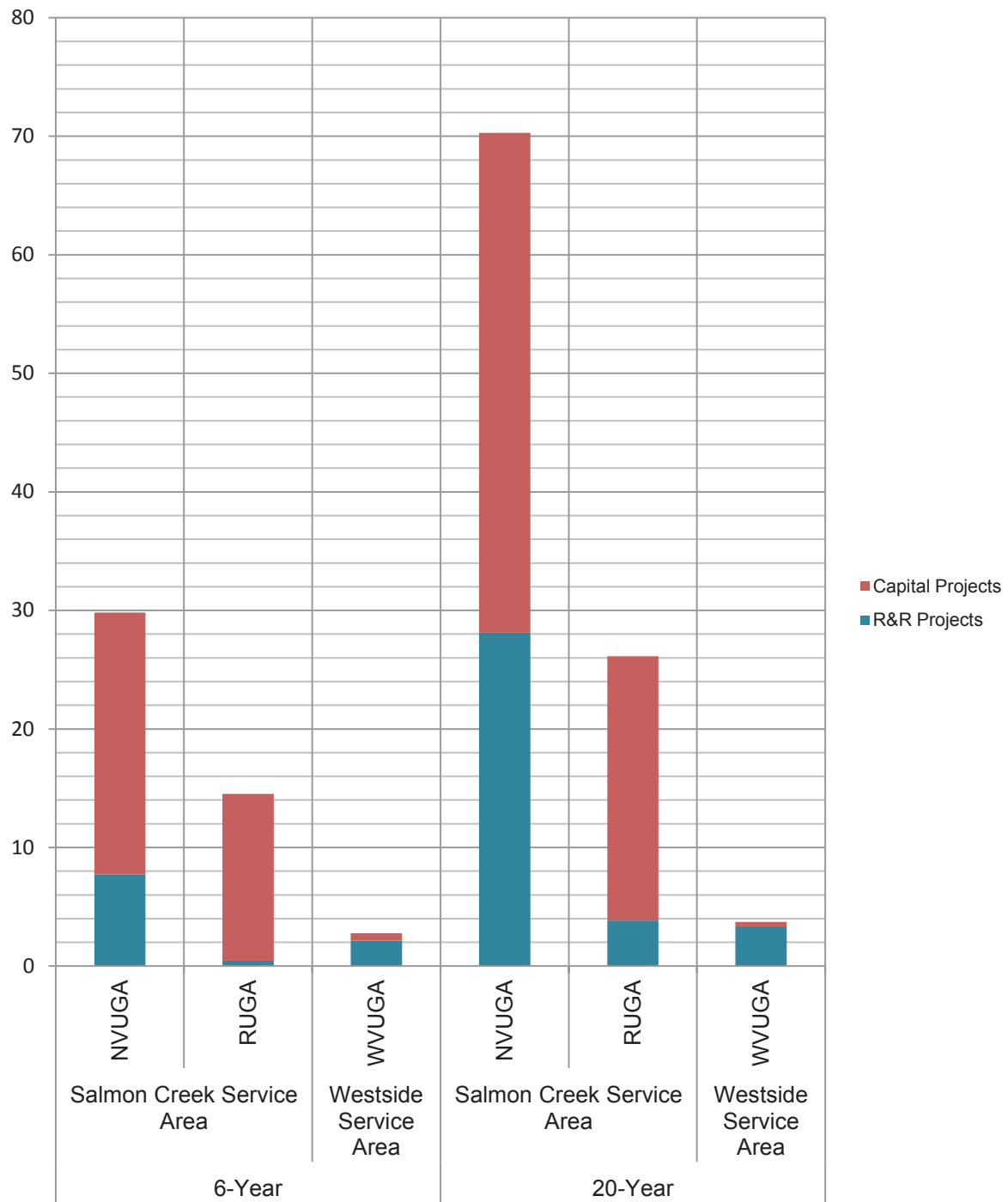
TABLE 10-1
CIP Summary

	(MILLIONS OF \$)		
	R&R PROJECTS	CAPITAL PROJECTS	GRAND TOTAL
6-YEAR CIP (2017-2022)	10.34	36.76	47.10
Salmon Creek Service Area	8.19	36.13	44.32
NVUGA	7.73	22.08	29.81
RUGA	0.46	14.05	14.51
Westside Service Area (WVUGA)	2.15	0.63	2.78
20-YEAR CIP (2036)	35.32	64.80	100.12
Salmon Creek Service Area	31.97	64.44	96.41
NVUGA	28.13	42.15	70.28
RUGA	3.84	22.29	26.13
Westside Service Area (WVUGA)	3.35	0.36	3.71
GRAND TOTAL	45.66	101.56	147.22



