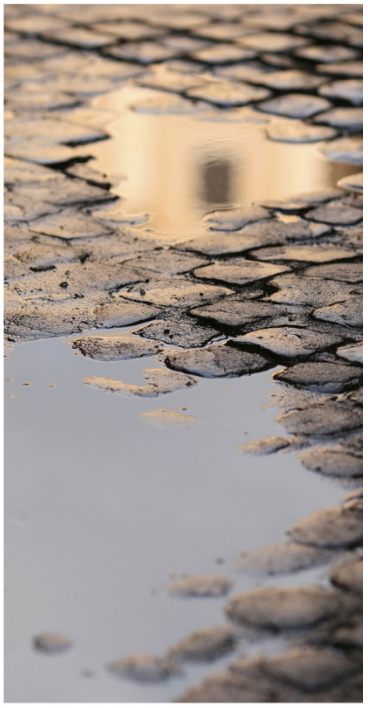
CITY OF
West Linn

Storm Drainage Master Plan

DRAFT FINAL // SEPTEMBER 2019



Brown AND Caldwell

West Linn Storm Drainage Master Plan

Prepared for
City of West Linn, Oregon
September 2019

This is a draft and is not intended to be a final representation
of the work done or recommendations made by Brown and Caldwell.
It should not be relied upon; consult the final report.

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List of Abbreviations

ac	acre
BC	Brown and Caldwell
BMP	best management practice
C	Capacity projects (capital planning)
CCTV	closed-circuit television
CDC	Community Development Code
CIP	capital improvement project
City	City of West Linn
CWA	Clean Water Act
DEQ	Oregon Department of Environmental Quality
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
G	general/asset management (capital planning)
GIS	geographic information system
H/H	hydrologic and hydraulic
Highway 43	Oregon Highway 43
HSG	hydrologic soil groups
I&I	inflow and infiltration
I	Addition projects (capital planning)
IGAs	intergovernmental agreements
LF	linear foot/feet
MS4	municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
ODOT	Oregon Department of Transportation
P	Planning projects (capital planning)
PCB	polychlorinated biphenyl
Plan	Storm Drainage Master Plan
R	Erosion projects (capital planning)
R/R	repair and replacement
SMP	Storm Drainage Master Plan
SOPs	standard operating procedures
SWMP	Stormwater Management Plan
TMDL	total maximum daily load
UGB	Urban Growth Boundary
WLMC	West Linn Municipal Code

Executive Summary

In 2017, the City of West Linn (City) initiated development of a multi-objective storm drainage master plan to guide stormwater and drainage-related capital project, program, and policy needs over a 10-year planning period. Efforts were initiated due to the outdated nature of the City's previous Surface Water Management Plan (dated 2006), an increased focus on water quality in conjunction with the changing regulations and observed system deficiencies warranting additional study.

This 2019 Storm Drainage Master Plan (Plan or SMP) is a supporting document to the City's Comprehensive Plan and provides an overview of drainage system improvements to address future growth, water quality, maintenance/system condition issues, and capacity issues. The City's overall storm drainage system is composed of piped and open channel (e.g., ditches, creeks) conveyances, in addition to collection, treatment, and detention facilities for stormwater management. The master planning process included the following steps:

- Evaluate City code related to stormwater management, to define planning and design criteria and identify implementation gaps.
- Identify, investigate and study known problem areas.
- Create hydrologic and hydraulic (H/H) models to evaluate storm drainage system capacity for key problem areas.
- Identify implementation priorities and associated costs.
- Develop an integrated storm drainage capital improvement program to address capacity, water quality, and maintenance needs.
- Develop a Plan that is useful and easy to read, reference, and update.

Master Plan Technical Analyses

Development of this SMP included the following technical analyses to evaluate stormwater system deficiencies and define project, program, and policy needs.

Code Evaluation. This effort included review of code and standards applicable to this SMP, as contained in the City's Municipal Code (WLMC), Public Works Standards (PWDS), Construction Specifications, and Community Development Code (CDC). Elements of the code review included conveyance, water quality, erosion and sediment control, maintenance, and code enforcement.

Project Needs Assessment. This effort included the distribution of surveys to the City and public, a GIS data review, site visits, a maintenance assessment, and meetings/workshops with City staff. Information collected resulted in development of a robust inventory of problem areas specific to stormwater infrastructure and stormwater facilities. Problem areas were reviewed to identify locations in need of further analysis or study.

Water Quality Assessment. Water quality opportunity areas were initially identified using a desktop GIS analysis to assess high pollutant generating land use areas (i.e., industrial or commercial), existing stormwater facility placement, and publicly-owned areas with potential to incorporate water quality. Site visits were conducted, and water quality opportunity areas compared with problem areas to see if an integrated approach to stormwater management (i.e., installation of water quality facilities to mitigate stormwater runoff) could address a reported issue.

Targeted Stormwater Drainage System Capacity Evaluation. Hydrologic and hydraulic (H/H) modeling to simulate rainfall and runoff characteristics was conducted for targeted areas of the City. The models simulate stormwater flow through pipe networks, drainage ditches, and culverts to identify capacity limitations under current and future development conditions.

General Recommendations

Project, program and policy recommendations in this SMP are proposed to improve and enhance drainage infrastructure and water resources throughout the City, as summarized by the following recommended actions.

- Implement identified system capacity improvements (i.e., reconfiguration, rerouting, upsizing) to manage more frequent, nuisance system flooding.
- Increase water quality treatment throughout the City by expanding treatment area coverage and enhancing the level of treatment provided in existing facilities.
- Incorporate LID or green infrastructure to expand water quality treatment in locations where utility improvements or transportation-related/pedestrian improvements are anticipated.
- Incorporate system configuration and condition data (i.e., stormwater facility inspection records, closed-circuit television [CCTV], survey) into a larger asset management program to allow for proactive maintenance, repair, and replacement of stormwater infrastructure.
- Conduct regular updates to the WLMC and PWDS to ensure clear guidance is provided to the development community and is consistent with regulatory requirements.
- Establish city policies to address beaver management as pertaining to local flooding issues.
- Clearly document capital project and program costs and schedule to inform future funding and rate analyses.

Capital Improvement Program

Project, programmatic, and policy recommendations in this SMP represent an integrated strategy to address storm drainage needs in the City. Recommendations include 26 capital projects and 5 city-wide programmatic efforts. Policy recommendations are based on the code evaluation and support project and programmatic needs.

Project and Program Summary

Capital projects address current and future stormwater infrastructure needs as a one-time project cost. Capital projects are categorized as capacity projects (C), infrastructure improvement and addition projects (I), water quality and erosion control projects (R), and planning projects (P).

Program recommendations address city-wide system repair and replacement (R/R) needs, routine system maintenance, and ongoing and opportunistic water quality retrofits. Program recommendations are categorized as general/asset management (G) and reflect an annual cost need.

Project and city-wide program objectives include:

- Increase system capacity (flood control)
- Improve system configuration
- Add infrastructure
- Increase water quality treatment (retrofit)
- Prevent erosion
- Address maintenance need

Table ES-1 summarizes the estimate cost and priority of identified capital projects and city-wide programs. Costs are provided for high and medium priority needs, which are anticipated for implementation over the 10-year SMP implementation timeframe. Lower priority project needs are listed for reference, but no cost provided.

Figure ES-1 shows the location of the proposed capital projects and programs, highlighting those considered a priority need.

Policy Recommendations

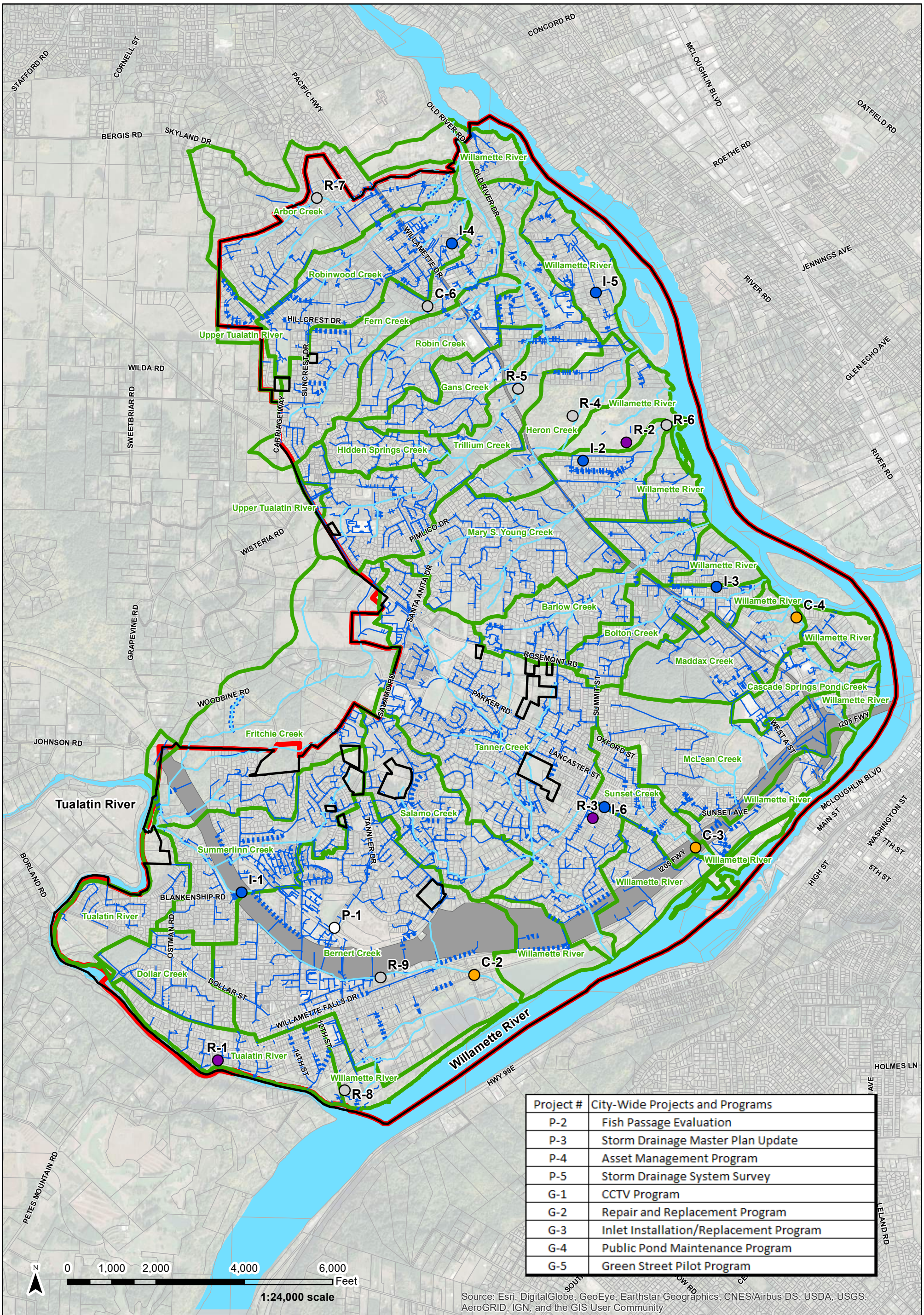
Policy recommendations are provided to 1) support future updates to technical design standards for stormwater systems, and 2) outline beaver management strategies to address beaver activity as related to localized stormwater system flooding.

Updated technical design standards would help support water quality improvement efforts by specifying approved stormwater facility types and design criteria to address specific pollutants of concern for the City. Establishing and documenting beaver management strategies would help mitigate beaver activity in susceptible stream channels as it contributes to the deficiencies in the City's stormwater collection and conveyance system.

Policy recommendations should be addressed with future updates to the WLMC, CDC, PWDS, or addressed through internal directives.

Table ES-1. Capital Project and Program Summary

Project Number	Project Name	Prioritization and Implementation Schedule		
		2019-2028 One-time Cost (High/Medium Priority)	2019-2028 Annual Cost (Medium Priority)	Future (Low Priority)
Capacity Projects				
C-1	Phase I Highway 43 Culvert Replacements	$1,045,000		
C-2	5th Avenue Culvert Replacement	$847,000		
C-3	Sunset Creek at Willamette Falls Drive Culvert Replacement	$282,000		
C-4	Maddox Creek at River Street Culvert Replacement	$385,000		
C-5	Phase II Highway 43 Culvert Replacements			X
C-6	Kantara Way Capacity Deficiency			X
Infrastructure Projects				
I-1	Blankenship Road Improvements	$856,000		
I-2	Mark Lane Improvements	$1,092,000		
I-3	Buck Street Improvements	$966,000		
I-4	Fairview Way Pipe Relocation	$1,620,000		
I-5	Nixon Avenue Pipe Relocation	$174,000		
I-6	Sunset Avenue Improvements	$1,593,000		
Retrofit Projects				
R-1	Public Pond #22 Retrofit (Katherine Court)	$89,000		
R-2	Mary S Young Park Parking Lot Retrofit	$2,075,000		
R-3	West Linn Public Works Department Planters	$174,000		
R-4	Mary S. Young Park Erosion Measures			X
R-5	Mary S. Young Park Trillium Creek Restoration			X
R-6	Mary S. Young Park Fish Restoration			X
R-7	Arbor Creek Culvert Hydromodification Improvements			X
R-8	Willamette Park Parking Lot Retrofit			X
R-9	Public Pond #18 Retrofit			X
Planning Projects				
P-1	Tannler Drive/Bernert Creek Basin Feasibility Study	$20,000		
P-2	Fish Passage Evaluation	$20,000		
P-3	Storm Drainage Master Plan Update	$300,000		
P-4	Asset Management Program Development	$150,000		
P-5	Stormwater System Survey	$300,000		
City-wide Programs				
G-1	CCTV Program		$344,000	
G-2	Repair and Replacement (R/R) Program		$750,000	
G-3	Inlet Installation and Replacement Program		$25,000	
G-4	Public Pond Maintenance Program		$100,000	
G-5	Green Street Pilot Program		$50,000	
	TOTAL (One-time Project Cost)	**$11,988,000**		
	TOTAL (Annual Program Cost)		**$1,269,000**	



Project #	City-Wide Projects and Programs
P-2	Fish Passage Evaluation
P-3	Storm Drainage Master Plan Update
P-4	Asset Management Program
P-5	Storm Drainage System Survey
G-1	CCTV Program
G-2	Repair and Replacement Program
G-3	Inlet Installation/Replacement Program
G-4	Public Pond Maintenance Program
G-5	Green Street Pilot Program

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure ES-1: Storm Drainage Capital Improvement Program Overview

Project Category
- Capacity
- Infrastructure
- Retrofit
- Planning
- Low Priority/Not Costed

- Stormwater Pipe
- Open Channel
- Streams
- Watershed Boundaries
- ODOT ROW
- City Limits
- UGB

CIPs C-1 (Phase I Highway 43 Culvert Replacement) and C-5 (Phase II Highway 43 Culvert Replacement) are not shown.

Data Source: City of West Linn GIS and Metro RLIS

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Map Publication/Print Date: August 2019 Produced by Brown and Caldwell

8/29/2019

Section 1

Introduction

The City of West Linn (City) developed this Storm Drainage Master Plan (SMP or Plan) to guide stormwater and drainage-related capital project, program, and policy decisions over a 10-year planning period.

The City's overall storm drainage system includes piped and open channel (e.g., ditches, creeks) conveyances, in addition to collection, treatment and detention facilities for stormwater management. There are 21 tributary creeks and streams (surface water bodies) that convey a majority of stormwater runoff from developed portions of the City to the Willamette River and Tualatin River. Thus, this SMP collectively considers both piped and open channel conveyances as part of the overall storm drainage system. This SMP addresses water quantity and quality for constructed drainage systems under the City's management.

The City manages approximately 123 miles of piped and open channel storm drainage infrastructure. The City is primarily developed, with limited potential for growth (based on the current urban growth boundary [UGB]) and moderate potential for infill or redevelopment. As such, the City needs a proactive plan to address existing capacity deficiencies, failing infrastructure, and regulatory drivers related to water quality improvement.

This Plan documents the process and methods used to evaluate the City's storm drainage infrastructure. Results of the evaluation provide the City with projects, programs, and policies for implementation.