FIGURE 10.3

CIP Summary Chart



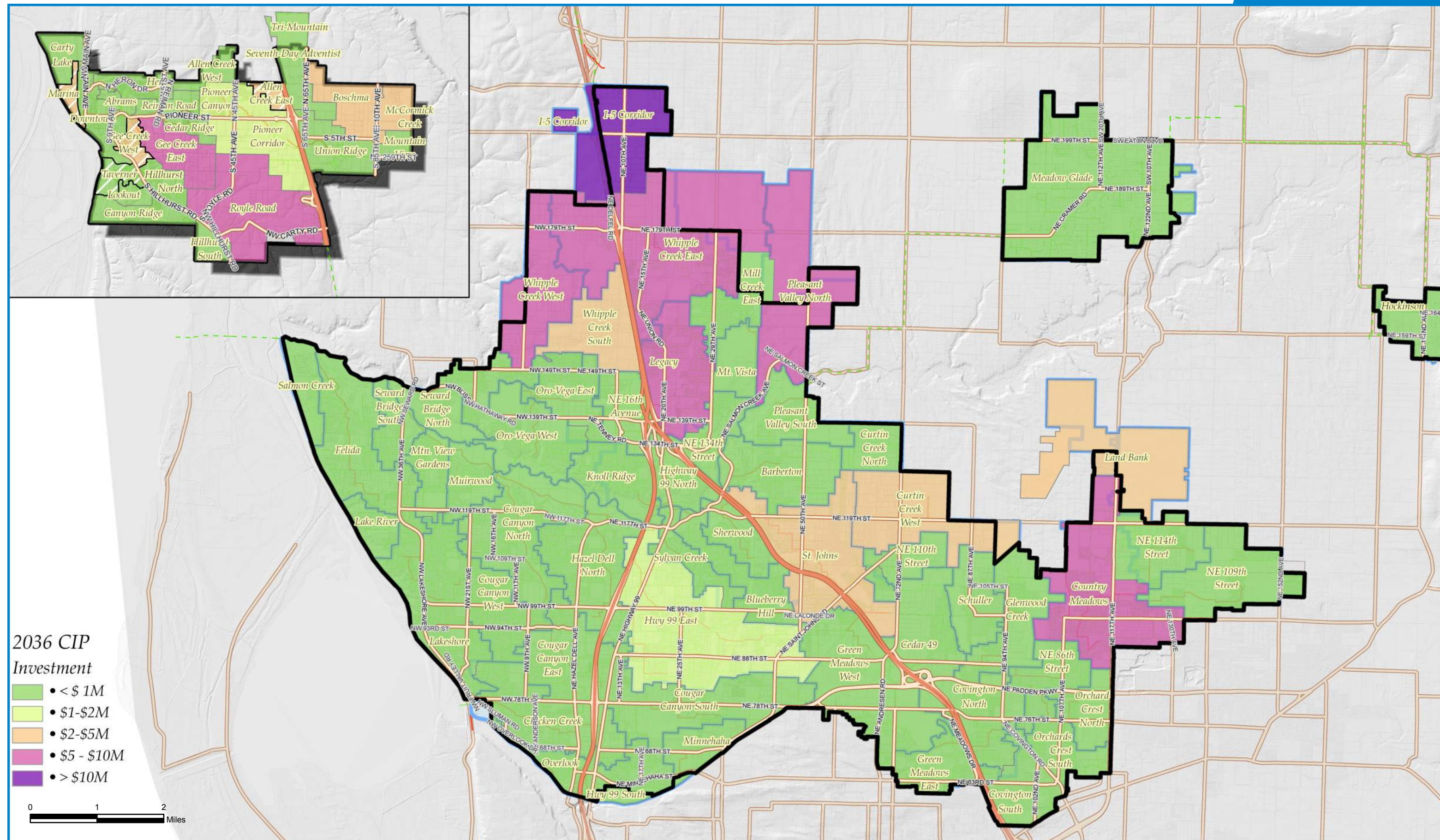


FIGURE 10.4
2036 CIP Distribution



Comprehensive Plan & Capital Improvements

10.3 Basis for Cost Estimates

Construction cost estimates have been prepared for most of the projects in the CIP. Documentation for these estimates is presented in Appendix O. In general, projects in the 6-year CIP are estimated at a level 4 (-30%/+50%), whereas projects in the 20-year CIP are estimated at a level 5 (-50%/+100%). This is consistent with the level of project definition for each CIP.

Costs for those projects that do not have supporting cost estimates are based on 1 of the following:

- » Actual bid amounts;
- » Detailed cost estimating done during the design phases; or
- » Cost allocations for ongoing programs.

Assumptions about quantities and unit prices are presented below. Quantities are estimated for each item and unit prices are estimated from recent bid results. An estimated construction cost is developed for each project including contingencies and sales tax. Total project costs are then estimated for each project, using 2017 dollars. Cost estimates do not include replacement of emergency generators, replacement of valves, odor control measures, motor operated valves or redundant force mains.

10.3.1 Construction Estimates- Assumptions

The construction cost estimates in Appendix O are based on the following assumptions:

- » Mobilization at 10% of the construction costs
- » Traffic control at 2% of hard asset costs
- » Dewatering estimated at a lump sum of \$20,000, where applicable
- » Sheeting, shoring and bracing estimated at \$10/lf
- » Pavement is limited to a trench width of 6 ft, plus an allowance of 1 ft on both sides of the trench, for a total width of 8 ft
- » Temporary sewer bypass estimated to be \$5,000 for each required bypass

- » Imported trench backfill - 50% of all excavations will require imported material, average trench width is 4 ft and average depth is 8 ft
- » General restoration at 2% of the hard asset costs
- » Temporary erosion and sediment control at 4% of the hard asset costs
- » Crushed surfacing base and top course at a total of 1 ft deep and a maximum pay width of 6 ft
- » Hot mix asphalt paving at a maximum thickness of 4 in and a maximum pay width of 8 ft for the entire length of all mainline sewers in right-of-way
- » A manhole for every 300 ft of gravity sewer
- » A lateral for every 100 ft of gravity sewer
- » Pump station rehabilitation includes no excavation; increase in the capacity is accomplished with pump and motor changes, and electrical revisions.

10.3.2 Allied and Other Costs – Assumptions

The allied and other costs in the construction cost estimates in Appendix O are based on the following assumptions:

- » 30% contingency to address the pre-design level of cost estimating
- » 8.4% State sales tax
- » 15% of the estimated construction cost is for engineering design, survey, and permits
- » 7% of the estimated construction cost is for construction services
- » 3% of the estimated construction cost is for District administration and legal costs
- » 5% of the estimated construction cost is for property/easement acquisition, where applicable

10.4 2036 Schematic Flow Routing

In Chapter 5, schematic drawings are presented in Figures 5.2, 5.3 and 5.4 representing general system architecture and current flow routing within each of the service areas. Current routing is used to model the conveyance system for 2016 peak flow conditions, as described in Chapter 7. Implementation of the CIP discussed in this chapter results in modest and generally isolated changes in the flow routing, including establishing a point of connection for those undeveloped mini-basins. In several instances, the addition or elimination of pump stations and force mains and the extension of trunk lines will redirect flow to and through different mini-basins. The overall architecture of the system and proposed routing for each mini-basin in 2036 is shown in Figures 10.5 and 10.6. There are no changes to the system in the Westside Service Area, therefore the 2016 and 2036 schematic is the same, as presented in Figure 5.2.