1.1 Storm Drainage Master Plan Objectives

The City's overarching goal for this SMP is to guide storm drainage infrastructure improvements over a 10-year implementation period. Improvements must address water quality, maintenance/system condition issues, and capacity issues into the future. Specific objectives of the City's SMP include the following:

- Establish a foundation for evaluating stormwater needs in West Linn.
- Solicit information from staff and stakeholders to inform the targeted and integrated identification of project needs and improvements.
- Identify known areas of storm drainage problems and flooding and provide project solutions related to collection, conveyance, treatment and detention.
    - Develop targeted hydrologic and hydraulic (H/H) models to evaluate system capacity based on current system information as obtained from the City's GIS and survey.
    - Assess the frequency of nuisance flooding based on developed H/H models.
- Enhance and expand water quality treatment throughout the City by improving existing treatment system functionality and implementing opportunistic retrofits to expand treatment area coverage within the City.
- Identify programmatic opportunities to address maintenance activities, system condition deficiencies, and water quality on a city-wide scale.

This Plan is intended to support regulatory directives under the City's Phase I National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer (MS4) Permit (Permit). The City is required to meet stormwater-related permit obligations as documented in their Stormwater Management Plan (SWMP) and referenced in intergovernmental agreements (IGAs), standard operating procedures (SOPs) and technical documents.

1.2 Background and Related Studies

The City's last storm drainage master plan was completed in 2006 (2006 Plan). Since 2006, identified capital projects have not consistently been implemented. Per objectives at the time, projects were primarily identified based on modeled system capacity deficiencies, specifically culverts. Projects were not prioritized in conjunction with observed deficiencies or City maintenance objectives. Project needs identified in the 2006 Plan require validation and update.

Various planning-level reports and studies prepared since the 2006 Plan were obtained during the development of this SMP to help inform areas of observed stormwater problems and potential project needs. Reports and studies reviewed and considered for this SMP are listed in Table 1-1.

Table 1-1. Existing Stormwater Planning Documentation and Reports

Report	Date	Summary and application to the SMP
West Linn Surface Water Management Plan	2006	Provides background information and historic basis for the need to update the SMP.
West Linn Stormwater Management Plan	2012	Summarizes programmatic and maintenance activities related to the implementation of the City's Phase I NPDES MS4 permit.
Stormwater Retrofit Plan for the City of West Linn	2015	Provides documentation of the City's retrofit strategy, which includes proposed stormwater pond retrofits and culvert retrofits.
Hydromodification Assessment	2015	Provides a summary of instream channel conditions and hydromodification indicators. Field notes and photo logs documenting system conditions are included. Project and policy needs are identified.
West Linn Transportation System Plan	2016	Identifies transportation improvement project needs including pedestrian improvements that may be coordinated with stormwater infrastructure or green street development activities.

1.3 SMP Development Process

The City developed this SMP using a collaborative approach with engineering and maintenance staff and the public to initially assess known storm drainage problem areas and identify areas where infrastructure addition, replacement, or retrofit is needed to address an issue. Individual assessment efforts to evaluate capacity limitations, water quality opportunities, and develop project concepts were conducted following this initial planning process. Capital project and program needs were prioritized prior to development of project and program costs. This overall process allowed the City to focus resources and develop information for areas and projects most likely to be prioritized in a capital improvement program.

Figure 1-1 outlines the approach used to develop this Plan. Detail related to specific assessment efforts can be found in the following technical memorandums, included in this Plan as appendices.

- Technical Memorandum #1 (TM1) - Stormwater Basis of Design and Code Review
- Technical Memorandum #2 (TM2) - Stormwater Basis of Planning
- Technical Memorandum # 3 (TM3) - Hydrology and Hydraulic Modeling Methods and Results

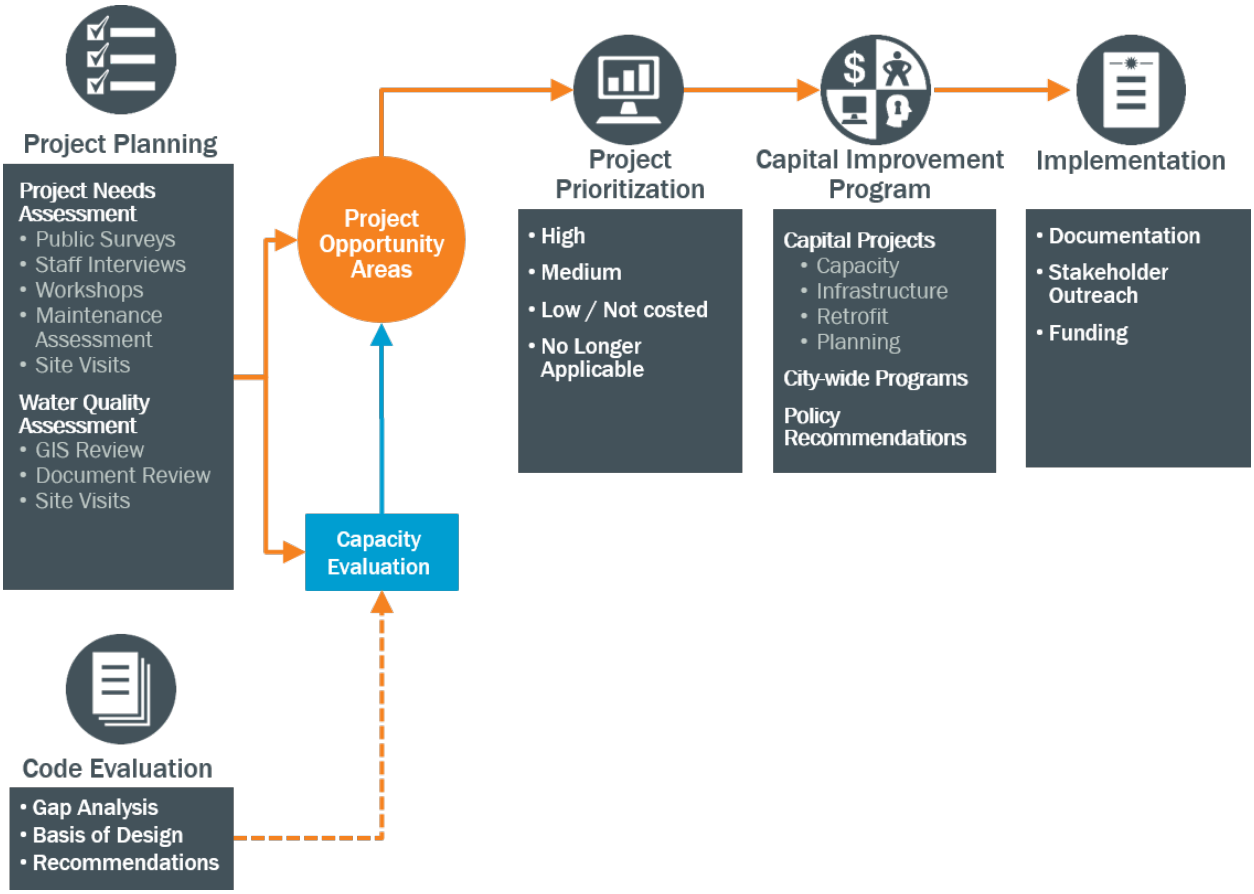


Figure 1-1. Storm Drainage Master Plan approach

1.4 Document Organization

Following this introductory Section 1, this SMP is organized as follows:

- Section 2 includes a description of the study area characteristics.
- Section 3 summarizes the stormwater code evaluation and determination of design criteria to serve as the basis of design.
- Section 4 summarizes the planning process including the project needs assessment (identification of stormwater problem areas) and the water quality assessment. Project Opportunity Areas stemming from the planning process are identified.
- Section 5 describes H/H modeling methods and results of the stormwater drainage system capacity evaluation, including qualification of capacity-related capital project needs.
- Section 6 summarizes the overall storm drainage capital improvement program recommendations including the final capital projects, city-wide programs, policies, and respective cost estimates.

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Section 2

Study Area Characteristics

This section provides an overview of study area characteristics, including location, topography, soils, land use, drainage system configuration, regulatory objectives, and current City stormwater program activities.

Referenced figures reflecting study area characteristics are located at the end of this section.

2.1 Location

The City of West Linn (City) is located 12 miles southwest of Portland, Oregon in Clackamas County. The City is approximately eight square miles in area, bounded on the north by the City of Lake Oswego, on the west by Unincorporated Clackamas County, and on the east by the Willamette River (Figure 2-1). Major transportation corridors of Interstate 205 (I-205) and Oregon Highway 43 (Highway 43) run through the City.

Figure 2-1. Location overview

There are several perennial streams within the City of West Linn that discharge to the Willamette and Tualatin Rivers (Figure 2–2) dividing the City into 24 major drainage basins that range in size from 40 to approximately 600 acres. Approximately 87 percent of the city area drains to Willamette River and the remainder is routed to the Tualatin River (West Linn TMDL Implementation Plan 2019).

2.2 Topography and Soils

West Linn's natural topography is characterized by steep hillsides to the west and relatively flat topography and floodplain area to the east and along the Tualatin and Willamette Rivers (Figure 2-3). Approximately 50 percent of the City has slopes exceeding 10 percent, including specific areas with slopes upwards of 25 percent. Topography can influence the conveyance capacity of channelized and piped infrastructure. Drastic slope changes can exacerbate ponding and backwater flow conditions. Significant grade changes are observed west of the Highway 43 corridor.

Soils are an important watershed characteristic for evaluating potential runoff rates and volumes. Soils are generalized into four categories, or hydrologic soil groups (HSG), which approximate soil runoff potential. These groups are A, B, C, and D, where A soils are characterized by high rates of infiltration and low runoff potential, and D soils are characterized by low rates of infiltration and high potential for runoff.

As shown in Figure 2-3, soils in the City are predominately silt loams with moderate to poor infiltration (HSG Type C, C/D, and D). Table 2-1 summarizes the NRCS hydrologic soil groups by percent coverage.

Table 2-1. Soil Conditions

Hydrologic Soil Group	Percent Coverage (%)
A	2.2
B	7.4
B/D	0.2
C	59.4
C/D	10.2
D	13.1
Water	7.5
Total	**100.0**

2.3 Land Use and Population

West Linn has experienced moderate growth over the last 20 years. In 2000, the City's population was 22,429. In 2019, the City of West Linn's population[1] is estimated to be 26,703, reflecting an average annual increase of less than 1 percent.

The City is primarily composed of low-density residential land use, with areas of commercial and industrial land use along the Willamette River, I-205 and Highway 43 corridors. Vacant lands with potential for redevelopment are located sporadically throughout the City. Expansion of the outer city boundary is not anticipated within the 10 year planning horizon of the SMP, but there are pockets of unincorporated area (mostly single tax lots) within the City where annexation is eventually anticipated. A breakdown of area within the city limits, UGB and contributing drainage basins is summarized in Table 2-2.

[1] http://worldpopulationreview.com/us-cities/west-linn-or-population/

Table 2-2. City of West Linn Area Overview	
Designated Area	Area (ac)
West Linn City Limits	5,186
Urban Growth Boundary	5,245
Contributing Drainage Area (for hydrology)	5,273

Land use coverage was developed in GIS to evaluate stormwater drainage conditions in the City. Land use coverage was based on City-provided GIS coverage of zoning and parks/open space areas. Vacant lands coverage from METRO was refined by City staff to reflect development that has occurred since the GIS coverage was developed. Impervious coverage by land use was provided by City staff based on values assumed in the 2006 Plan, compared with values used by neighboring jurisdictions, and verified based on spot comparisons to aerial imagery. Impervious percentage by land use is shown in Table 2-3.

Table 2-3. Land Use Coverage and Impervious Percentages		
Land Use Category	Impervious Percentage	Percentage of City Area
Commercial	85	2.9
Industrial	85	2.7
Vacant	3	5.3
Open Space/Park	0	11.7
Mixed Use	85	0.3
Residential (High/Multi-family)	50	3.4
Residential (Medium Density)	35	6.1
Residential (Low Density)	30	56.9
Transportation (ODOT Corridor)	35	4.4
No zoning (waterbodies)	0	6.2
TOTAL	--	**100.0**

Figure 2-4 reflects land use coverage for purposes of hydrologic calculations.

2.4 Climate and Rainfall

The northern Willamette Valley climate is characterized by cool wet winters and warm dry summers. Most rainfall occurs between October and April. On average, November is the wettest month with an average of 9.3 inches of rainfall. July and August are the warmest and driest months with average high temperatures above 80 degrees Fahrenheit and less than 1 inch of rain per month. The average annual precipitation for the Portland metropolitan area ranges from 37 to 43 inches, with an average of 1.8 inches of snowfall annually. West Linn specifically averages 44 inches of rainfall a year and 1 inch of snowfall annually.

In December 2015, the Portland metro area experienced a large rainfall event that delivered more than 5 inches of rain over a 3-day period and 2.81 inches in one 24-hour period. This event was estimated to represent between a 50- and 100-year recurrence event because of the intensity and nature of the rainfall. Research suggests that these “severe” events are expected to occur more frequently as the earth undergoes climate change.

2.5 Storm Drainage Infrastructure

The City manages more than 113 miles (approximately 595,260 linear feet [LF]) of stormwater drainage pipe and culverts and approximately 10 miles (52,422 LF) of open channels/ drainage ditches. Table 2-4 summarizes pipe, culvert and open channel system assets by mapped (in GIS) size throughout the City.

Table 2-4. System Asset Inventory–Pipes, Culverts, and Open Channels

Diameter	Length (LF)
N/A	8,570
0-6	29,130
8-12	431,490
14-18	77,950
20-24	28,030
27-30	6,470
36	10,990
40-42	890
48	920
54	310
60	230
66	100
72	220
>72	460
Total (Pipe and Culvert)	595,260
Total (Open Channel)	52,422
Total (Mapped Stream/Creek)	159,491

In addition to the storm drainage system assets identified above, approximately 30 miles of stream channels flow within the city limits, conveying stormwater to the Willamette and Tualatin Rivers. Approximately 15 percent of the stream channels in the City are piped, and thus included as part of the City's asset inventory in Table 2-4.

Table 2-5 summarizes major storm structures in the City, such as manholes, catch basins, clean outs, swales and ponds. Except for swales and ponds, other water quality facilities (i.e., raingardens, planters, porous pavement) are not mapped individually, and thus not included in the storm infrastructure inventory. However, the City does maintain a GIS coverage of public and private water quality facility drainage areas, for compliance with their National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer (MS4) permit. The water quality facility drainage area coverage was developed to reflect development-specific areas that are collectively treated by green streets or other low impact development techniques including raingardens and planters.

Figure 2-5 shows mapped individual public and private water quality facilities and contributing water quality facility drainage areas in the City. Approximately 17% of the City area currently has some form of onsite or regional stormwater treatment.

Table 2-5. Storm Infrastructure	
Facility	Number
Catch basin	2,977
Clean out	86
Ditch inlet/Inlet structure	665
Manholes/Pollution control manholes	1,543/142
Public ponds	47
Public wetlands	6
Swales (public and private)	203

Note: Excludes identified county, ODOT and private infrastructure, unless specified.

2.6 Regulatory Framework

The Oregon Department of Environmental Quality (DEQ) is responsible for implementing provisions of the federal Clean Water Act (CWA) pertaining to stormwater discharges and surface water quality. DEQ issues water quality permits related to surface water discharges, establishes water quality criteria for waterbodies based on designated use, and conducts studies and evaluations to determine whether a waterbody adheres to water quality standards.

Water quality regulations and improvement of instream (receiving water) quality are drivers for this SMP. As a result, a specific objective is identification of additional opportunities for water quality improvement and treatment facilities.

2.6.1 National Pollutant Discharge Elimination System (NPDES) Permit Program

The NPDES Municipal Separate Storm Sewer (MS4) permit program regulates discharges of stormwater to receiving waters from urban areas and requires permitted municipalities to develop and implement stormwater control measures to address stormwater quality.

The City of West Linn is one of 13 co-permittees on the Clackamas County Phase 1 NPDES MS4 Permit for discharges from their stormwater system. Other co-permittees include the neighboring cities of Oregon City, Milwaukie, Lake Oswego, and Gladstone, as well as Clackamas County. The City's NPDES MS4 permit was last issued in 2012 and is currently in administrative extension. Stormwater program requirements, as documented in the City's effective (2012) SWMP address:

- Illicit Discharge Detection and Elimination
- Industrial and Commercial Facilities
- Construction Site Runoff Control
- Education and Outreach
- Public Involvement and Participation
- Post-Construction Stormwater Management
- Pollution Prevention for Municipal Operations
- Stormwater Management Facilities Operation and Maintenance Activities

The 2012 NPDES MS4 permit required the City to prepare and implement a stormwater retrofit strategy and a hydromodification assessment. These technical assessments identified the need for development of water quality-related capital projects and are referenced in Table 1-1.