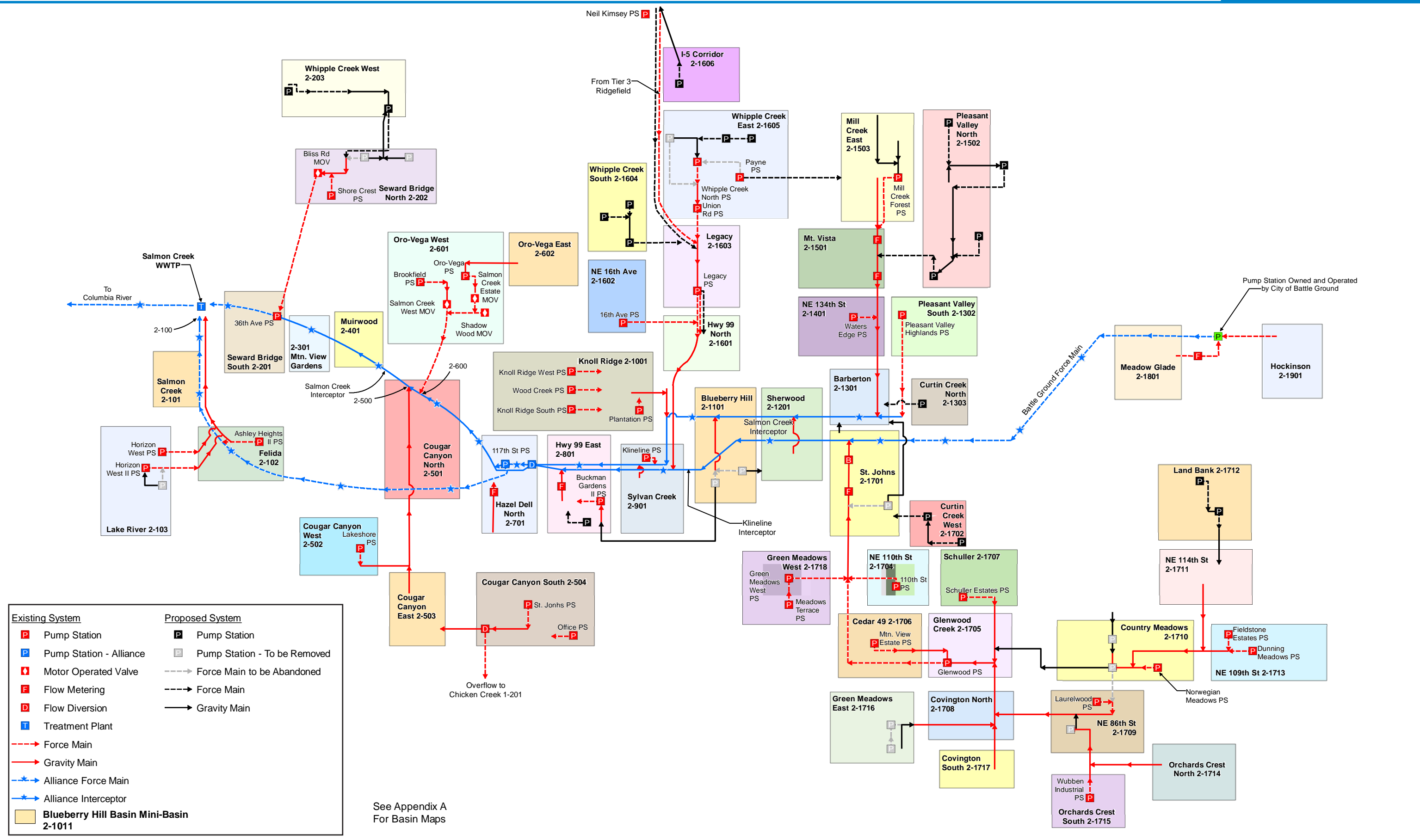


FIGURE 10.5
2036 NVUGA Schematic

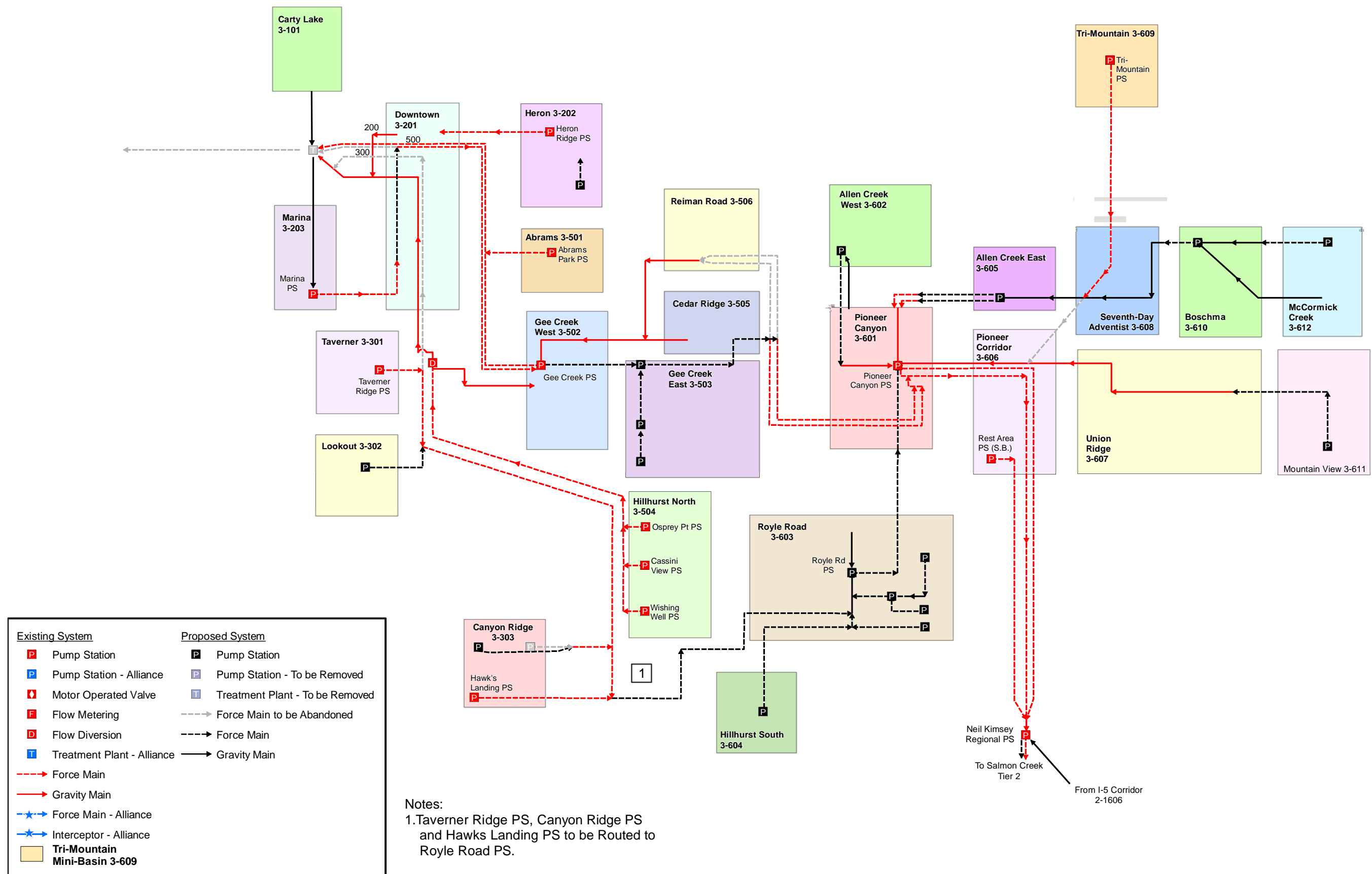
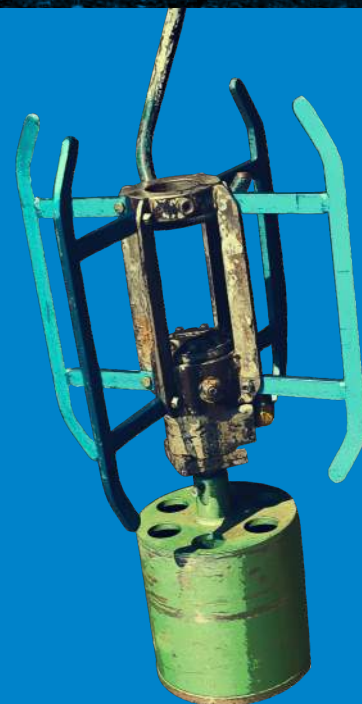
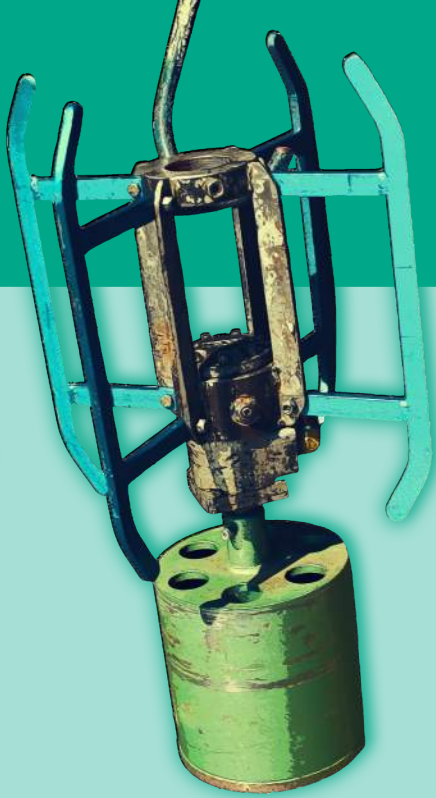


FIGURE 10.6
 2036 RUGA Schematic



Financial Analysis





This tap cutter, driven by hydraulic water pressure, saws through obstructions entering from the sides of sewer mains, such as protruding sewer taps

Financial Analysis



11

11.1 Introduction

The objective of the financial plan is to provide a financial program that allows the wastewater utility to remain financially viable while delivering its services. It is based on identifying the total cost of providing wastewater service and executing the CIP presented in Chapter 10. The viability analysis considers the past financial condition of the utility, the sufficiency of revenues to meet current and future financial and policy obligations and the financial impact to rates and charges of executing the CIP. The plan defines a financial strategy that is projected to fully fund the wastewater program.

11.2 Past Financial Performance

This section includes a historical summary of financial performance as reported by the District on the *Statement of Revenues, Expenses and Changes in Net Position* and the *Statement of Net Position*. These statements indicate the District has realized strong historical financial performance.

TABLE 11-1

Statement of Revenues, Expenses and Changes in Net Position

	2011	2012	2013	2014	2015	2016
Revenues						
Charges for Services	\$ 14,327,747	\$ 14,543,675	\$ 15,343,633	\$ 17,396,279	\$ 17,542,643	\$ 18,691,943
Permits	35,800	43,925	70,190	101,725	127,150	150,445
Miscellaneous	339,839	372,531	479,837	667,866	455,941	541,129
Interest and Investment Income	289,494	201,405	104,321	271,600	307,304	339,891
Nonoperating Revenues	779,450	10,878	15,444	47,304	552,060	878,135
Total Revenues	15,772,330	15,172,414	16,013,425	18,484,774	18,985,098	20,601,543
Expenses						
Operating expenses	16,695,257	17,053,387	18,880,888	21,027,808	23,078,519	29,062,822
Nonoperating Expenses	746,648	38,500	15,742	-	395,683	300,287
Interest Expense	1,468,083	2,471,265	668,591	670,994	508,173	172,641
Total Expenses	18,909,988	19,563,152	19,565,221	21,698,802	23,982,375	29,535,750
Income Before Contributions	(3,137,658)	(4,390,738)	(3,551,796)	(3,214,028)	(4,997,277)	(8,934,207)
Capital Contributions	3,893,612	9,241,739	5,618,773	8,753,630	11,377,064	14,711,919
Special Item-Transfer of Operations	-	-	-	11,842,196	21,153,127	-
Change in Net Position	755,954	4,851,001	2,066,977	17,381,798	27,532,914	5,777,712
Net Position, Beginning of Year	134,804,828	135,210,436	140,503,387	142,570,364	159,952,162	184,651,293
Prior Period Adjustments	(350,346)	562,720	-	-	233,794	(802,010)
Change in Accounting Principle	-	(120,770)	-	-	(3,067,577)	-
Net Position, End of Year	\$ 135,210,436	\$ 140,503,387	\$ 142,570,364	\$ 159,952,162	\$ 184,651,293	\$ 189,626,995

11.2.1 Assessment of Annual Financial Performance

FINDINGS AND TRENDS

- » Sewer rate revenue has been increasing at sufficient levels to fund annual operating expenses, including depreciation expense, as a result of a combination of customer growth and periodic rate increases.