Future permit compliance has been considered in the identification of capital projects and programs documented in this SMP. Outcomes from the technical assessments were also referenced as part of the planning process. As such, implementation of this SMP is anticipated to help address future permit requirements that stem from previous analyses.

2.6.2 Total Maximum Daily Load (TMDL) and 303(d) Listings

Section 303(d) of the CWA requires states to develop a list of water bodies that do not meet water quality standards. This list is used to identify and prioritize water bodies for development of TMDLs. A TMDL identifies the assimilation capacity of a water body for specific pollutants and establishes pollutant load allocations for sources of discharge to the water body. DEQ is responsible for both the periodic assessment and establishment of the 303(d) list in Oregon and development of TMDLs.

The Willamette and Tualatin Rivers are the major receiving waters for West Linn. These rivers and corresponding tributaries are on the 303(d) list for various parameters of concern and hold TMDLs for specific sources of pollutant loading. Table 2-6 summarizes the current TMDL and 303(d) parameters relevant to the City. The current 303(d) list reflects the addition of pesticides and metals not reflected in previous 303(d) listings. A TMDL for mercury is underway and expected to be finalized in 2019.

Table 2-6. TMDL and 303(d) Summary for West Linn

Watershed/ Major Basin	Sub-basin(s)	TMDL Year	Applicable TMDL Parameters	TMDL surrogate Parameters	Applicable 303(d) Parameters [a]
Willamette River	Lower Willamette	2006	Mercury Bacteria (*E. coli*) Temperature	Effective shade (surrogate for temperature)	• Aldrin • Biological criteria • Chlordane • Chlorophyll a • Copper • Cyanide • DDT/DDE • Dieldrin • Iron • Lead • Polychlorinated biphenyls (PCBs) • Polynuclear Aromatic Hydrocarbons (PAHs)
	Middle Willamette	2006	Mercury Bacteria (*E. coli*) Temperature	Effective shade (surrogate for temperature)	• Aldrin • Biological criteria • Chlorophyll a • DDT/DDE • Dieldrin • Iron • PCBs
Tualatin River	Tualatin	2001 and 2012 (update)	Bacteria (*E. coli*) Chlorophyll a pH Dissolved Oxygen (DO) Temperature	• Total phosphorus (surrogate for chlorophyll a and pH) • Total suspended solids (equivalent parameter for SVS, a surrogate for DO) • Effective shade (surrogate for temperature)	• Ammonia • Biological criteria • Copper • Iron • Lead • Zinc

a. The 2012 303(d) list for Oregon was approved by EPA in December 2018. It is the effective list for Oregon.

As a Phase I NPDES MS4 jurisdiction, the City is required to establish TMDL benchmarks, which are quantifiable pollutant load reduction estimates established to evaluate progress towards meeting TMDL requirements applicable to the City. Through this SMP effort, and because the City is primarily built out, identification of water quality opportunities focused on the retrofit of existing stormwater facilities and less on the installation of new, regional stormwater treatment facilities. Additional information is provided in Section 4.2.

2.7 Storm Drainage System Maintenance and Program Management

The maintenance of the City's storm drainage system assets is important to ensure that the full life expectancy is achieved and the system is functioning as constructed. As part of the project planning process, current stormwater maintenance activities and frequencies were considered in conjunction with stormwater problem areas to determine if programmatic improvements (i.e., increased frequency, expanded program coverage, new program development) may be more effective than a capital project to meet City needs (see Section 4.4).

Under the City's Phase I NPDES MS4 permit and 2012 SWMP, certain stormwater system maintenance activities are required to address water quality improvements. Maintenance activities typically occur on a scheduled basis but also in response to citizen and staff inquiries and requests. Current stormwater maintenance activities and frequencies are outlined in Table 2-7.

Table 2-7. City Maintenance Activities (per 2012 SWMP)

Activity	Frequency required	Annual target [a]	Annual effort [a]
TV inspection	As needed	Varies	100-200 ft
Pipeline cleaning	As needed	Varies	Varies
Ditch inspection/cleaning	As needed	Varies	Varies
CB inspection and cleaning (public)	Annual	All	2,853 inspected; 713 cleaned
MH cleaning (Pollution Control)	Annual	All	145 PCMH inspected; 145 cleaned
Street sweeping	3-6x/year	Varies	Varies
Public water quality pond inspections [b]	Annual	49	49
Public pond maintenance	As needed	--	262 hours
Private WQ facility inspections [c]	As needed	--	27 facility inspections

a. *Based on the City's 2017-2018 annual report.*

b. *Inspection of public stormwater treatment and detention facilities is required per the SWMP. City efforts focus on pond inspection and maintenance activities.*

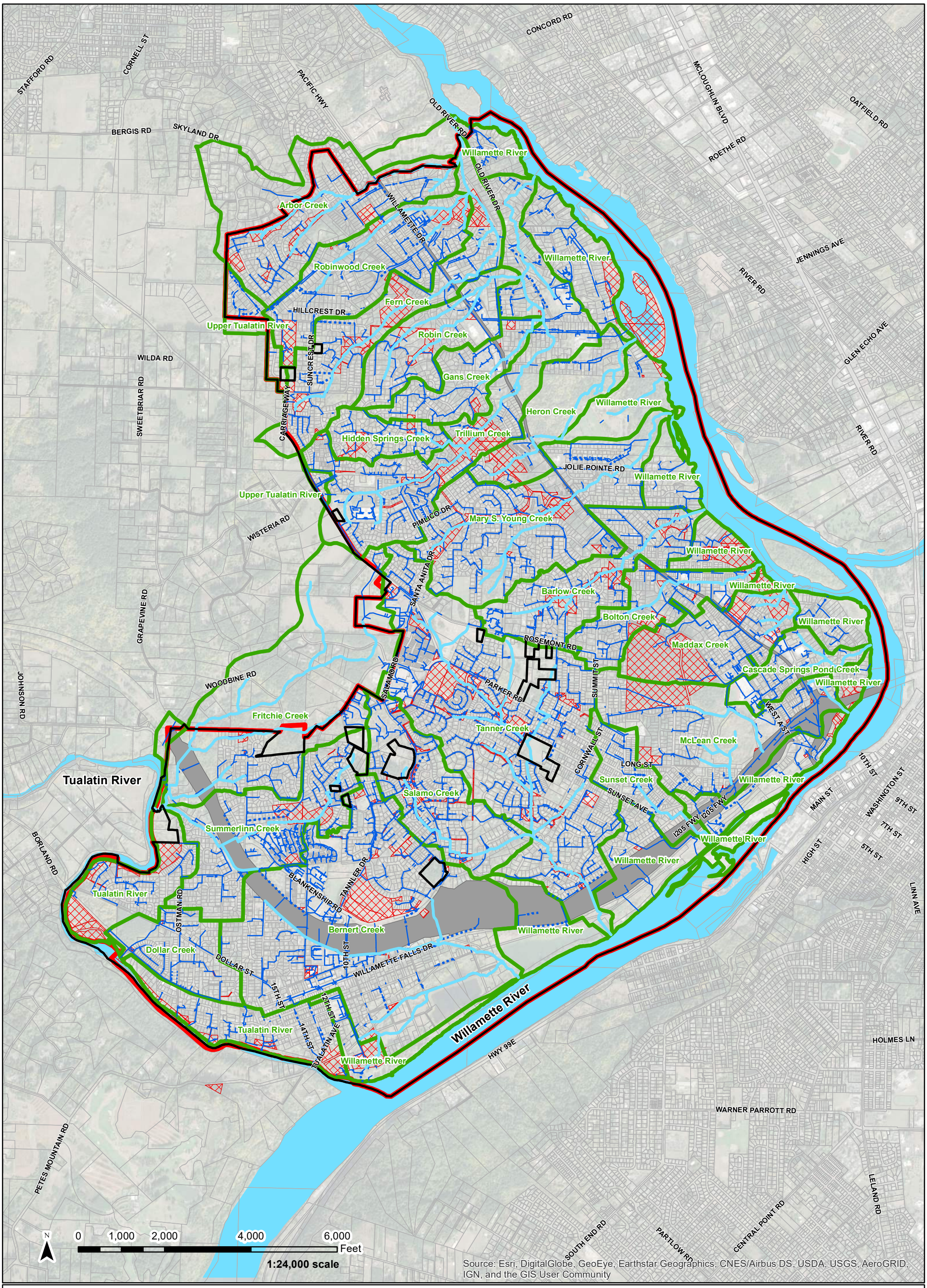
c. *Annual report indicates the number of new private maintenance agreements received. Approximately 30% of registered facilities report on maintenance compliance annually.*

Specific to water quality facility inspections and maintenance, the City has guidance documents and program instructions to assist City staff and the public in performing maintenance activities.

Funded maintenance programs conducted by the City's Environmental Services Division are defined in Table 2-8 per the City's 2018-2019 budget. Existing (current) funding allocations must be considered with respect to proposed expanded programmatic efforts and activities (see Section 6.4).

Table 2-8. Existing Program Funding (2018-19)

Relevant Activity	Annual Budget
Repair of Stormlines	$100,000
Repair of MH/CBs	$10,000
CCTV Inspection	Generally performed with in-house staff/equipment



CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 2-2: Storm Drainage System Overview

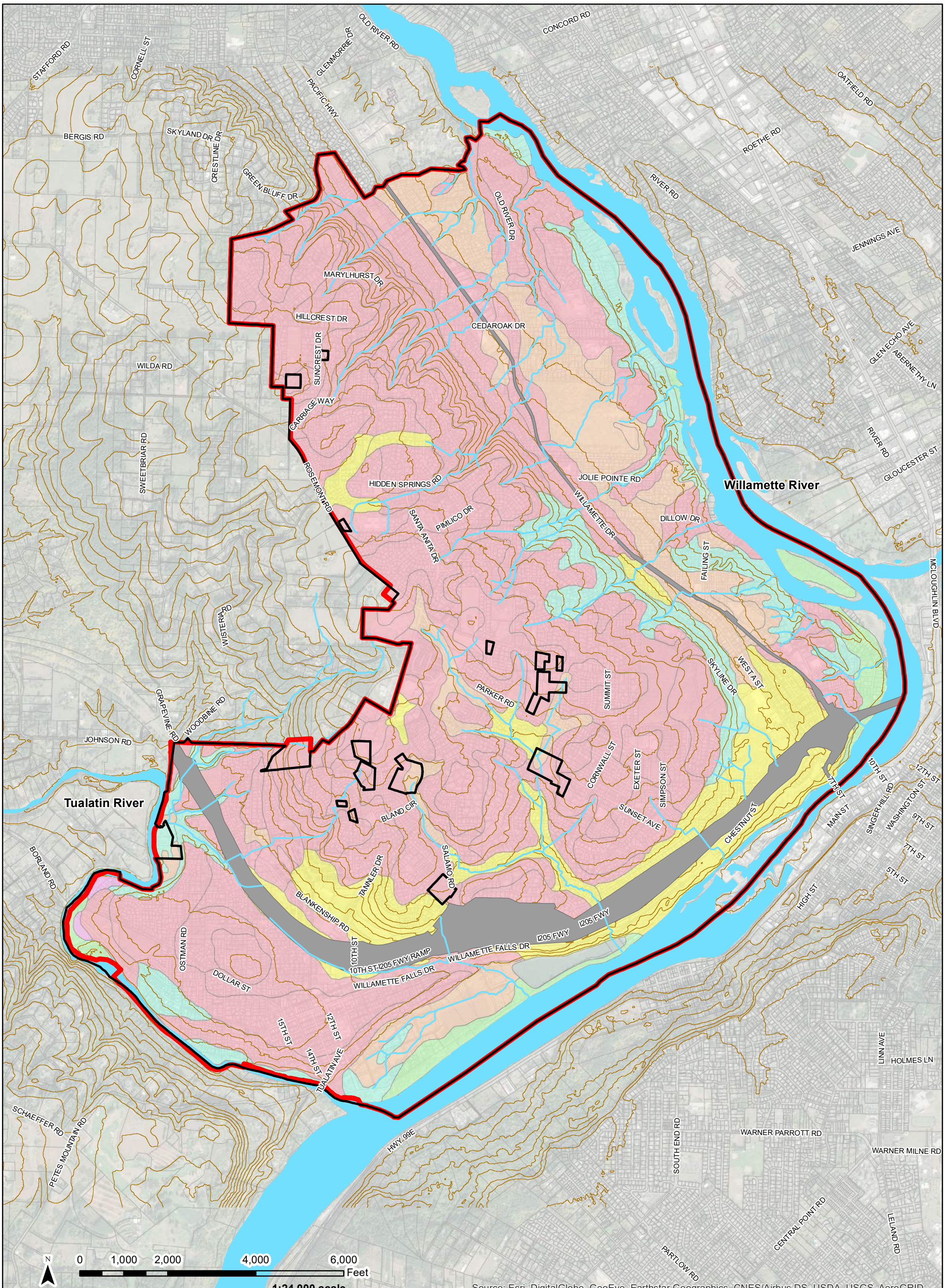
Public Property
Stormwater Pipe
Open Channel
Streams
Watershed Boundaries
ODOT ROW
City Limits
UGB

Data Source: City of West Linn GIS and Metro RLIS

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Map Publication/Print Date: August 2019 Produced by Brown and Caldwell

8/29/2019



CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 2-3: Soils and Topography

Hydrologic Soil Group
- A
- B
- B/D
- C
- C/D
- D

- Contours (50 ft)
- Streams
- ODOT ROW
- City Limits
- UGB

Data Source: City of West Linn GIS and Metro RLIS

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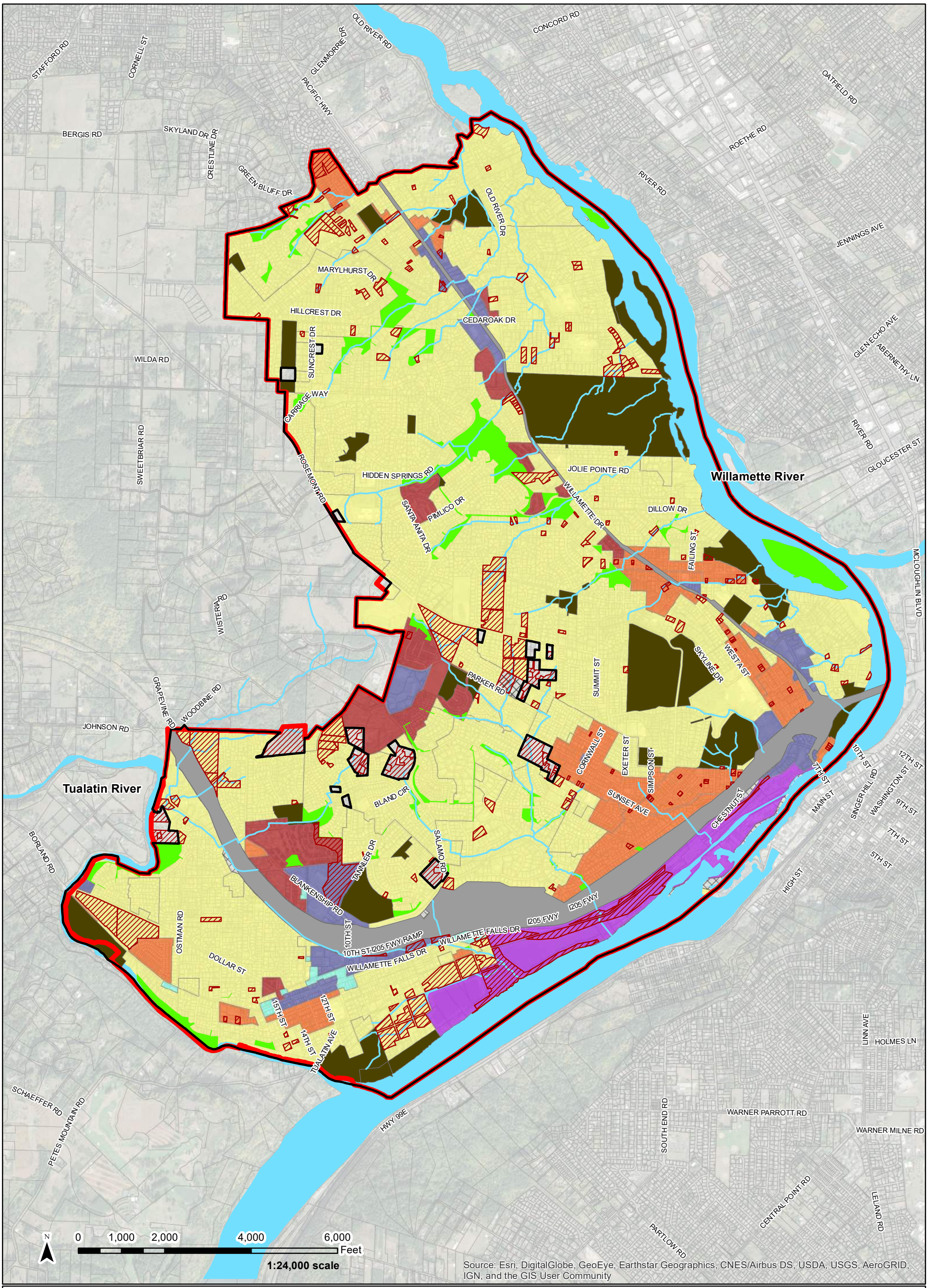

CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 2-4: Existing Land Use

- Commercial
- Industrial
- Residential (Low Density)
- Residential (Medium Density)
- Residential (High Density/Multi-family)
- Mixed Use
- No Zoning (Unzoned)
- Vacant
- Parks
- Open Spaces
- Streams
- ODOT ROW
- City Limits (2017)
- UGB

Data Source: City of West Linn GIS and Metro RLIS

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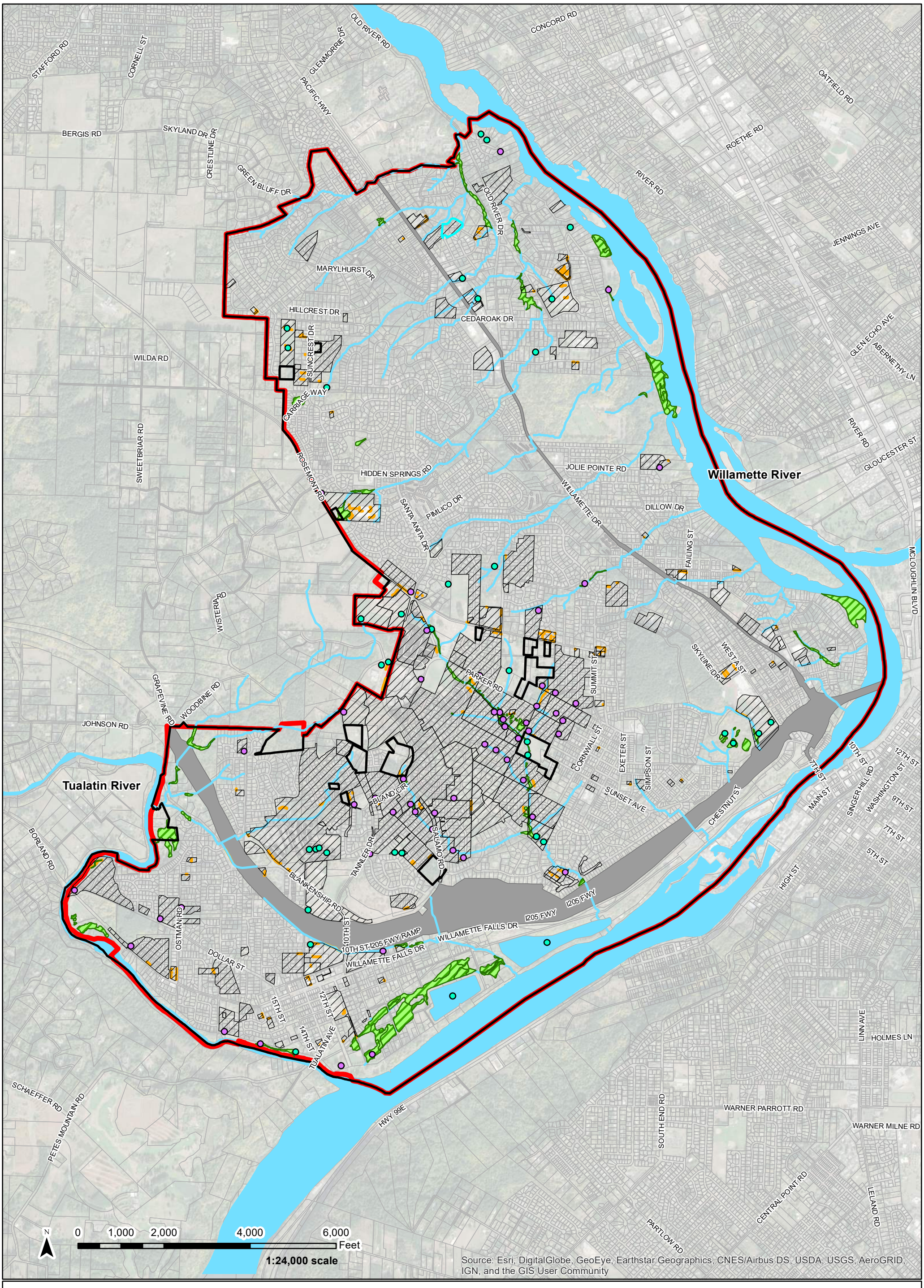

CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 2-5: Storm Drainage Treatment Facilities and Drainage Areas

- Private Ponds
- Public Ponds
- Swale
- Wetlands
- Water Quality Facility Drainage Areas[1]
- Streams
- ODOT ROW
- City Limits
- UGB

Data Source: City of West Linn GIS and Metro RLIS

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

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1. Other water quality facilities (i.e. rain gardens, planters, porous pavement) not individually mapped are reflected in this coverage.

9/9/2019

Section 3

Code Evaluation and Basis of Design

This section summarizes review of the City's current (as of October 2018) code and standards applicable to this SMP. Elements of the code review included conveyance, water quality, erosion and sediment control, maintenance, and code enforcement. Code review was limited to the following sections of City code and standards:

- West Linn Municipal Code (WLMC), Chapter 4 Utilities, Chapter 5 Nuisances, and Chapter 8.105 Building Permittee Responsible for Erosion Prevention and Sediment Control
- West Linn Public Works Design Standards (PWDS), Section 2, Storm Drain Requirements
- West Linn Public Works Standard Construction Specifications, Division 6, Storm Drain Technical Requirements
- West Linn Community Development Code (CDC), Chapter 55 Design Review, Chapter 56 Parks and Natural Area Design Review, and Chapter 92 Required Improvements

The initial code review was conducted in November 2017 and identified inconsistencies, implementation gaps, and technical recommendations. As a result, in October 2018, the City addressed select recommendations from the initial code review in an update of their PWDS. Outstanding (following the October 2018 update) recommendations and basis of design used to evaluate system deficiencies and develop capital projects for this SMP are detailed below.

The comprehensive code review, reflecting original recommendations and updates made to the PWDS in October 2018, is documented in Technical Memorandum #1 (TM1), included in this SMP as Appendix A.

3.1 Code Recommendations

The following outstanding code recommendations reflect: 1) potential modifications to the City's policies and technical design standards, and 2) adjustments to code to improve clarity, resolve discrepancies, and ease implementation of existing policy and standards.

Example language to address recommendations specific for PWDS 2.0040 and 2.0050 can be found in Appendix A, Attachment C.

3.1.1 Technical Standards and Stormwater Policy Changes

Recommendations listed are specific to the CDC and PWDS and intended to improve consistency with the NPDES MS4 permit requirements and guide developers implementing stormwater management in the City. Note that recommended changes may require a more in-depth review of current City practices and pending updates to the Portland Stormwater Management Manual (SWMM), to establish City policy prior to code development.

- **CDC**: Consider updating current floodplain management code sections to reflect floodplain standards consistent with the *Program Level Biological Assessment* for the National Floodplain Insurance Program for the State of Oregon (February 2013). In addition, floodplain management regulations should be moved from the CDC to the WLMC.
- **PWDS, Water Quality:** Modify PWDS 2.0013 to state specific design storms. Based on the site-specific analysis conducted for Clackamas County jurisdictions, the water quality design storm should be the 1 inch 24-hour design storm, resulting in capture of 80 percent of the annual runoff volume.
- **PWDS, Facility Selection:** Expand PWDS 2.0013 or 2.0040 and 2.0050 to list a City-specific facility selection hierarchy that prioritizes green infrastructure facilities and clarify which impervious area reduction techniques (e.g., green roofs, pervious pavers/pavements, tree planting, rainwater harvesting) are allowable in the City.

3.1.2 Clarity and Implementation Changes

Recommendations listed below are intended to improve clarity and ease implementation related to the referenced use of the Portland SWMM. Proposed revisions should not impact City policy or technical standards.

The PWDS currently references the entire Portland SWMM. Portland makes frequent updates to the SWMM and associated details and forms, which should be considered by the City. Recommended adjustments related to implementation of the Portland SWMM are listed below.

- **PWDS, Facility Selection:** Revise PWDS 2.0013 or 2.0040 and 2.0050 to include a City-specific list of allowable BMPs and BMP selection hierarchy. This would give the City more control over the types of facilities that are installed in West Linn. The PWDS could still refer to the Portland SWMM for a list of allowable proprietary treatment technologies.
- **PWDS, SWMM References**: Throughout the PWDS, revise general Portland SWMM references to instead refer to the "BMP sizing methodologies, design criteria, and typical drawings in the Portland Stormwater Management Manual" so that designers have clear guidance for the specific portions of the Portland manual that apply to West Linn.
- **PWDS, Technical Guidelines**: Consider adding detail to PWDS 2.0040 and 2.0050 to refer to specific technical guidelines in the Portland SWMM. These could include the Portland SWMM appendices related to infiltration testing, proprietary treatment technologies, source control standards, maintenance standards, and soil and plant lists.

Table 3-1 summarizes additional recommendations solely to improve clarity and minimize use of redundant or repetitive references in the City's current standards.

Table 3-1. Recommended Code and Standard Clarifications		
Section	Recommended Revision	Notes
WLMC4.063 General Discharge Prohibitions	Consider adding a list of permissible or conditionally allowable discharges, consistent with NPDES MS4 permit section A.4.a.xii.	
WLMC 4.065 City Responsibilities	Expand the list of drainage facilities to include "stormwater treatment and control facilities located on public property."	Current language indicates that the City is responsible only for flood control facilities.
WLMC 8.105 Erosion Prevention/Sediment Control	Add a reference to PWDS 2.0060 for erosion control permit types and applicable thresholds.	Erosion control permits are required only for projects that disturb over 1,000 sf. WLMC 8.105 indicates that all building permit projects require an erosion control permit.
PWDS 2.0011 Site Drainage Requirements	Delete items D and E	Items D and E relate to minimum requirements for detention and water quality facilities and are covered under the appropriate section (PWDS 2.0013).
PWDS 2.0045 Detention Facilities	Reformat for clarity: numbered items 3 and 5 should be C and D; numbered item 4 should be combined with item A.	Item A and item 4 have duplicate content.

3.2 Basis of Design

Table 3-2 lists applicable design criteria used to identify areas of the storm drainage system with capacity limitations and develop projects to address capacity deficiencies. Design criteria reflect the most recent update to the PWDS in October 2018. Expanded tables of drainage design criteria are included in Appendix A and Appendix C (TM3, *Hydrology and Hydraulic Modeling Methods and Results*).

Table 3-2. Project Evaluation and Design Criteria		
Criteria	Source	Standard
Water Quality Facility Design	PWDS 2.0013	All water quality facilities shall meet the design requirements of the current edition of the City of Portland SWMM.
Conveyance Piping Design	PWDS 2.0013	• Design to convey the 10-year storm event. • Minimum slope of 0.0055 (0.55%). • Minimum velocity of 2 feet per second, when flowing full. • Pipe roughness design coefficient shall not be less than 0.013.
Culvert Design	PWDS 2.0014	Design to convey the 25-year storm event such that the headwater does not exceed 1.5 times the culvert diameter.
Open Channel Design	PWDS 2.0013	Control discharge so that the average velocity during the 10-year event is below the erosive velocity of the channel.
Pipe Size	PWDS 2.0012 PWDS 2.0033	12" minimum diameter for mains in the public right-of-way.
Pipe Material	PWDS 2.0012	• Concrete, PVC, HDPE smooth interior/corrugated exterior are allowable. • Ribbed PVC is preferred for storm drains up to 24" in diameter. • Reinforced concrete is preferred for storm drains over 24" in diameter. • Ductile iron is allowed in areas where additional strength is required.
Pipe Cover	PWDS 2.0023	Minimum cover shall be 30" above the top of the bell of the pipe in paved areas and 36" in all other locations. When minimum cover cannot be provided, implement additional strength measures.
Structure Spacing	PWDS 2.0031-2.0033	Maximum of 500 feet between manholes.

Design storms are precipitation patterns typically used to evaluate the capacity of storm drainage systems and design capital improvements for the desired level of service. Design storms evaluated in this SMP include the 2-, 10-, and 25-year recurrence interval 24-hour events. Design storms are not specified in the City's PWDS (see Section 3.1.1). As such, the rainfall depths were taken from Clean Water Services (CWS') *Design & Construction Standards*, Standard Detail Drawing No. 1280 (Table 3-3).

Table 3-3. Design Storm Depths

Design storm event	Rainfall depth, inches
2-year, 24-hour	2.50
10-year, 24-hour	3.45
25-year, 24-hour	3.90

Section 4

Project Planning Process

This section summarizes the project planning process and identification of Stormwater Project Opportunity Areas, which inform the capital project, program and policy development efforts. A project needs assessment and a water quality assessment were conducted as part of this collaborative process with city staff (engineering and maintenance) and the public. Proposed roadway improvements along Oregon Highway 43 (Highway 43) also informed the process.

This process allowed the City to focus resources and develop information for areas and projects most likely to be prioritized in a capital improvement program. This process qualified project needs in consideration of the SMP objectives, specifically: resolving known areas of stormwater drainage problems and flooding; enhancing and expanding water quality treatment; and identifying programs and policies to address stormwater needs on a city-wide scale.

The project planning process is described in additional detail in Technical Memorandum #2 (TM2), included in this SMP as Appendix B. The final Stormwater Project Opportunity list and figure depicting project opportunity locations recommended for the storm drainage capital improvement program is provided in Appendix C.

4.1 Project Needs Assessment

The project needs assessment included the identification of "stormwater problem areas" as areas of the City with reported and observed deficiencies. It also included the evaluation of whether a public infrastructure improvement, addition, replacement, or retrofit would address the deficiency. As the City is not anticipating significant growth or change in contributing stormwater runoff, city-wide hydraulic modeling, as conducted for the 2006 Plan, was not conducted to identify project needs.

The City typically receives few complaints regarding the storm drainage system function or capacity. The City also anticipates limited growth (annexations) and new development over the SMP planning period (i.e., 10 years). As such, a qualitative effort to evaluate the identified stormwater problem areas was used to validate the need for system improvements (projects or programs).

Data sources used for the project needs assessment included the following:

- System GIS data[2]
- Public and City staff surveys

[2] Approximately 77% of the piped storm drainage system inverts were not reflected in GIS. This data gap was considered in the context of conducting city-wide hydraulic modeling.

- Planning documentation and reports
  - Stormwater Retrofit Plan (2015)
  - Hydromodification Assessment (2015)
- Previous Project List (per the City's 2006 Plan)
- Site Visits
- Project Workshops with City staff (November 30, 2017 and February 15, 2018)

A total of 65 stormwater problem areas were originally identified, compiled and categorized in accordance with the following primary deficiency:

- Capacity
- System Configuration
- Infrastructure Needs
- Erosion
- Water Quality (related to existing system performance)
- Maintenance
- System Condition

Identified system deficiencies include failing infrastructure as well as capacity limitations.

(Photo: Culvert crossing at 5th Ave.)

Stormwater problem areas were documented in a matrix format and sorted based on whether a capital project or city-wide program would best address the deficiency. See Appendix B for detail.

4.2 Water Quality Assessment

A water quality assessment was conducted to identify additional project opportunities for consideration in the City's SMP. This assessment addresses commitments outlined in the City's Stormwater Retrofit Plan (2015), 2012 NPDES MS4 permit, and 2012 SWMP.

City charter (West Linn Charter, Chapter 11, Section 46) limits the use of park property for any "nonauthorized" use without voter approval as related to the construction of utilities. A regional stormwater treatment facility would be considered a utility subject to provisions of this charter. As described previously, the City is also primarily built out with limited available property for acquisition and/or use for construction of a regional stormwater treatment facility. As such, the water quality assessment focused on the "retrofit" of existing stormwater infrastructure, to minimize land use and administrative challenges related to the addition of new stormwater infrastructure in public property. The water quality assessment focused on the following objectives:

1. Expand treatment area coverage of existing stormwater treatment facilities or practices;
2. Improve the function of existing stormwater treatment facilities; and
3. Incorporate low impact development (LID) or green infrastructure applications where possible, as they promote infiltration and runoff volume reduction in addition to treatment.