» Although operating income has been positive, connection charge revenues are included in the revenue line for "Capital Contributions." Without the connection charge revenues, the trend indicates that current rates will become inadequate to continue to fund depreciation expense. To avoid eroding net income and to keep pace with inflation, modest future rate increases are necessary and are reflected in the projected retail rates later in this chapter.

TABLE 11-2
Statement of Net Position

	2011	2012	2013	2014	2015	2016
Assets						
Current and Other Assets	\$ 45,191,335	\$ 39,151,478	\$ 40,626,955	\$ 44,955,737	\$ 41,123,278	\$ 43,253,905
Capital Assets (net of depreciation) and Construction Work in Process	139,694,293	137,075,707	135,725,542	162,224,667	177,778,137	179,865,064
Total Assets	184,885,628	176,227,185	176,352,497	207,180,404	218,901,415	223,118,969
Deferred Outflows	-	-	-	-	368,348	634,345
Liabilities						
Long-term Liabilities	39,775,974	30,381,806	29,001,844	38,730,717	27,812,301	26,867,336
Other Liabilities	9,899,218	5,341,992	4,780,289	8,497,525	6,355,303	7,194,661
Total Liabilities	49,675,192	35,723,798	33,782,133	47,228,242	34,167,604	34,061,997
Deferred Inflows	-	-	-	-	450,866	64,322
Net Position						
Net Investment in Capital Assets	97,647,089	105,309,986	105,412,741	122,930,994	154,191,734	158,056,983
Restricted - Debt Service Resesrve	2,122,351	-	-	-	541,765	541,765
Unrestricted	35,440,997	35,193,401	37,157,623	37,021,168	29,917,794	31,028,247
Total Net Position	\$ 135,210,437	\$ 140,503,387	\$ 142,570,364	\$ 159,952,162	\$ 184,651,293	\$ 189,626,995



11.2.2 Assessment of Cumulative Financial Position

FINDINGS AND TRENDS

- » The current ratio (current assets divided by current liabilities) increased from about 4:1 to about 5:1 between 2011 and 2016. A ratio of 2:1 or higher is considered very positive in terms of liquidity.
- » Long-term liabilities decreased in 2012, when the District defeased its contractual obligation (\$13,675,000) to Clark County for the SCTP Phase III expansion project. Proceeds from a 2012 District bond issuance (\$5,417,645) partially funded defeasance of the County's 2001 sewer revenue bonds.
- » Long-term liabilities increased in 2014, with \$10,784,922 in draws from 2 Public Works Trust Fund (PWTF) loans for construction of the DCWTS.
- » Long-term liabilities decreased on January 1, 2015 when the District transferred all funding for the SCTP Phase IV expansion project to the Alliance, comprised of 4 PWTF loans (\$12,314,587) and a State Revolving Fund (SRF) loan (\$676,309).

11.3 Current Financial Structure

This section summarizes the financial structure used as the basis for the capital funding strategy and financial forecast developed as part of this Plan.

11.3.1 Financial Plan

The District is an enterprise responsible for funding all of its related costs. It does not receive any general tax revenues from taxpayers. The primary source of funding for the sewer utility is derived from ongoing charges for service (monthly rates), with additional revenues coming from miscellaneous fees, investment earnings and system development charges (SDCs) imposed on new development. The District controls the level of user charges by resolution, and, subject to statutory authority, can adjust user charges as needed to meet its financial objectives.

The financial plan can only provide a qualified assurance of financial feasibility if it considers the “total system” costs of providing wastewater service – both operating and capital. To meet these objectives, the following elements are completed:

» CAPITAL FUNDING PLAN

Identifies the total CIP obligations for the planning period. The plan defines a strategy for funding the CIP including an analysis of available resources from rate revenues, existing reserves, SDCs, debt financing and any special resources that may be readily available (e.g. grants, developer contributions, etc.). The capital funding plan impacts the financial plan through debt financing (resulting in annual debt service) and the assumed rate revenue resources available for capital funding.



» FINANCIAL FORECAST

Identifies future annual (non-capital) costs associated with the management, operation and maintenance of the wastewater system. Included in the financial plan is a reserve analysis that forecasts cash flow and fund balance activity, helping ensure that minimum fund balance policies are met. The financial plan ultimately evaluates the sufficiency of utility revenues in meeting all obligations, including cash uses such as operating expenses, debt service, capital outlays and reserve contributions, as well as any coverage requirements associated with long-term debt. The financial forecast also identifies the future adjustments required to fully fund all utility obligations during the capital planning period.

11.3.2 Capital Funding Strategy

Table 11-3 summarizes the estimated cost of the 6-year CIP.

The CIP shown in Table 11-3 identifies a total of \$47.1 million in collection system improvement projects (in 2017 dollars) over the 6-year planning period. Approximately \$10.3 million is budgeted to fund restoration and replacement (R&R) projects on existing infrastructure, and \$36.8 million is budgeted to construct new District infrastructure, increasing utility, capacity or sewer availability to potential new customers.

TABLE 11-3
2017-2022 Capital Funding Strategy (millions of \$)*

	2017	2018	2019	2020	2021	2022	6-YEAR TOTAL
Salmon Creek Service Area							
NVUGA							
Restoration & Replacement	\$ 0.97	\$ 2.62	\$ 0.99	\$ 1.45	\$ 0.97	\$ 0.73	\$ 7.73
Capital Improvement Projects	3.52	3.79	3.85	1.91	3.27	5.73	22.08
Subtotal	4.50	6.41	4.83	3.36	4.24	6.47	29.81
RUGA							
Restoration & Replacement	0.06	0.09	0.06	0.09	0.06	0.09	0.46
Capital Improvement Projects	5.29	3.26	3.41	0.47	1.54	0.08	14.05
Subtotal	5.35	3.35	3.47	0.56	1.61	0.17	14.51
Total Salmon Creek Service Area	9.85	9.76	8.31	3.92	5.85	6.64	44.32
Westside Service Area (WVUGA)							
Restoration & Replacement	0.30	0.42	0.30	0.42	0.30	0.42	2.15
Capital Improvement Projects	0.24	0.15	0.15	0.02	0.07	-	0.63
Total Westside Service Area	0.54	0.56	0.45	0.44	0.37	0.42	2.78
Total Capital Improvement Program	\$ 10.38	\$ 10.33	\$ 8.76	\$ 4.36	\$ 6.21	\$7 .06	\$ 47.10

* Excludes Developer Contributions and Cost to Complete beyond 2022.

11.4 Available Funding Assistance and Financing Resources

Long-term capital funding strategies are critical to ensure adequate resources are available to fund the CIP. In addition to the District's utility resources, such as accumulated cash resources, rate funded capital and SDC revenues, capital needs can be met from outside resources, as well as grants, low interest loans and bond financing. Following is a summary of both utility (internal) resources and outside resources.

11.4.1 Utility Resources

To fund capital needs, the District can commit its utility (internal) resources such as existing cash and investments, capital-related revenues and rate revenue. Ongoing revenues from rates and capital-related charges are best suited to fund ongoing R&R and maintenance needs.

RATES

An allocation from cash and rate revenues is used to fund repair and replacement costs on existing District infrastructure. This is done by allocating a portion of rate revenues to fund annual depreciation expense. An allocation from cash and rate revenues also funds debt service and pays regional treatment charges.

SDC

The District imposes a connection fee, also known as an SDC, on new customers as a condition to connect to the public sewer system. The SDC promotes equity between new and existing customers while providing a source of revenue to fund capital improvement projects.

LOCAL FACILITIES CHARGES (LFCS)

LFCs are a District-imposed charge to recover the project specific costs related to extension of local sewer service to only those benefitting properties. It is a reimbursement to the District for the cost of a local facility that directly serves a property.



DEVELOPER EXTENSIONS/ LATECOMER AGREEMENTS

The developer extension is a requirement that a developer install onsite and sometimes offsite improvements as a condition of extending service. Part of the agreement between the District and the developer might include a latecomer agreement, resulting in a latecomer charge to new connections to the privately-funded extension. The District collects a payment from new customers connecting to the developer-installed improvements, then passes the funds on to the developer who installed the facilities.

LOCAL IMPROVEMENT DISTRICTS (LIDS)/UTILITY LOCAL IMPROVEMENT DISTRICTS (ULIDS)

LIDs and ULIDs are another mechanism for funding infrastructure that assesses a charge on a property based on the special benefit derived by the construction of specific facilities. Some ULIDs also recover related general facilities costs that would otherwise be included in the SDC.



11.4.2 Outside Resources

Various grant, loan and bond opportunities are available to the District through federal and state agencies to fund CIP.

GOVERNMENT PROGRAMS

While federal and state grant programs have historically been available to utilities for capital funding assistance, may have been eliminated, reduced in scope and amount or replaced by loan programs. Remaining programs are general lightly funded and heavily subscribed. Two programs most recently utilized by the District are below.

- » **Public Works Trust Fund.** The PWTF program, administered by the Department of Commerce, offers low-interest loans for local governments to finance infrastructure construction and rehabilitation. The District has been eligible for and received PWTF loans for several domestic sanitary sewer projects over the past few years. Since 2013, however, the program has not received any further funding from the Washington Legislature. In fact, loan repayment revenues from the Public Works Assistance Account have been redirected to the State General Fund.

- » **State Revolving Fund.** The SRF program, administered by the Department of Ecology, is available to fund 20 years of growth for eligible wastewater treatment construction projects.

PUBLIC DEBT

- » **Revenue Bonds/Private Placements.** Sewer revenue bonds are secured by utility revenues, and they are a common mechanism to fund utility capital improvements. Revenue bonds typically have higher interest rates than general obligation bonds due to a limited commitment for repayment. They also require security conditions related to the maintenance of dedicated reserves (debt service reserve) and financial performance (added bond debt service coverage). The District agrees to satisfy these requirements by resolution as a condition of bond sale. A private placement, typically the sale of a single bond to a single buyer, functions similar to a revenue bond. The issuance process is much simpler and issuance costs are greatly reduced with a privately placed bond.

11.5 Financial Forecast

The financial forecast, or revenue requirement analysis, forecasts the amount of annual revenue that needs to be generated by user rates. The analysis evaluates the sufficiency of the sewer utility's revenues to meet its financial obligations, including O&M expenses, debt repayment, rate-funded capital needs and any other policy-based needs.

11.5.1 Revenue Sufficiency

The analysis determines the amount of revenue needed in a given year to meet that year's expected financial obligations. Three revenue sufficiency tests are used by the District for such analysis.

CASH FLOW TEST

The cash flow test identifies all known cash requirements for the District, including O&M expenses, debt service payments, rate-funded system reinvestment funding or directly funded capital outlays and any additions to specified reserve balances.

COVERAGE TEST

The coverage test is based on a commitment made by the District when issuing revenue bonds and some other forms of long-term debt. The District's existing revenue bond covenants require the District to maintain a coverage ratio of 1.10 as a legal minimum. In other words, the District's rate revenue must be sufficient to pay O&M expenses, annual revenue bond debt service payments, plus an additional 10% of the revenue bond payments. Any excess cash flow derived from the added coverage can be used for any purpose, including funding capital projects. Targeting a higher coverage ratio can help the District achieve a better credit rating and provide lower interest rates for future debt issuances.

RESERVES REQUIREMENT TESTS

The reserves requirement test ensures reserves by fund and total reserves across all funds meet both best practice guidance and Board adopted reserve levels. The District's cash and investment balances are separated into the following reserve accounts:

- » **Operating (O&M, Alliance Reserves, Unemployment Reserve) Account Reserves.** Operating reserves provide an appropriate financial buffer to accommodate fluctuations in cash balances resulting from differences in revenue and expense cycles, unanticipated cash expenses or unanticipated revenue shortfalls. This analysis assumes that the District maintains a minimum O&M Accounts balance equal to 120 days of O&M expenses. Based on the 2017 Budget, this policy corresponds to a minimum balance of \$6.1 million.
- » **Debt (Debt Service and Debt Service Reserve) Account Reserves.** This reserve is required by the District's bond covenants to provide security against default risk. The reserve requirement is defined as the least of 3 measures: maximum annual revenue bond debt service, 125% of average annual debt service and 10% of the amount issued. Based on the District's current debt schedules, the reserve requirement is approximately a minimum balance of \$1.9 million.
- » **Capital (R&R and CIP) Account Reserves.** The capital accounts facilitate the segregation of resources assigned to capital purposes from other resources available for operating purposes. They can serve as capital contingency reserves to accommodate capital cost overruns or unanticipated capital needs. A percentage of the cost of fixed assets is commonly used to set a minimum balance for the capital accounts. Other potential benchmarks include a rolling average of capital expenditures or an amount based on the cost of the District's most expensive asset.
 - ♦ R&R account reserve policy: a minimum of 1 year of depreciation expense, a minimum reserve balance of \$4.0 million.
 - ♦ CIP account reserve policy: 25% of the current year's CIP budget or \$3.0 million, whichever is greater. Based on the 2017 Budget, this policy corresponds to a minimum reserve balance of \$3.0 million.