A desktop GIS evaluation was conducted to comprehensively look at locations that would benefit from water quality improvements and facilities that could be retrofit to improve water quality. Areas of the City with anticipated relatively higher pollutant load generation based on land use and pollutants of concern (see Table 2-6) were targeted. Existing, mapped stormwater ponds were inventoried and evaluated to assess retrofit potential. Pond ownership condition (public, private), installation date, configuration (online vs offline), and potential for future development to occur upstream were considered as part of the pond inventory. Stormwater problem areas (Section 4.1) where collection system improvements are identified as

needed were targeted for incorporation of LID or green infrastructure applications. Opportunistic areas (i.e., vacant, public, or undeveloped areas) where regional treatment facilities may be located were reviewed, but minimal opportunities identified.

A total of 21 water quality opportunities were initially identified. Ten opportunities (locations) overlapped with results of the project needs assessment, and thus water quality was integrated into the project development process for those locations. Five opportunities were identified as potential new projects. Six opportunities were removed from consideration due to site constraints, limited potential for retrofit or land acquisition, or where water quality is already being addressed. See Appendix B for detail.

Green infrastructure incorporated into existing streetscapes can aid in stormwater collection as well as treatment.

(Photo: Stormwater "bubbler" applications on Buck St.)

4.3 Highway 43 Drainage Evaluation

The City is currently partnering with ODOT under the Highway 43 Multimodal Transportation Project (Highway 43 Project) to construct a new bike lane and sidewalk along Highway 43. The project effort is divided into two phases, with Phase I extending from Arbor Drive to Hidden Springs Road. Phase II extends from Hidden Springs Road to I-205. The City entered into a Cooperative Maintenance Agreement with ODOT in February 2018 to initiate design and construction of Phase I. Construction of Phase I is anticipated to begin in 2020. Roadway improvements are anticipated to change the roadway grade and expand impervious surface area subject to water quality treatment requirements.

Given anticipated improvements to the roadway alignment and profile, five stormwater problem areas identified during the project needs assessment (Section 4.1) are likely to change or be addressed through the improvements to roadway drainage as part of this project. These areas are documented as a Stormwater Project Opportunity Area (Appendix C), but not directly addressed with a proposed project in this SMP.

There are currently 24 mapped crossings (culverts) under Highway 43 that convey upstream piped or open channel drainage systems. With timing of the Highway 43 project, the City opted to evaluate the conveyance capacity of the culvert crossings so that capital projects can be identified to address the upsizing and/or realignment of crossings and implementation can occur in conjunction with the scheduled roadway improvements. This hydraulic evaluation is summarized in Section 5.

New and replaced impervious area resulting from the Highway 43 Project are subject to the City design standards for stormwater treatment. Federal funding and anticipated Nationwide permitting requirements for this transportation project also make stormwater management subject to SLOPES V requirements. Opportunities for water quality treatment associated with Highway 43 improvements were evaluated as part of the water quality assessment (Section 4.2)[3], but due to the unknown gradation and design of the roadway, water quality treatment needs are not directly addressed with proposed projects in this SMP.

[3] The City received voter approval for the use of park property to support stormwater management associated with Highway 43 improvements, and therefore park property may be used to site stormwater facility installations for this purpose.

4.4 Results

Appendix C (Table C-1 and Figure C-1) summarizes the Stormwater Project Opportunity Areas identified through the project needs, water quality, and Highway 43 project assessment efforts. This information was originally compiled and documented as part of the project planning process (Appendix B). However, additional refinements during the project needs prioritization (Section 4.4.1) and capacity evaluation (Section 5) resulted in updates to the Appendix B documentation.

Table C-1 summarizes 22 capital project needs resulting from the assessments. Three of these capital project needs are proposed to be addressed as part of a planning study. Fourteen additional locations are proposed for consolidation, to be addressed as part of city-wide program development addressing city-scale maintenance needs and opportunistic water quality improvements. Additional detail on capital project and program development is provided in Section 6.

There were 28 originally-identified project needs that, upon additional review and discussion with the City, were not considered viable project or program opportunities. These locations are documented in Appendix C for reference.

4.4.1 Project Prioritization

Stormwater Project Opportunity Areas were reviewed by city staff to prioritize those areas requiring development of detailed project concepts and costs in accordance with a defined project implementation schedule. Project opportunities considered high or medium priority are anticipated to be initiated over the 10-year implementation period, and thus warranted a project concept and cost estimate. Program opportunities were collectively considered medium priority, thus warranting funding but not at the expense of high priority project needs.

Table 4-1 summarizes the prioritization criteria used to rank opportunities. Prioritization criteria applicable to specific Stormwater Project Opportunity Areas is reflected in Table C-1. Full results of the prioritization effort are described in Section 6.

Table 4-1. Prioritization Criteria

Criteria	Scoring Definition		
	High (H)	Medium (M)	Lower (L)
Flooding Issue	• Addresses an area of known or significant capacity deficiency or erosion potential. • Identified as currently flooding per hydraulic modeling efforts.	• Addresses localized flooding issue.	• No reported flooding concerns or safety issues associated with project location.
Water Quality Improvement	• Project addresses pollutants of concern and may be classified as a retrofit per the City's 2015 Retrofit Plan.		• Project moderately improves or doesn't improve water quality.
Location	• Located on public property or within the public ROW		• Located on private property in its entirety.
Maintenance	• Project addresses failing infrastructure or a lack of infrastructure. • Project provides increased longevity for facility function.	• Project will reduce existing maintenance needs or complaints.	• Project does not address existing maintenance deficiency.
Concurrence with Transportation Projects	• Project is associated with a transportation project anticipated for construction in the next 5-years.	• Project is associated with a transportation project anticipated for construction in the next 5 to 10 years.	• Associated transportation project is not expected in the next 10 years or a pending transportation project will address deficiency without additional resources.
Special Interest	• Project has City Council, city staff, or public interest/motivation.	• Project has some public interest/motivation.	• Project has no public driver or interest.

4.4.2 Modeling Needs

After identifying Stormwater Project Opportunity Areas and priorities, modeling needs were evaluated. The project needs assessment included the identification of six targeted areas of the city that would benefit from hydrologic and hydraulic modeling to confirm observed deficiencies and inform conceptual sizing of improvements:

1. 5th Avenue Culvert (Location ID 13)
2. Blankenship Road (Location ID 47)
3. Fairview Way (Location ID 56)
4. Sunset Creek Culvert at Willamette Falls Drive (Location ID 59)
5. Fern Creek at Kantara Way (Location ID 60)
6. Maddox Creek at River Street (Location ID 63)

In addition to the six locations listed above, the need to evaluate capacity of the 24 culvert crossings underneath Highway 43 was also identified.

Refer to Appendix C for description and map of modeling needs by Location ID. Detail related to the hydrologic and hydraulic (H/H) modeling methodology, model results and associated project development is included in Section 5.

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Section 5

Storm Drainage System Capacity Evaluation

Stormwater conveyance is the primary function of the City's storm drainage infrastructure. This section summarizes the H/H system modeling approach and results for targeted areas of the City, to verify observed capacity limitations and develop project solutions.

Existing and future system capacity was evaluated for six targeted areas of the City, as well as the 24 culvert crossings under Highway 43. Capital project recommendations were developed for each modeled area following verification of capacity limitations and assessment of project alternatives. Six capital project recommendations result from this H/H modeling effort (see Section 6.4).

The system capacity evaluation and H/H model results are described in additional detail in Technical Memorandum #3 (TM3), included in this SMP as Appendix D.

5.1 Modeling Approach

H/H modeling was conducted for areas of the City with known capacity limitations or where flooding is frequently observed. This targeted modeling approach focused resources on specific areas of the city where additional information is needed to quantify system flooding and develop project solutions.

For this SMP, the following modeling approach was used to evaluate conveyance capacity:

1. Compile a list of known and suspected problem areas and evaluate which areas will require modeling to inform corrective measures (see Section 4.1);
2. Assess modeling needs in terms of whether a detailed or more limited hydraulic model is required (refer to Section 5.3.1);
3. Review available data (via GIS, as-builts, etc.) to identify data gaps and data required for model development;
4. Document observed data gaps in a format to support the City-obtained collection of field survey information and updates to the City's GIS;
5. Refine delineated subbasins (per the City's 2006 Plan) and develop a city-wide hydrologic model to estimate stormwater runoff generated for existing and future development conditions;
6. Develop the hydraulic models;
7. Validate modeled flooding using anecdotal information (photographs, City records);
8. Verify capacity constraints and identify potential sources or causes of flooding with City staff; and
9. Use the validated hydraulic models to simulate alternative conveyance system designs and develop potential solutions to capacity problems.

5.2 Hydrologic Model Development and Results

A city-wide hydrologic model was developed using XP-Storm Water Management Model (XPSWMM) version 2016.1. Within the model, the RUNOFF method was used to estimate hydrology. The input parameters for the RUNOFF Method included subbasin area, slope, width, infiltration conditions, and impervious percentage. The hydrology routine in XPSWMM converts rainfall into stormwater runoff based on design storm parameters (e.g., volume and intensity of rainfall), the input parameters listed above, and the infiltration conditions of the soils based on soil type.

Hydrologic model methods are described in additional detail and results are tabulated in Appendix D. Overall, when compared to existing conditions, the hydrologic model results showed minimal increases in future flows for most subbasins, due to limited potential for new development activities (i.e., mapped vacant lands). The largest increases in flow were identified in subbasins with larger amounts of vacant land, such as in the Bernert Creek and Tanner Creek watersheds.

5.3 Hydraulic Model Development and Results

To evaluate flood hazards and stormwater infrastructure capacity, the XPSWMM computer model was used to simulate select pipe and open-channel systems and calculate peak flows, water surface elevations, and velocities within the modeled infrastructure for select design storms. Hydraulic model input parameters included conduit (pipe or open channel) name, upstream (US) and downstream (DS) node information (name, invert elevation, rim elevation), conduit length, conduit slope, conduit shape, and pipe diameter.

5.3.1 Model Development

For purposes of this SMP, hydraulic model development was categorized as either detailed hydraulic modeling or limited hydraulic modeling.

Detailed hydraulic modeling incorporated the use of multiple nodes and links to evaluate performance of a collection system network. Two areas of the City were selected for detailed hydraulic modeling due to reported flooding frequency and the need to understand the potential cause(s) and extents of flooding:

1. Blankenship Road (Location ID 47)
2. Fairview Way (Location ID 56)

Limited hydraulic modeling included the assessment of capacity of a single link (i.e., culvert), accounting for the contributing upstream drainage but not incorporating hydraulic modeling of the upstream collection system. Five areas of the City were selected for limited hydraulic modeling:

1. 5th Avenue Culvert (Location ID 13)
2. Sunset Creek Culvert at Willamette Falls Drive (Location ID 59)
3. Fern Creek at Kantara Way (Location ID 60)
4. Maddox Creek at River Street (Location ID 63)
5. Highway 43 Culvert Crossings (24 total)

Flat topography and an insufficient stormwater collection system along Blankenship Road frequently results in ponded water and road closures during storms.

(Photo: Blankenship Road at I-205)

Figure 5-1 provides an overview of the hydraulic modeling locations (with the exception of the Highway 43 culverts) and contributing drainage area. Figure 5-2 provides the same overview specific for the Highway 43 culverts.

5.3.2 Results and Capital Project Development

The hydraulic model results show very little increase in future flows for areas that are fully developed. The hydraulic model results confirmed stormwater problem areas/capacity limited areas as identified by City staff or in the 2006 Plan and provided additional information about potential sources of the flooding problems.

For the detailed hydraulic model areas, flooding was identified when water exited the closed conveyance system, or for open channels, when the maximum water surface elevation at any modeled node was equal to or greater than the ground elevation of the node. For the limited hydraulic model locations, flooding was identified for culverts based on whether the headwater was above 1.5 times the culvert diameter (see Table 3-2). A secondary design criterion for culverts (headwater was less than 1 foot below the roadway subgrade) was also evaluated, but not used to determine system deficiencies due to the unknown accuracy of the roadway elevations.

Detailed hydraulic modeling results are provided in Appendix D, including tables reflecting maximum water surface elevations and maximum peak flows for each modeled conduit.

Table 5-1 below summarizes the model estimated frequency of flooding for each modeled system and resulting capital project development approach.

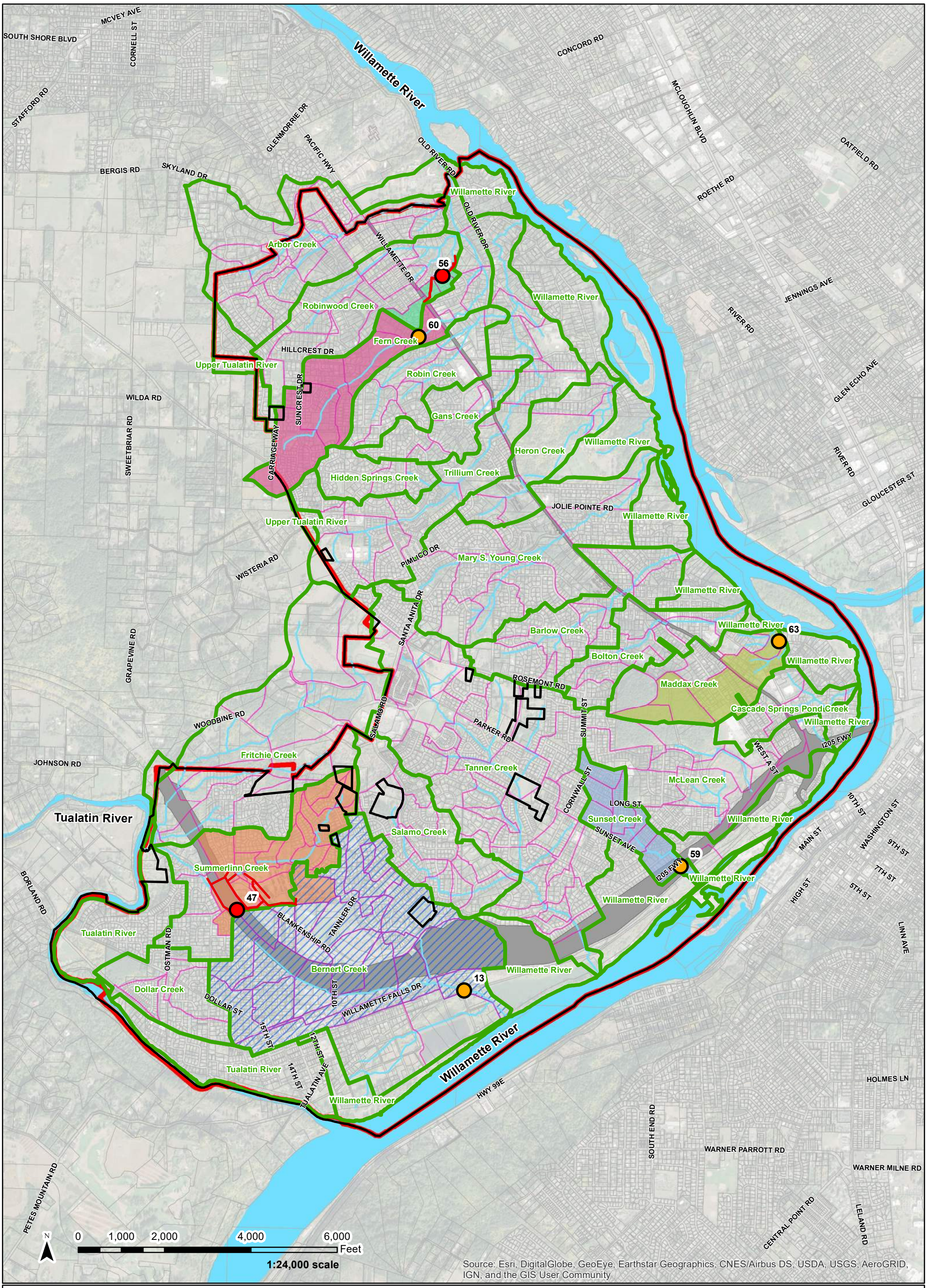
Table 5-1. Capacity Evaluation Results

Model Area	Modeling Approach	Frequency of Flooding	Capital Project Development (Y/N)
5th Avenue Culvert (Location ID 13)	Limited	2-year, existing condition	Y – High Priority Project Need
Blankenship Road (Location ID 47)	Detailed	2-year and 10-year, existing condition for select pipes	Y - High Priority Project Need
Fairview Way (Location ID 56)	Detailed	10-year, existing condition for select pipes	Y – High Priority Project Need
Sunset Creek Culvert at Willamette Falls Drive (Location ID 59)	Limited	2-year, existing condition	Y – High Priority Project Need
Fern Creek at Kantara Way (Location ID 60	Limited	2-year, existing condition	Y – Low Priority Project Need [a]
Maddox Creek at River Street (Location ID 63)	Limited	2-year, existing condition	Y – High Priority Project Need
Phase I Highway 43 Culverts [b] (Crossings A – M)	Limited	• 2-year, existing condition (Crossings A, B, C, H, L, M) • 10-year, existing condition (Crossing D) • 25-year, existing condition (Crossing J)	Y – High Priority Project Need
Phase II (Future) Highway 43 Culverts [b] (Crossings N - X)	Limited	• 2-year, existing condition (Crossing P) • 10-year, existing condition (Crossings O, S, W) • 25-year, existing condition (Crossing R)	Y – Low Priority Project Need [c]

a. *This location is considered low priority following review with the City. The culvert location is in a ravine with no reported flooding or potential for property damage. It is still considered a capital project need but has not been costed under this SMP.*

b. *Refer to Figure 5-2 for crossing locations and naming.*

c. *These crossings are considered low priority following review with the City. Timing of the future, Phase II construction is unknown. These crossings are still considered a capital project need but have not been costed under this SMP.*



CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 5-1: Storm Drainage System Overview (Targeted Hydraulic Model Locations)

Contributing Drainage Area (by Location ID)
- 13
- 47
- 56
- 59
- 60
- 63
- Modeled Conveyance System (detailed model)

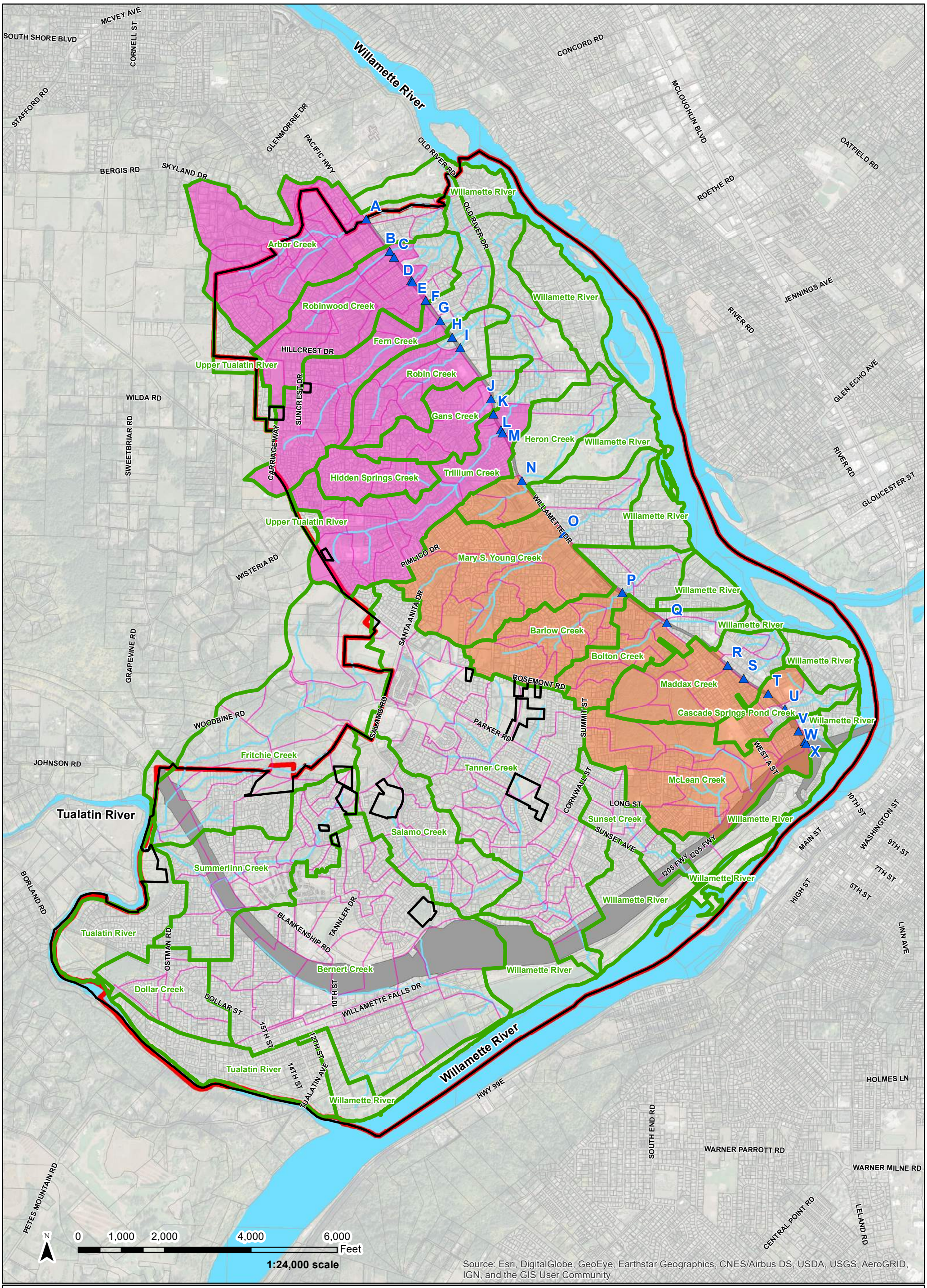
- Detailed Hydraulic Model
- Limited Hydraulic Model
- Streams
- Watershed Boundaries
- Subbasins
- ODOT ROW
- City Limits
- UGB

Data Source: City of West Linn GIS and Metro RLIS

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Map Publication/Print Date: August 2019 Produced by Brown and Caldwell

8/29/2019



CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 5-2: Storm Drainage System Overview
(Highway 43 Crossing)

Contributing Drainage Area
- Highway 43 (Phase I)
- Highway 43 (Future)
- Highway 43 Crossings

- Streams
- Watershed Boundaries
- Subbasins
- ODOT ROW
- City Limits
- UGB

Data Source: City of West Linn GIS and Metro RLIS

Disclaimer: This product is for informational purposes and may not have been prepared for or be suitable for legal, engineering, or surveying purposes. Users of this information should review or consult the primary data and information sources to ascertain the usability of the information.

Map Publication/Print Date: August 2019 Produced by Brown and Caldwell

8/29/2019

Section 6

Capital Improvement Program

This section summarizes the capital project, program, and policy recommendations identified through the master planning process, collectively comprising the City's Storm Drainage Capital Improvement Program.

A total of 26 capital projects, including 5 planning-related studies, were identified to address current and future storm drainage infrastructure needs related to capacity/flooding, water quality, and system condition and repair. Capital project recommendations are considered a one-time cost and are categorized (numbered) as follows:

- Capacity Projects (C)
- Infrastructure Improvements/Addition Projects (I)
- Water Quality Retrofit/Erosion Prevention and Control Projects (R)
- Planning Projects (P)

Five programmatic recommendations addressing city-wide system repair and replacement (R/R) needs, routine system maintenance, and ongoing water quality retrofits were also identified. Program recommendations are intended to support ongoing asset management efforts and are considered annual costs. These city-wide programs are categorized as:

- General/Asset Management Programs (G)

Table 6-1 provides a comprehensive summary of the storm drainage capital improvement program, including project and program costs and schedule. Costs are provided for high and medium priority project needs. The SMP schedule is based on a 10-year implementation timeframe and is associated with identified project priorities. Program recommendations are considered medium priority and associated costs are annual. Policy recommendations are detailed in Section 6.5 but not reflected in Table 6-1, due to no cost being associated with the policies.

Figure 6-1, at the end of this section, provides an overview of project locations throughout the City by priority and category.

6.1 Summary of Recommended Actions

Project, program and policy recommendations in this SMP are proposed to improve and enhance drainage infrastructure and water resources throughout the City, as summarized by the following recommended actions.

- Implement identified system capacity improvements (i.e., reconfiguration, rerouting, upsizing) to manage more frequent, nuisance system flooding.
- Increase water quality treatment throughout the City by expanding treatment area coverage and enhancing the level of treatment provided in existing facilities.

- Incorporate LID or green infrastructure to expand water quality treatment in locations where utility improvements or transportation-related/pedestrian improvements are anticipated.
- Incorporate system configuration and condition data (i.e., stormwater facility inspection records, CCTV, survey) into a larger asset management program to allow for proactive maintenance, repair, and replacement of stormwater infrastructure.
- Conduct regular updates to the WLMC and PWDS to ensure clear guidance is provided to the development community and is consistent with regulatory requirements.
- Establish city policies to address beaver management as pertaining to local flooding issues.
- Clearly document capital project and program costs and schedule to inform future funding and rate analyses.

6.2 Cost Assumptions

Project costs are based on the total capital investment necessary to complete a project (i.e., engineering through construction). Program costs are more subjective in nature, qualified based on the City's current maintenance activities and annual expenditures.

Unit costs for project (construction) elements are based on recent bid tabs and stormwater master planning efforts, adjusted for 2018 based on a historical cost index. Cost estimates presented in this SMP are Association for the Advancement of Cost Engineering (AACE) Class 5 Conceptual Level or Project Viability Estimates. Actual costs may vary from these estimates between -50 percent to +100 percent, although changes to design may result in cost differences outside of this anticipated range.

Project cost estimates use unit cost information for construction elements and apply a 30 percent construction contingency, a 20 percent planning contingency, and multipliers to account for traffic control/utility relocation (5–10 percent) and erosion control (2 percent). Additional multipliers to account for engineering and permitting (15–35 percent) and construction administration (10 percent) are applied to the total construction cost with contingencies. The range in engineering and permitting costs is based on the anticipated permitting level of effort, such as whether in-water work is anticipated. For planning purposes, costs were rounded to the nearest $1,000.

Appendix E includes unit costs developed for this SMP and presents the planning-level cost estimates for high and medium priority capital projects. Cost assumptions related to program recommendations are described in Section 6.5.

Land acquisition and easements are not included in the cost estimates, as most projects are located on City property or within the City right-of-way.

Table 6-1. Storm Drainage Capital Project and Program Summary [c]

Project No. [a]	Stormwater Project Opportunity Area Location ID	Project Name	Project Objectives	Location	Basin/ Waterbody	Contributing Drainage Area, Acres	Project Summary	Estimated Cost [b]	SDC Eligible Cost [b]	Project Timing			
										Annual (2019-2028)	High Priority (2019-2023)	Medium Priority (2024-2028)	Low Priority/ Not costed (2029-2038)
Capacity Projects													
C-1	N/A	Phase I Highway 43 Culvert Replacements	• Increase system capacity	Various crossings along Highway 43	Varies	930	• City is partnering with ODOT on widening and pedestrian improvements along Highway 43. • Phase I extends from Arbor Drive to Hidden Springs Road. • Eight capacity deficient culvert crossings to be upsized in conjunction with the current roadway improvements (see Appendix F for detail).	$1,045,000	$28,000		X		
C-2	13	5th Avenue Culvert Replacement	• Increase system capacity • Improve system configuration • Prevent Erosion	5th Avenue just east of 4th Street	Bernert Creek	461	• Install approximately 160 LF of 4' x 9' reinforced concrete box culvert and relocate existing utilities as needed. • Align new box culvert with existing stream alignment.	$847,000	$106,000		X		
C-3	59	Sunset Creek at Willamette Falls Drive Culvert Replacement	• Increase system capacity	Sunset Creek crossing under Willamette Falls Drive southeast of Sunset Avenue and Imperial Drive intersection	Sunset Creek	69	• Replace approximately 92 LF of existing 18" diameter pipe with two parallel 30" diameter HDPE pipe.	$282,000	$2,000		X		
C-4	63	Maddox Creek at River Street Culvert Replacement	• Increase system capacity	Western end of River Street, west of the Burns Street intersection.	Maddox Creek	84	• Replace approximately 165 LF if existing 18" diameter culverts with two parallel 36" diameter HDPE pipe.	$385,000	$7,000		X		
C-5	N/A	Phase II Highway 43 Culvert Replacements	• Increase system capacity	Various crossings along Highway 43	Varies	789	• City is partnering with ODOT on widening and pedestrian improvements along Highway 43. • Phase II extends from Hidden Springs Road to the Interstate 205 overpass. • Five capacity deficient culvert crossings identified per hydraulic modeling (see Appendix D). • Phase II design to be initiated after 2020	---	---				X
C-6	60	Kantara Way Capacity Deficiency	• Increase system capacity	Kantara Way	Fern Creek	141	• Hydraulic evaluation indicates existing culvert is capacity deficient. Culvert grade results in scour and erosion. • Project location is in a canyon with no reported complaints or potential for property damage. • Potential project solution may require reconfiguration as an open channel and modification to existing water line near this location.	---	---				X
Infrastructure Projects													
I-1	47	Blankenship Road Improvements	• Increase system capacity • Improve system configuration	Blankenship Road between Debok Road and Johnson Road intersections.	Summerlinn Creek	159	• Install approximately 300 LF of 24" diameter HDPE storm sewer. • Install approximately 356 LF of 30" diameter HDPE storm sewer. • Install new field ditch inlet in the ditch north of Blankenship Rd. • Replace approximately 23 LF of 24" diameter storm sewer outfall with 30" diameter HDPE.	$856,000	$97,000		X		
I-2	4	Mark Lane Improvements	• Add infrastructure • Increase water quality treatment (retrofit)	Mark Lane (east of Lowell Ave)	Mary S. Young Creek	6	• Install approximately 1,050 LF of new 12" main line pipe along Mark Ln. • Install flow-through stormwater planters along Mark Ln ROW to convey overflow to the main line via lateral piping.	$1,092,000	$5,000		X		

Table 6-1. Storm Drainage Capital Project and Program Summary [c]

Project No. [a]	Stormwater Project Opportunity Area Location ID	Project Name	Project Objectives	Location	Basin/ Waterbody	Contributing Drainage Area, Acres	Project Summary	Estimated Cost [b]	SDC Eligible Cost [b]	Project Timing			
										Annual (2019-2028)	High Priority (2019-2023)	Medium Priority (2024-2028)	Low Priority/ Not costed (2029-2038)
I-3	5	Buck Street Improvements	• Add infrastructure • Increase water quality treatment (retrofit) • Prevent Erosion	Buck Street (east of Greer Street)	Bolton Creek	5	• Install approximately 750 LF of new 12" main line pipe along Buck St. • Install flow-through stormwater planters along Buck St ROW to convey overflow to the main line via lateral piping. • Install new curb and gutter system for unimproved section of Buck St. • Replace existing outfall at the end of Buck St and provide outlet protection.	$966,000	$89,000		X		
I-4	56	Fairview Way Pipe Relocation	• Increase system capacity • Improve system configuration	Fairview Way between Highway 43 and Robinwood Creek.	Robinwood Creek Fern Creek	29	• Install new storm pipe alignment along Fairview Way from manhole RW-CB-0144.1 to manhole RW-CB-0126.1 and ultimately discharges to Robinwood Creek. • Install approximately 1,174 LF of 18" HDPE; approximately 253 LF of 30" RCP; and approximately 325 LF of 36" HDPE. • Install 11 manholes associated with the proposed conveyance system in Fairview Way.	$1,620,000	$40,000			X	
I-5	1	Nixon Avenue Pipe Relocation	• Improve system configuration	Nixon Ave (between 18730 and 18740 Nixon Ave)	Willamette River	10	• Relocate existing pipe currently under resident's garage. • Install new 12" piping to convey drainage north along Nixon Ave ROW and east between 18730 and 18740 Nixon Ave parcels to a new outlet structure.	$174,000	$2,000			X	
I-6	10	Sunset Avenue Improvements	• Add infrastructure • Prevent Erosion	Sunset Ave (between Cornwall St and Walnut St)	Tanner Creek Sunset Creek McLean Creek Willamette River	35	• Project to be constructed in conjunction with transportation system improvement project, which will install curb/gutter, bike lane, and sidewalk along Sunset Ave. • Install new 12" piping along Sunset Ave ROW from Cornwall St to Walnut St to replace to existing piping and open channel sections. • Install manholes and catch basins at intersections along the upper portion of Sunset Ave, where main line is in the middle of the road.	$1,593,000	$32,000			X	
Retrofit Projects													
R-1	70	Public Pond #22 Retrofit	• Increase water quality treatment (retrofit)	25545 Katherine Court	Willamette River	8	• Rehabilitate the existing water quality pond by clearing trees and invasive vegetation, removing accumulated sediment, replacing with amended soils, regrading, and planting of water quality appropriate vegetation. • Pond outflow structure to be inspected and replaced if needed.	$89,000	$1,000		X		
R-2	67	Mary S. Young Park Parking Lot Retrofit	• Increase water quality treatment (retrofit)	Mary S. Young Park Parking Lot	Mary S. Young Creek	2	• Replace existing impervious parking lot with 67,000 ft^2 of pervious pavers. • Connect pervious pavers drain layer to existing catch basin in northeast corner of parking lot.	$2,075,000	NA			X	
R-3	68	West Linn Public Works Department Planters	• Increase water quality treatment (retrofit)	West Linn Public Works Department (4100 Norfolk St)	Tanner Creek	1	• Install one stormwater planter on West Linn Public Works Department property to treat drainage from northern portion of site and one planter along Norfolk St ROW to treat drainage from the southern portion of site. • Remove existing bubbler within Norfolk St ROW and connect to new 12" piping to stormwater planter in Norfolk St ROW. • Connect stormwater planter overflow to existing catch basin along Norfolk St via 12" piping.	$174,000	NA			X	
R-4	40	Mary S. Young Park Erosion Measures	• Prevent Erosion	Mary S. Young Park	Heron Creek	TBD	• Install in-stream bank erosion measures to minimize erosion issues along park trail and bridge. • Bridge repair related to washout is currently funded; remaining work is restoration and a potential mitigation project. • Potential grant funding opportunity.	---	---				X