11.5.2 Current Account Structure

The District operates as a financially viable and fiscally responsible enterprise. The financial structure and policy framework is described in further detail below.

11.5.3 Financial Policies

Other key elements of the financial policy framework re described below:

EXPENDITURES POLICY

The District's operating budget will not use one-time revenues to support ongoing expenditures. All current expenditures will be paid with current revenues. Long-term debt will not be used to fund current expenditures.

LONG-TERM FINANCIAL FORECASTING

In conjunction with the annual budget, a 6-year financial forecast is developed and updated annually. The 6-year CIP and annual budget are prepared within the framework of a 20-year GSP. The Plan is updated periodically and is designed to provide a readily accessible and easy to understand infrastructure plan that is based on practical planning assumptions.

INVESTMENT POLICY

The District invests funds in a manner that will, in order of priority, 1) preserve the safety of principle in the District's investment portfolio, 2) remain sufficiently liquid to enable the District to meet all reasonably anticipated operating requirements and 3) provide the District with investment yields attaining a market rate of return.

11.5.4 Capital Funding

The District Board has a practice of funding existing debt service on capital from rates, and of funding future capital needs from a combination of rates, SDC charges or debt undertaken to fund major discrete capital projects.

FINANCIAL FORECAST

The financial forecast is developed from the 2017 Budget, along with other key factors and assumptions. The key revenue and expense assumptions used to develop the financial forecast are described below.

- » **Rate Revenue.** Rate revenue is projected to be about \$19.4 million for 2017, based on actual 2016 revenue collections and expected growth. Other (non-rate) revenues of \$1.6 million are forecast based on the 2017 Budget. Planning period rate revenues and other revenues are forecast to incrementally grow over the next 5 years to \$23.5 million and \$1.8 million in 2022, respectively.
- » **SDC Revenue.** Based on the 2017 Budget, SDC revenue is projected to be \$7.6 million. Strong ERU growth over the 6-year planning period is forecast based upon the continued development activity and the number of projects currently under plan review.
- » **Growth.** The financial analysis assumes a growth of 1,550 ERUs in 2017, and continued strong growth in the following 5 years.
- » **Expenses.** O&M expense projections are based on the 2017 Budget, and most are forecast to increase over the following 5 years with either general cost inflation (3% per year), salary costs (5% per year) or benefit costs (6% per year). Capital project costs are assumed to increase at 5% per year over the 6-year planning window, based on the recent inflation in the ENR Construction Cost Index.
- » **Debt.** The sewer utility has an outstanding revenue bond and 3 outstanding loans. Currently annual debt service is forecast to be approximately \$1.9 million through 2022 and no new debt is forecast for the remainder of the study period.

Although the financial plan is completed for the 20-year time horizon of this Plan, the rate strategy focuses on the shorter-term planning period from 2017 through 2022. Table 11-4 summarizes the annual revenue requirements based on the forecast of revenues, expenditures, fund balances and fiscal policies.

Table 11-4 also shows the sewer utility's combined fund balance decreasing over the study period, beginning 2017 at \$35.2 million and ending 2022 with roughly \$32.0 million. The fund balance decrease is associated with implementation of capital projects in the early 2020s. Because the District currently has reserves somewhat greater than required to meet all financial tests, this is an intentional drawdown of fund balance that is consistent with District financial policies and planning assumptions.

TABLE 11-4
Revenue Requirement Forecast

	2017	2018	2019	2020	2021	2022
Revenues						
Charges for Services	\$ 19,387,581	\$ 19,997,241	\$ 20,710,606	\$ 21,868,151	\$ 22,415,551	\$ 23,470,808
Other Operating Revenues	1,593,500	1,689,234	1,601,405	1,650,504	1,697,066	1,758,222
Total Revenues	20,981,081	21,686,475	22,312,011	23,518,655	24,112,617	25,229,030
Expenses						
Operating Expenses	18,286,500	19,373,791	19,758,880	20,319,825	21,379,864	22,019,457
Debt Service	1,921,089	1,914,544	1,907,998	1,901,452	1,894,906	1,888,360
Rate Funded Capital	1,335,204	3,122,688	1,348,974	1,961,639	1,331,270	1,240,225
Total Expenses	21,542,793	24,411,023	23,015,852	24,182,916	24,606,040	25,148,042
Surplus/(Deficiency)	(561,712)	\$2,724,548)	(703,841)	(664,261)	(493,423)	80,988
Annual Rate Adjustment	0.00%	0.00%	0.00%	2.63%	0.00%	2.56%
Collection/(Use) of Reserves for Rate Management	\$ (695,233)	\$ (3,036,817)	\$ (838,738)	\$ (860,425)	\$ (626,550)	\$ (43,034)
Coverage Ratio Realized	1.10	1.10	1.10	1.10	1.10	1.10
<i>Coverage Ratio Required</i>	<i>1.10</i>	<i>1.10</i>	<i>1.10</i>	<i>1.10</i>	<i>1.10</i>	<i>1.10</i>
Ending Combined Fund Balance	\$ 35,194,407	\$ 38,240,466	\$ 35,138,730	\$ 33,639,810	\$ 32,849,218	\$ 32,024,020
<i>Combined Minimum Target Balance</i>	<i>\$ 23,239,252</i>	<i>\$ 22,910,455</i>	<i>\$ 23,261,978</i>	<i>\$ 23,672,194</i>	<i>\$ 25,286,397</i>	<i>\$ 25,634,404</i>

11.6 Current and Projected Rates



11.6.1 Existing and Projected Retail Rates

Summarized in Table 11-5 below, the District's current and projected rate structure for residential customers is a fixed monthly charge per ERU by service area. This fixed rate applies to all residential customers with a couple of exceptions. Low-income senior customers pay a rate discounted either 20% or 35% of standard rates depending on their specific qualifying income levels. Additionally, multi-family living units are discounted and pay 80% of the standard rate.

TABLE 11-5
Sewer Rates Forecast

	2017	2018	2019	2020	2021	2022
SALMON CREEK SERVICE AREA						
NVUGA						
Monthly Sewer Rates	\$ 38.00	\$ 38.00	\$ 38.00	\$ 39.00	\$ 39.00	\$ 40.00
Senior Discount - 20%	30.40	30.40	30.40	31.20	31.20	32.00
Senior Discount - 35%	24.70	24.70	24.70	25.35	25.35	26.00
Multi-family Unit	30.40	30.40	30.40	31.20	31.20	32.00
RUGA						
Monthly Sewer Rates	55.70	55.00	54.10	54.30	53.70	54.10
Senior Discount - 20%	44.56	44.00	43.28	43.44	42.96	43.28
Senior Discount - 35%	36.21	35.75	35.17	35.30	34.91	35.17
Multi-family Unit	44.56	44.00	43.28	43.44	42.96	43.28
WESTSIDE SERVICE AREA (WVUGA)						
Monthly Sewer Rates	38.00	38.00	38.00	39.00	39.00	40.00
Senior Discount - 20%	30.40	30.40	30.40	31.20	31.20	32.00
Senior Discount - 35%	24.70	24.70	24.70	25.35	25.35	26.00
Multi-family Unit	30.40	30.40	30.40	31.20	31.20	32.00

TABLE 11-6**System Development Charges (SDC) Forecast**

	2017	2018	2019	2020	2021	2022
<i>Salmon Creek Service Area</i>						
NVUGA	\$ 4,708	\$ 4,708	\$ 4,708	\$ 4,708	\$ 4,708	\$ 4,708
RUGA	7,550	7,550	7,550	7,550	7,550	7,550
<i>Westside Service Area (WVUGA)</i>	1,720	1,720	1,720	1,720	1,720	1,720

TABLE 11-7**Customer Projections**

	2017	2018	2019	2020	2021	2022
Salmon Creek Service Area						
NVUGA	38,077	39,112	40,147	41,181	42,216	43,251
RUGA	4,155	5,254	6,354	7,453	8,552	9,651
Subtotal	42,232	44,366	46,500	48,634	50,768	52,902
Westside Service Area (WVUGA)	4,139	4,167	4,196	4,224	4,252	4,280
Total Customers	46,371	48,533	50,696	52,858	55,020	57,182

11.6.2 Existing and Projected System Development Charges

SDCs are legal sources of funding provided through development and growth in customers typically used by utilities to support capital needs. SDCs are a form of connection charges as authorized in Section 57.08.005 RCW. They are imposed on new customers connecting to the system as a condition of service, in addition to any other costs incurred to connect the customer. The underlying premise of the SDC is that new growth (i.e. future customers) will pay an equitable share of system costs through an upfront charge for system capacity. SDC rates are reviewed periodically to ensure the revenues generated from new connections will sufficiently fund new infrastructure (or capital purchases) added to the District's collection system. SDCs are forecast to remain level over the study period 2017-2022, as shown in Table 11-6.

11.6.3 Customer Base

The customer base represents ERUs that can be supported by the planned system capacity. The customer projections used to estimate the total ERUs, along with the annual growth in customer base, is presented in Table 11-7.

The rates, SDCs and ERU growth projections summarized in this section will provide the revenue streams necessary to fund all operations, debt service and capital repairs/additions through this study period 2017-2022.

11.7 Affordability Evaluation

A common affordability benchmark for utility rates is to test the monthly median income equivalent against the existing and projected monthly utility rates. The PWTF board reduces interest rates and extends repayment terms of “distressed” communities, defined as communities with a utility bill that exceeds 1.5% of median household income. The Department of Ecology uses a threshold of 2% of median household income when evaluating eligibility for grants, forgivable-principal loans and interest rate reductions for other loans.

The most recent Census data (2016) indicates that the median household income (MHI) in Clark County (NVUGA and WVUGA) and the RUGA, adjusted to 2017, is \$67,879 and \$95,307, respectively. Table 11-8 summarizes the affordability evaluation.

Table 11-8 indicates that the total residential sewer bill would remain below 0.70% of MHI, which falls well within the range specified as “affordable” or “non-distressed” by both the PWTF board and Ecology.

TABLE 11-8

Affordability Evaluation by Median Household Income (MHI)

	2017	2018	2019	2020	2021	2022
Salmon Creek Service Area						
NVUGA						
Annual residential sewer bill	\$ 456.00	\$ 456.00	\$ 456.00	\$ 468.00	\$ 468.00	\$ 480.00
Median household income*	67,879	70,526	73,277	76,135	79,104	82,189
Annual bill as % of MHI - NVUGA	0.67%	0.65%	0.62%	0.61%	0.59%	0.58%
RUGA						
Annual residential sewer bill	\$ 668.40	\$ 660.00	\$ 649.20	\$ 651.60	\$ 644.40	\$ 649.20
Median household income*	95,307	99,024	102,885	106,898	111,067	115,399
Annual bill as % of MHI - RUGA	0.70%	0.67%	0.63%	0.61%	0.58%	0.56%
WVUGA						
Annual residential sewer bill	\$ 456.00	\$ 456.00	\$ 456.00	\$ 468.00	\$ 468.00	\$ 480.00
Median household income*	67,879	70,526	73,277	76,135	79,104	82,189
Annual bill as % of MHI - WSA	0.67%	0.65%	0.62%	0.61%	0.59%	0.58%

* 2016 MHI inflated at average annual rate of 3.9%



11.8 Conclusion

The results of this analysis indicate that the District will maintain reasonable wastewater rate levels while financing the capital projects indicated in this Plan. The District has in place financial policies, such as annual system reinvestment reserve funding, that will allow the District to continue to maintain strong financial health.

These findings are dependent on the District increasing rates and charges as indicated in this chapter and on the source data and assumptions used in the financial forecast. Should there be significant change to the assumptions, such as the changes to cost or timing of the CIP, financial forecast findings would change as well. By practice, the District updates this financial forecast annually in order to assess changes in the underlying assumptions and to provide for long-term affordability and stability in the retail rates and charges required to support the utility on a sustaining basis.