Table 6-1. Storm Drainage Capital Project and Program Summary [c]

Project No. [a]	Stormwater Project Opportunity Area Location ID	Project Name	Project Objectives	Location	Basin/ Waterbody	Contributing Drainage Area, Acres	Project Summary	Estimated Cost [b]	SDC Eligible Cost [b]	Project Timing			
										Annual (2019-2028)	High Priority (2019-2023)	Medium Priority (2024-2028)	Low Priority/ Not costed (2029-2038)
R-5	43	Mary S. Young Park Trillium Creek Restoration	• Prevent Erosion • Increase water quality treatment (retrofit)	Trillium Creek in Mary S. Young Park	Trillium Creek	TBD	• Restore channel connectivity with floodplain and improve bed material and channel meander for habitat improvement. • Conduct other creek stabilization measures. • Potential grant funding opportunity (see previous work completed).	---	---				X
R-6	45	Mary S. Young Park Fish Restoration Measures	• Increase water quality treatment (retrofit)	Mary S. Young Creek	Mary S. Young Creek	TBD	• Remove culvert at Mary S. Young Creek to improve water quality and provide fish restoration measures in accordance with the Mary S. Young Creek Restoration Concept Plan. • Potential grant funding opportunity.	---	---				X
R-7	49	Arbor Creek Culvert Hydromodification Improvements	• Prevent Erosion	Downstream of Arbor Creek culvert at Hillside Drive, near Skye Parkway	Arbor Creek	246	• Realign existing culvert crossing Arbor Creek to minimize drop. • Add bank protection and energy dissipation structure to alleviate existing scour hole and bank erosion.	---	---				X
R-8	66	Willamette Park Parking Lot Retrofit	• Increase water quality treatment (retrofit)	Willamette Park Parking Lot	Willamette River	2	• Replace existing impervious parking lot with pervious pavers.	---	---				X
R-9	69	Public Pond #18 Retrofit	• Increase water quality treatment (retrofit)	Public Pond #18 (BC ID)	Bernert Creek	TBD	• Rehabilitate the existing water quality pond by clearing trees and invasive vegetation, removing accumulated sediment, replacing with amended soils, regrading, and planting of water quality appropriate vegetation. • Pond outflow structure to be inspected and replaced if needed.	---	---				X
Planning Projects													
P-1	16	Tannler Drive/Bernert Creek Basin Feasibility Study	• Add infrastructure	Tannler Drive	Bernert Creek	N/A	• Closed stormwater system adjacent to Tannler Drive could be an opportunity to daylight the pipe for aesthetics and water quality. • Conduct feasibility study to identify project concept and estimated cost.	$20,000	N/A		X		
P-2	54, 57	Fish Passage Evaluation	• Add Infrastructure	East of Willamette Drive (Highway 43)	Varies	N/A	• The 2006 MP reported that there are variable needs to replace culverts throughout the City for fish passage. • Conduct evaluation and coordinate with ODFW to confirm culvert replacement needs.	$20,000	N/A			X	
P-3	N/A	Surface Water Master Plan Update	• Increase system capacity • Add infrastructure • Increase water quality treatment (retrofit)	City-wide	Varies	N/A	• Update the City's Surface Water Master Plan in the next 10+ year timeframe.	$300,000	N/A			X	
P-4	N/A	Asset Management Program	N/A	City-wide	Varies	N/A	• Develop an asset management program to assess current practices, review software and tools, identify gaps in current practices, and prepare/ implement an asset management program. • Cost assumes coordinated effort with sanitary asset management program (50% cost share)	$150,000	N/A			X	
P-5	N/A	Stormwater System Survey	N/A	City-wide	Varies	N/A	• Conduct city-wide survey of storm system assets including establishment of consistent datum, horizontal and vertical survey of structures including inverts and rim elevations, and GIS processing to incorporate results into asset database. • Data to be used to populate asset management program. • Does not assume survey of open channel systems or cross sections.	$300,000	N/A		X		

Table 6-1. Storm Drainage Capital Project and Program Summary [c]

Project No. [a]	Stormwater Project Opportunity Area Location ID	Project Name	Project Objectives	Location	Basin/ Waterbody	Contributing Drainage Area, Acres	Project Summary	Estimated Cost [b]	SDC Eligible Cost [b]	Project Timing			
										Annual (2019-2028)	High Priority (2019-2023)	Medium Priority (2024-2028)	Low Priority/ Not costed (2029-2038)
Programs													
G-1	N/A	CCTV Program	N/A	City-wide	Varies	N/A	• Complete city-wide inspection over a 10-year planning period (assumes 60,000 LF of pipe inspected annually) • Evaluate results to inform asset management program and repair/ replacement needs. • Annual cost includes contingency (30%) and engineering multiplier (15%)	$344,000	N/A	X			
G-2	N/A	Repair and Replacement Program	• Add infrastructure • Address maintenance need	City-wide	Varies	N/A	• Assume replacement of one mile of deficient pipe annually (due to age and failure risk). • Consider opportunities to realign pipe within the ROW. • Cost excludes contingency and multipliers.	$750,000	N/A	X			
G-3	20, 28, 32, 37, 42, 48	Inlet Installation/ Replacement Program	• Add Infrastructure • Address maintenance need	City-wide	Varies	N/A	• Install curb inlets to alleviate localized drainage issues in high-traffic or heavily vegetated roadways. • Cost assumes 10 inlets/ year. • Cost excludes contingency and multipliers.	$25,000	N/A	X			
G-4	52	Public Pond Maintenance Program	• Increase water quality treatment (retrofit) • Address maintenance need	City-wide	Varies	N/A	• Conduct extensive maintenance of ponds and/or retrofit detention ponds for water quality improvement. • Target facility locations in residential neighborhoods and those facilities installed pre-2004. • Cost assumes one facility per year.	$100,000	N/A	X			
G-5	11, 15, 18, 19, 23, 25, 35	Green Street Pilot Program	• Increase water quality treatment (retrofit)	City-wide	Varies	N/A	• Install green street retrofits in residential neighborhoods in conjunction with other utility or transportation-related improvements. • Identify sites based on local drainage concerns.	$50,000	N/A	X			

Notes: *N/A: Not Applicable*

TBD: To be Determined in conjunction with refined CIP development.

a. CIP numbering reflects the following project type designations: C = Capacity; I = Infrastructure Improvement/ Addition; R = Retrofit/ Erosion Prevention and Control; P = Planning; and G = General/ Annual Maintenance

b. Estimated costs and SDC eligible costs are based on detailed cost summaries provided in Appendix E. Costs and associated drainage areas were not developed and calculated for low priority (unfunded) CIPs.

c. Policy recommendations are not included due to no associated project number and/or cost.

6.3 Sizing and Design Assumptions

Capital project sizing generally followed the City's PWDS and design criteria summarized in Table 3-2.

- **Capacity Projects**. Projects to construct or replace stormwater infrastructure referred to the City's PWDS (dated October 2018). Conveyance-related projects were sized for the 10-year, 24-hour design event. Culvert sizing was based on maintaining a headwater elevation less than 1.5 times the diameter of the culvert. System surcharging was considered permissible.
- **Water Quality Projects**. Water quality projects were generally sized in accordance with the 2016 Portland SWMM. LID and green infrastructure (Projects I-2 and I-3) were sized based on a 6 percent sizing factor applied to contributing impervious area. However, it should be noted that retrofit project applications were typically unable to meet applicable design criteria due to area constraints. During final project design an attempt should be made to size facilities to maximize water quality treatment within the available area.
- **New Infrastructure**. Several capital projects require new infrastructure in locations where no storm system exists. New infrastructure alignments are in the public ROW only. However, it should be noted that final design may require additional structures, alternate alignments, or deeper/shallower infrastructure than assumed for the conceptual project design to address utility conflicts and other constraints not identified as part of this SMP. Survey will be required to verify elevations and locations. Conceptual layouts for select capital projects are illustrated in Appendix F.

6.4 Capital Projects

Capital projects are identified as one of four categories: capacity, infrastructure, retrofit, or planning.

Through an integrated project development approach (see Section 4), capital project needs and opportunities were consolidated by location and defined as Stormwater Project Opportunity Areas. As such, identified capital projects address multiple objectives in a single project. Project objectives included:

- Increase system capacity (flood control)
- Improve system configuration
- Add infrastructure
- Increase water quality treatment (retrofit)
- Prevent erosion
- Address maintenance need

High and medium priority capital projects that compose this capital improvement program are summarized below by category. Additional detail related to project layout and configuration used to inform cost estimating is provided in Appendix F.

6.4.1 Capacity Projects

Phase 1 Highway 43 Culvert Replacement (C-1). In 2018, the City and ODOT initiated design efforts to widen and construct pedestrian improvements along Highway 43 through West Linn. There are 24 mapped culvert crossings under Highway 43, of which 13 are identified as deficient under existing development conditions based on hydraulic modeling conducted for this SMP. Culvert upsizing and/or reconfiguration is recommended to occur in conjunction with the roadway improvements.

Project C-1 includes upsizing eight crossings located in Phase 1 (Arbor Drive to Hidden Springs Road) of the Highway 43 project alignment. Other utility improvement and replacement efforts are currently underway (water system replacement). This was identified as a high priority project need.

5th Avenue Culvert Replacement (C-2). This project need was identified in the City's 2006 Plan and confirmed based on recent site visits, City staff input, and hydraulic modeling. Project C-2 includes upsizing the existing 30-inch-diameter culvert under 5th Avenue with a 4 ft x 9 ft box culvert and realigning the culvert along the existing stream alignment to minimize bank erosion and degradation of existing infrastructure in its proximity. This was identified as a high priority project need.

Sunset Creek at Willamette Falls Drive Culvert Replacement (C-3). This project need was identified in the City's 2006 Plan and confirmed based on recent site visits, City staff input, and hydraulic modeling. Project C-3 includes upsizing the existing 18-inch-diameter culvert with two parallel, 30-inch-diameter pipes while maintaining the existing drainage patterns and point of discharge. Parallel pipes are proposed due to limited depth of cover in the project proximity. This was identified as a high priority project need.

Maddox Creek at River Street Culvert Replacement (C-4). This project need was identified during the project needs assessment and confirmed based on recent site visits, City staff input, and hydraulic modeling. Project C-4 includes upsizing the existing 18-inch-diameter culvert with two parallel, 36-inch-diameter pipes while maintaining the existing drainage patterns and point of discharge. The current system configuration is inconsistent with the City's GIS and will require field survey to confirm configuration and connectivity. This was identified as a high priority project need.

6.4.2 Infrastructure Projects

Blankenship Road Improvements (I-1). This project need was identified during the project needs assessment and confirmed based on recent site visits, City staff input, and hydraulic modeling. Previous efforts to address roadway flooding at this location have not been successful.

Project I-1 includes installation and/or upsizing of approximately 800' of stormwater conveyance pipe along Blankenship Road east of Interstate 205 (I-205). Reconfiguration of the system is required to divert flow from the drainage ditch along the I-205 right-of-way (ROW). Due to the flat grade of the open channel collection system and overland flow contribution, additional site survey is recommended to verify drainage patterns and contributing areas. Project sizing assumes that ODOT infrastructure is conveying drainage from the north/northeast of the project location. This was identified as a high priority project need.

Figure 6-2, located at the end of this section, shows the proposed project alignment.

Mark Lane Improvements (I-2). This project need was identified during the project needs assessment, water quality assessment, and confirmed based on recent site visits and City staff input. A lack of drainage infrastructure at this location results in localized flooding. This area was identified to have high inflow and infiltration (I&I), potentially related to the limited stormwater infrastructure.

Project I-2 includes installation of 1,050 feet of 12-inch-diameter storm pipe down Mark Lane and approximately 5,000 square feet (ft^2) of stormwater planters within the public ROW. Planter locations are considered conceptual and will need to be confirmed in conjunction with the final pipe alignment. This was identified as a high priority project need.

Buck Street Improvements (I-3). This project need was identified during the project needs assessment, water quality assessment, and confirmed based on recent site visits and City staff input. A lack of drainage infrastructure and presence of stormwater bubblers results in localized flooding in this area.

Project I-3 includes installation of 750 feet of 12-inch-diameter storm pipe down Buck Street and approximately 3,750 ft^2 of stormwater planters within the public ROW. Planter locations are considered conceptual and locations will need to be confirmed in conjunction with the final pipe alignment. Due to reported erosion concerns, this project also includes replacement of the stormwater outfall and inclusion of outfall protection. This was identified as a high priority project need.

Fairview Way Pipe Relocation (I-4). This project need was identified during the project needs assessment and confirmed based on recent site visits, City staff input, and hydraulic modeling. Much of the existing system is configured on private property and the system condition is questionable.

Project I-4 includes rerouting the existing collection system east of Highway 43 to the public ROW within Fairview Way and installation of approximately 1,780 feet of stormwater conveyance pipe ranging in diameter from 18 to 36 inches. The project includes abandoning the existing outfall to Robinwood Creek and relocating/rerouting localized drainage further downstream on Robinwood Creek. This was identified as a high priority project need.

Figure 6-3, located at the end of this section, shows the proposed project alignment.

Nixon Avenue Pipe Relocation (I-5). This project need was identified during the project needs assessment and confirmed based on recent site visits and City staff input. The existing system is configured on private property and the system condition is questionable. Project I-5 includes installation of 325 feet of 12-inch-diameter storm pipe within a public stormwater easement between 18730 and 18740 Nixon Avenue. This was identified as a medium priority project need.

Sunset Avenue Improvements (I-6). This project need was identified during the project needs assessment and confirmed based on recent site visits and City staff input. A lack of drainage infrastructure results in localized flooding and erosion of the adjacent roadside ditch. This area was also identified to have high I&I, potentially related to limited stormwater infrastructure in the area.

Project I-6 includes installation of 3,620 feet of 12-inch-diameter storm pipe down Sunset Avenue from Cornwall Street to Walnut Street. Water quality retrofits using green infrastructure were not considered along the project alignment due to grade constraints. This was identified as a medium priority project need.

6.4.3 Retrofit Projects

Public Pond #22 Retrofit (R-1). This project need was identified during the water quality assessment and confirmed based on recent site visits and City staff input. Project R-1 includes extended maintenance and retrofit of an existing detention pond to improve water quality function. Maintenance activities required include tree removal and sediment removal. To enhance treatment function, amended soils and vegetation will need to be installed and the outlet structure reconfigured to promote increased retention time. Expansion of the pond footprint may be considered to treat additional flows from upstream development. This was identified as a medium priority project need.

Mary S. Young Park Parking Lot Retrofit (R-2). This project need was identified during the water quality assessment and confirmed based on recent site visits and City staff input. Project R-2 includes the installation of approximately 1.5 acres of permeable pavers at the public parking lot at Mary S. Young Park. Existing pavement is in poor condition. Recent permeable paver applications have been successfully implemented at other public parking areas in the City (i.e., Willamette Park). This was identified as a medium priority project need.

Pavement restoration and asphalt resurfacing needs present opportunities to incorporate alternative surface water management strategies

(Photo: Mary S. Young Park Parking Lot Retrofit location)

West Linn Public Works Department Planters (R-3). This project need was identified during the water quality assessment and confirmed based on recent site visits and City staff input. This project need was also identified as part of the City's 2015 Stormwater Retrofit Plan. Project R-3 includes the installation of approximate 1,175 ft^2 of stormwater planters to improve water quality treatment of the City's Public Works Yard along Norfolk Street. Planter locations are considered conceptual and locations will need to be confirmed in conjunction with final pipe alignment. This was identified as a medium priority project need.

6.4.4 Planning Projects

Tannler Drive/Bernert Creek Basin Feasibility Study (P-1). This project need was identified during the project needs assessment. City staff and the public identified an opportunity to daylight a portion of the piped storm system, adjacent to Tannler Drive. Daylighting the pipe may improve aesthetics and water quality in the area. The reported pipe depth may result in geotechnical challenges and limit the ability to daylight the system without encroaching on adjacent natural resources (trees). Project P-1 is budgeted as a $20,000 planning study to evaluate the feasibility of the proposed project. This was identified as a high priority project need, based on feedback from the public.

Fish Passage Evaluation (P-2). This project need was identified during the project needs assessment. The 2006 Plan identified multiple culverts requiring replacement for fish passage. Project P-2 is budgeted as a $20,000 planning study to evaluate existing culverts east of Highway 43, coordinate with the Oregon Department of Fish and Wildlife to confirm species presence, and confirm which culverts require replacement for fish passage. This was identified as a medium priority project need.

Storm Drainage Master Plan Update (P-3). Project P-3 assumes the City will update this Storm Drainage Master Plan within the next 10-15-year planning period. An estimated budget of $300,000 is included for the update. This was identified as a medium priority project need.

Asset Management Program (P-4). Project P-4 reflects development of an asset management program to aid in the prioritization of repair and replacement (R/R) activities due to condition deficiencies. Implementation of an asset management program will help reduce reactionary operations and maintenance activities and result in development of proactive scheduled R/R activities based on system condition, age, and performance.

An asset management program requires assessment of current practices and procedures, review of software applications and tools, integration/refinement of GIS data, and development of procedures and documentation. Program development efforts will be coordinated with the sanitary utility. An estimated budget of $150,000 was included in this plan, assuming coordination with the sanitary system (see 2019 Sanitary Sewer Master Plan (SSMP), Project PL-1). Projects stemming from the asset management program will be addressed as part of the City's annual R/R budget (see Project G-2). This was identified as a medium priority project need.

Stormwater System Survey (P-5). Current stormwater system GIS information for the City is incomplete. Approximately 70 percent of mapped stormwater infrastructure is missing elevation or size related information. In addition, stormwater treatment facilities have not been routinely mapped in GIS. Project P-5 reflects development of a city-wide stormwater system survey to inform development of the asset management program (see Project P-4). An estimated budget of $300,000 is included, based on the need to survey approximately 4,500 structures (excluding open channel conveyances). This was identified as a high priority project need.

6.5 Program Descriptions

City-wide program development efforts also stemmed from the integrated project development approach. During the project planning process (Section 4), select maintenance-related project needs were consolidated into larger program opportunities instead of developed as multiple, stand-alone individual projects. Table 6-1 reflects specific opportunity areas by Location ID that are applicable to the identified programs.

Development of city-wide programs can be advantageous for a City as they can be used to establish dedicated funding sources in support of priority, multi-year and multi-objective efforts. Programs (with a dedicated annual funding source) can also provide additional flexibility with respect to project implementation schedules and allow projects to be conducted on an opportunistic basis.

Five programs were identified to address routine system maintenance needs and the opportunistic installation of water quality improvements. All programs are considered medium priority and require annual funding. The City's annual stormwater system maintenance budget should be referenced and considered when establishing programs so that existing funds are allocated accordingly. Program recommendations and cost assumptions are summarized below for each recommended program.

6.5.1 CCTV Program (G-1)

This program includes expanding the existing CCTV efforts to inspect the City's stormwater mainlines. This program will help the City determine pipeline condition as part of the larger asset management program (see Project P-4) and help determine R/R needs. It is assumed that the City will inspect approximately 10 percent of the system per year (or approximately 60,000 LF). An annual cost of $344,000 is estimated, which includes construction contingency (30 percent), traffic control, and an engineering multiplier of 15 percent to cover review of the results.

6.5.2 Repair and Replacement (R/R) Program (G-2)

This program includes allocating an annual cost of $750,000 to the R/R of aging and failing pipe, structures, and relocation of the public storm system into the public ROW. This estimate is consistent with the 2019 SSMP R/R Program effort, which assumes replacement of one mile of deficient pipe per year. Because the City's stormwater system is primarily composed of plastic pipe, the actual life span is unknown. Locations should be prioritized based on CCTV efforts and consider the schedule of other utility system improvements or projects to minimize construction impacts.

6.5.3 Inlet Installation and Replacement Program (G-3)

This program stemmed from the project needs assessment. It involves the relocation of existing inlets to address localized flooding and ponding. It may require replacement of grated inlets with curb inlets in high traffic roads where debris accumulates and clogs the inlets. Six locations were identified during the project needs assessment effort (refer to Table C-1 for descriptions of each location). Locations include:

- Failing Street (Location ID 20)
- Sinclair Street (Location ID 28)
- Summit Street between Apollo Avenue and Causey Street (Location ID 32)
- Elmran Drive near Old River Road (Location ID 37)
- Lower Midhill Road (Location ID 42)
- Debok Road (Location ID 48)

An annual cost of $25,000 was estimated.

6.5.4 Public Pond Maintenance Program (G-4)

This program stemmed from the project needs assessment and water quality assessment. It involves the routine and restorative maintenance of public stormwater ponds, based on inspection results. It may include the rehabilitation or retrofit of existing stormwater detention ponds (constructed prior to 2004) to promote increased water quality treatment function and/or coverage. Ponds located in or near residential neighborhoods may be prioritized, as they provide both aesthetic and water quality benefits.

As part of the water quality assessment, a pond inventory was conducted to identify: 1) ponds installed prior to 2004 (and likely installed without treatment function); and 2) ponds located near vacant lands (and could be retrofit to provide water quality treatment for new development). The pond inventory resulted in the identification of two ponds meeting both criteria, which were included as Stormwater Project Opportunity Areas. However, additional ponds may benefit from inclusion in an ongoing maintenance program. Potential locations include:

- Remington Drive and Rogue Way (Public Pond #68)
- Cascade Summit Apartments Pond at Weatherhill Road (Public Pond #49)
- Public Ponds at Sabo Lane and Beacon Hill Lane (Public Pond #54, 48, 52)

An annual cost of $100,000 was estimated and based on major maintenance of one public pond per year.

6.5.5 Green Street Pilot Program (G-5)

This program stemmed from the project needs assessment and water quality assessment. It involves the opportunistic incorporation of green street and LID features in conjunction with scheduled transportation improvements (i.e., unimproved streets requiring installation of curb and sidewalk) or other utility improvement projects. Sites may be prioritized based on the presence of local drainage issues. Installations will address NPDES MS4 requirements related to stormwater retrofits. Seven locations were identified during the project needs assessment effort (refer to Table C-1 for descriptions of each location). Locations include:

- Exeter Street and Lancaster Street (Location ID 11)
- Willamette Neighborhood between 14th and 16th Avenues (Location ID 15)
- Suncrest Avenue, Valleyview Drive, and Hillcrest Street (Location ID 18)
- LaFave Street, Jolie Point Road, Munger Drive, and Lowell Avenue (Location ID 19)
- Kenthorpe Way (Location ID 23)
- Cornwell Road and York Street (Location ID 25)
- Dillow Drive at Larson (Location ID 35)

An annual cost of $50,000 was estimated.

6.6 Policy Recommendations

The following policy recommendations were considered for potential incorporation into future updates to the West Linn Municipal Code (WLMC), West Linn Community Development Code (CDC), West Linn Public Works Design Standards (PWDS), or addressed through internal directives.

6.5.1 Technical and Editorial Stormwater Code Updates

As described in Section 3.1, results of the code review identified recommended modifications to the WLMC, CDC, and PWDS to: 1) update the City's policies and technical design standards related to stormwater management; and 2) adjust code to improve clarity, resolve discrepancies, and ease implementation of existing policy and standards. Such refinements would help support water quality improvement efforts by specifying facility types and design criteria to address specific pollutants of concern for the City.

Code recommendations are detailed in Section 3.1.1 and 3.1.2 and in Appendix A.

Beaver activity can result in system clogging and backwater conditions in stormwater infrastructure

(Photo: Clogged stormwater conveyance pipe due to beaver activity at Johnson Road)

6.5.2 Beaver Management Requirements

The project needs assessment identified significant beaver activity contributing to localized flooding along investigated stream reaches (see Table C-1, Location ID 12). Beavers provide many benefits to stream ecology and habitat, but in urban areas, beaver activity can also result in localized flooding and backwater effects in stream channels.

Beavers are classified as "Protected Furbearers" in Oregon, and thus excluded from take (Oregon Administrative Rule 498.012) (Portland 2010). Oregon Department of Fish and Wildlife (ODFW) encourages public and private landowners to first use beaver exclusion and habitat modification techniques to minimize beaver activity in locations that are susceptible to impacts from beaver activity. Live trapping of beavers is legal, but relocation is illegal without a permit from ODFW.

The City may choose to implement/codify beaver management techniques to selectively encourage/discourage beaver activity based on the characteristics of the stormwater drainage systems, topography and vegetation. The City of Portland and King County both implement actions and management strategies outlined in guidance documents to deter beaver activity on public property. Such management strategies the City may consider include:

- Selective planting: Encourage/discourage beaver activity through planting of preferred plant species. To minimize or deter beaver activity, avoid use of alder, birch, cottonwood, willow, and other preferred deciduous plants in riparian restoration projects. Use non-desirable plant species including Sitka spruce, elderberry, cascara, and osoberry, as they are not preferred food plants for beavers.

- Fencing/tree barriers: Install fencing to isolate one or groups of trees from beaver foraging. Fencing should extend between 2 feet and 4 feet in height. Install fencing around inlets of culverts or spillways to prevent inlets from being blocked by beavers.
- Tree painting: Paint the bottom (2 feet to 4 feet) of trunk with latex paint/sand mixture.
- Flood/Flow Control: Install a flexible pond leveler (a pipe through the beaver dam) to control water levels. Beaver dam removal can also be conducted to lower water levels, but this activity is time intensive and generally only a temporary solution.
- Relocation: Relocate beavers to intentionally create ponds/wetlands in desired locations. ODFW permitting is required.

6.7 Project and Program Cost Summary

A summary of capital project and program costs comprising this surface water capital improvement program is provided in Table 6-2 below. Low priority project needs scheduled outside of the 10-year implementation timeframe are not reflected.

Table 6-2. Summary of Capital Project and Program Cost and Schedule

Project Number	Project Name	Schedule		
		2019-2023 (High Priority)	2024-2028 (Medium Priority)	Annual Cost (Medium Priority)
Capacity Projects		**$2,559,000**		
C-1	Phase I Highway 43 Culvert Replacements	$1,045,000		
C-2	5th Avenue Culvert Replacement	$847,000		
C-3	Sunset Creek at Willamette Falls Drive Culvert Replacement	$282,000		
C-4	Maddox Creek at River Street Culvert Replacement	$385,000		
Infrastructure Projects		**$2,914,000**	**$3,387,000**	
I-1	Blankenship Road Improvements	$856,000		
I-2	Mark Lane Improvements	$1,092,000		
I-3	Buck Street Improvements	$966,000		
I-4	Fairview Way Pipe Relocation		$1,620,000	
I-5	Nixon Avenue Pipe Relocation		$174,000	
I-6	Sunset Avenue Improvements		$1,593,000	
Retrofit Projects		**$89,000**	**$2,249,000**	
R-1	Public Pond #22 Retrofit (Katherine Court)	$89,000		
R-2	Mary S Young Park Parking Lot Retrofit		$2,075,000	
R-3	West Linn Public Works Department Planters		$174,000	
Planning Projects		**$320,000**	**$470,000**	
P-1	Tannler Drive/Bernert Creek Feasibility Study	$20,000		
P-2	Fish Passage Evaluation		$20,000	
P-3	Surface Water Master Plan Update		$300,000	
P-4	Asset Management Program Development		$150,000	
P-5	Stormwater System Survey	$300,000		
Programs				**$1,269,000**
G-1	CCTV Program			$344,000
G-2	Repair and Replacement (R/R) Program			$750,000
G-3	Inlet Installation and Replacement Program			$25,000
G-4	Public Pond Maintenance Program			$100,000
G-5	Green Street Pilot Program			$50,000
	TOTAL	**$5,882,000**	**$6,106,000**	**$1,269,000**

CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 6-1: Storm Drainage Capital Improvement Program Overview

Project #	City-Wide Projects and Programs
P-2	Fish Passage Evaluation
P-3	Storm Drainage Master Plan Update
P-4	Asset Management Program
P-5	Storm Drainage System Survey
G-1	CCTV Program
G-2	Repair and Replacement Program
G-3	Inlet Installation/Replacement Program
G-4	Public Pond Maintenance Program
G-5	Green Street Pilot Program

Project Category

- Capacity
- Infrastructure
- Retrofit
- Planning
- Low Priority/Not Costed

- Stormwater Pipe
- Open Channel
- Streams
- Watershed Boundaries
- ODOT ROW
- City Limits
- UGB

CIPs C-1 (Phase I Highway 43 Culvert Replacement) and C-5 (Phase II Highway 43 Culvert Replacement) are not shown.

N

0 1,000 2,000 4,000 6,000 Feet

1:24,000 scale

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Data Source: City of West Linn GIS and Metro RLIS

Map Publication/Print Date: August 2019 Produced by Brown and Caldwell

8/29/2019

CIP development assumes no stormwater contribution from this area. All drainage from the north/northeast is conveyed to the ODOT culvert. City to coordinate with ODOT to determine updates to culvert inlet to ensure all drainage is captured.

MARGERY ST
VILLAGE PARK PL
SL6
SL5-2
SL4
FALL OAKS CT
SL5-1
ODOT Culvert
SUMMERLINN DR
I205 FWY
SL3E1
DEBOK RD
SL3-2
SL3-1
JOHNSON RD
Node365
SL-MH-1608
SL-MH-0181
SL3-3
SL3-5
18"
24"
BLANKENSHIP RD
30"
24"
24"
24"
Node360
SL-DI-1606
30"
Node366
SL2
30"
30"
SL-MH-1604
SL-MH-1602
Node363
SL-CB-1612
SL3S1
BE5W2
SL3-4
ANN CT
BE5W3

0 50 100 200 300 Feet

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1:1,200 scale

N

CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 6-2: Blankenship Road Improvements (Project I-1)

- Streams
- ODOT ROW
- Subbasins
- Catch Basin
- Inlet
- Manhole
- Outfall
- Existing Stormwater Pipe
- New Manhole/Inlet
- New Pipe
- Remove Pipe

Data Source: City of West Linn GIS and Metro RLIS

Map Publication/Print Date: August 2019 Produced by Brown and Caldwell

9/4/2019

1:1,200 scale

N

CITY OF WEST LINN, OREGON

Storm Drainage and Sanitary Master Plan 2019

Figure 6-3: Fairview Way Pipe Relocation (Project I-4)

- Streams
- ODOT ROW
- Subbasins
- Catch Basin
- Inlet
- Manhole
- Outfall
- Existing Stormwater Pipe
- New Manhole
- New Pipe
- Abandon/Remove Pipe

Data Source: City of West Linn GIS and Metro RLIS

Map Publication/Print Date: Aug 2019 Produced by Brown and Caldwell

8/29/2019

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Section 7

References and Limitations

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Limitations

This document was prepared solely for City of West Linn in accordance with professional standards at the time the services were performed and in accordance with the contract between City of West Linn and Brown and Caldwell dated May 9, 2017. This document is governed by the specific scope of work authorized by City of West Linn; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by City of West Linn and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

Appendix A: TM1: Stormwater Basis of Design and Code Review

Appendix B: TM2: Stormwater Basis of Planning

Appendix C: Final Stormwater Project Opportunity Areas

Appendix D: TM3: Hydrology and Hydraulic Modeling Methods and Results

Appendix E: Detailed Cost Estimates

Appendix F: Capital Project Descriptions and Figures