DRAFT

City of Puyallup
Stormwater Comprehensive Plan

Prepared for
City of Puyallup Public Works Department
Puyallup, Washington
June 10, 2024

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

BiOp	Biological Opinion
BMP	best management practice
CCI	construction cost index
cfs	cubic feet per second
CIP	capital improvement project
City	City of Puyallup
CoF	consequence of failure
County	Pierce County
CSDP	2012 Comprehensive Storm Drainage Plan
CWA	Clean Water Act
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
Ecology Manual	2019 Washington State Department of Ecology Stormwater Management Manual for Western Washington
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESAP	Environmental and Sustainability Action Plan
FEMA	Federal Emergency Management Agency
FTE	full time equivalent
GASB	Governmental Accounting Standards Board
GMA	Growth Management Act
GPP	Green Puyallup Partnership
HSPF	Hydrologic Simulation Program-Fortran
IDDE	illicit discharge detection and elimination
LID	low impact development
LiDAR	light detection and ranging
LoF	likelihood of failure
LOS	level(s) of service
LU	land use
M&O	maintenance and operations
MM	monitoring and modeling
MS4	municipal separate storm sewer system
NHC	Northwest Hydraulic Consultants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
Phase II Permit	Western Washington Phase II Municipal Stormwater Permit
Plan	2024 Stormwater Comprehensive Plan
PMC	Puyallup Municipal Code
PTI	Puyallup Tribe of Indians
RCW	Revised Code of Washington
RM	river mile
R/R	repair and replacement
SDC	system development charge
SEPA	State Environmental Policy Act
SLR	sea level rise
State	state of Washington
SWMM	Storm Water Management Model
SWMP	Stormwater Management Program
TMDL	total maximum daily load
UIC	underground injection control
UKN	unknown
UGA	urban growth area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
yr	year

Executive Summary

This Stormwater Comprehensive Plan (Plan) for the City of Puyallup (City) updates the previous plan, which was completed in 2012. The Plan is needed to update the list of projects for the City's Capital Facilities Plan, support continued growth and development, and address aging infrastructure and new regulatory requirements.

ES-1 Level of Service Goals

ES-2 Stormwater Drainage System Evaluation

ES-3 Recommended Improvements

ES-4 Implementation Plan

Section 1 – Introduction

Introduction

This Stormwater Comprehensive Plan (Plan) for the City of Puyallup (City), Washington updates the previous plan that was completed in 2012. The City has updated the Plan for several reasons:

- The Washington State Growth Management Act (GMA) requires that planning documents be reassessed and updated periodically.
- The City's Capital Facilities Plan needs to be reevaluated to account for completed projects, changes in storm drain system conditions, new development, new stormwater management regulations, and anticipated revenues.
- Recent studies suggest that storm intensities are increasing due to climate change and that the Puyallup River is aggrading. These conditions could increase backwater-related flooding along storm lines that discharge to the Puyallup River.
- The City must maintain compliance with evolving regulatory requirements, such as the Western Washington Phase II Municipal Stormwater Permit (Phase II Permit), EPA Municipal Stormwater Permit, total maximum daily loads (TMDL) for Clarks Creek and the Puyallup River, and an Administrative Order from the Washington State Department of Ecology (Ecology) for channel stabilization in the Clarks Creek watershed.

1.1 Purpose and Approach

The purpose of this Plan is to guide the City's future storm and surface water utility (utility) activities and improvements. Preparation of this Plan involved:

- Characterizing the City's stormwater infrastructure
- Identifying system deficiencies
- Estimating project costs
- Providing guidance for stormwater management
- Supporting future capital and operation and maintenance (O&M) activities
- Prioritizing and providing guidance on a culvert replacement framework
- Prioritizing and providing guidance on stormwater pipe, structures, and pump station upgrades
- Summarizing existing National Pollutant Discharge Elimination System (NPDES) permit requirements and programs
- Providing a multi-year plan to achieve desired service levels

1.2 Planning and Review Process

1.2.1 Coordination with Other City Planning Efforts

The Plan is being developed in coordination with the stormwater, flooding, and water quality elements of other City planning efforts, including the Puyallup Comprehensive Plan and the Environmental and Sustainability Action Plan.

Puyallup Comprehensive Plan. The City is preparing for a major update to its Comprehensive Plan called *Puyallup 2044*. The last major update occurred in 2015 and it has been updated annually

since then. Stormwater-related goals and policies are documented in the 2015 Comprehensive Plan (amended 2023) under the Water Quality and Drainage Goals section of Chapter 3: Land Use (LU). These related goals and policies are:

- LU-35 Protect lives, property, and improvements from flood hazards.
  - LU - 35.1 Identify flood-hazard areas.
  - LU - 35.2 Utilize certified floodplain information as identified on Flood Insurance Rate Maps as prepared by FEMA (Federal Emergency Management Agency).
  - LU - 35.3 Develop performance standards for flood hazard areas that will minimize damage to structure while minimizing impacts to floodplains.
  - LU - 35.4 Identify appropriate uses within floodplains that are least likely to be impacted by 100 and 500 year flood events.
- LU-26 Minimize impacts of development to water quality.
  - LU - 36.1 Establish performance standards to meet current NPDES permit requirements related to surface water management for new or redevelopment.
  - LU - 36.2 Promote and encourage new development to minimize impervious coverage, native vegetation loss, and stormwater runoff, and make low impact development (LID) the preferred and commonly used approach to site development.
  - LU - 36.3 Pursue funding for demonstration projects to improve surface water management and water quality including the potential for LID in new developments.
  - LU - 36.4 Protect water quality through the continuation and possible expansion of City programs, regulations, and pilot programs.
  - LU - 36.5 Protect water quality by educating citizens about proper waste disposal and eliminating pollutants that enter the stormwater system.
  - LU - 36.6 Maintain and enhance natural drainage systems to protect water quality, reduce public costs, protect property, and prevent environmental degradation.
  - LU - 36.7 Where feasible, stormwater facilities should be designed to provide supplemental benefits, such as wildlife habitat, water quality treatment, and passive recreation.

Environmental and Sustainability Action Plan. The Environmental and Sustainability Action Plan (ESAP) identifies strategies and actions the City will take to protect natural systems, increase transportation options, ensure clean energy and water, reduce pollution, and limit weather-related impacts. The ESAP and associated Community Vulnerability Assessment use relevant City climate change trends to quantify the vulnerability of different City sectors to the adverse impacts of climate change. BC reviewed the ESAP and Community Vulnerability Assessment for context on vulnerability of natural systems (e.g., streams, habitat, and stormwater infrastructure), and to inform recommended studies and projects related to climate change and stormwater infrastructure.

1.2.2 Coordination with Puyallup Tribe of Indians

City staff plan to share this Draft Plan with the Puyallup Tribe of Indians (PTI), discuss PTI comments, and incorporate recommendations.

1.2.3 Reports to Planning Commission and City Council

Planning Commission. City staff will present the Plan to the Planning Commission in three meetings. Prior to the first meeting, City staff will share this Draft Plan. The first meeting will include a project and plan introduction. The City stormwater staff will incorporate Commission recommendations and prepare a Final Draft Plan for Commission review and discussion in the second meeting. The final meeting will be a Planning Commission hearing. Prior to the hearing, the Commission will have the opportunity to review the near Final Plan. The goal of the hearing is to discuss the Commission's recommendations before finalizing the Plan.

City Council. City staff plan to present the Final Plan to City Council after review and approval by the Planning Commission. After presenting the Final Plan, City staff will return to City Council to present an ordinance to adopt the City of Puyallup Stormwater Comprehensive Plan.

State Environmental Policy Act. The State Environmental Policy Act (SEPA) requires the State of Washington and local agencies to consider the likely environmental consequences of a proposed project or plan before approving or denying that proposal. This process provides a way to identify possible environmental impacts and identify measures to avoid or mitigate potential adverse impacts that may result from governmental decisions. As the lead agency, the City is responsible for identifying and evaluating the potential adverse environmental impacts of this Plan. The SEPA evaluation will be documented in the form of an environmental checklist that is sent to other agencies and the public for review and comment. SEPA compliance documentation is provided in Appendix A.

1.3 Document Organization

This Plan focuses on the recommended stormwater management actions for the City utility. It is organized into the following sections:

Executive Summary

Section 1 - Introduction: introduces the plan purpose and approach and describes the planning coordination and review process.

Section 2 - Background: provides background information relevant to the City's stormwater utility, including the City's stormwater planning history, stormwater utility components, policies, standards, and level of service (LOS) goals.

Section 3 - Regulatory Considerations: Description of current and future regulations that impact stormwater utility planning and operation.

Section 4 - Drainage System Characteristics: describes the City's drainage system and drainage and water quality problems.

Section 5 - Drainage System Evaluation: describes how the identified problems were prioritized and analyzed to identify causes and corrective measures.

Section 6 - Stormwater Management Programs: provides review of current programs and development of new and improved programs.

Section 7 - Repair and Replacement Programs: provides a summary of new repair and replacement programs for stormwater pump stations, infrastructure, (pipes and structures), culverts.

Section 8 - Recommended Improvements: describes recommended projects and programs.

Section 9 - Implementation Plan: summarizes the plan to lay out a future work framework for projects and programmatic measures based on anticipated revenues.

Section 10 - Drainage Basin Summaries: describes the City drainage system, drainage, and water quality problems as well as proposed projects by drainage basin.

Section 11 - Limitations

Appendices A through F contain supporting information, such the SEPA check list, problem and project identification tables and prioritization criteria, hydrologic and hydraulic modeling details, program summary technical memoranda, capital improvement costs, and subbasin mapping.

Section 2 - Background

Background

This section provides a brief description of the City's stormwater planning history, stormwater utility components, and LOS goals for its storm and surface water utility.

2.1 Stormwater Planning History

The City adopted its first stormwater plan, the Comprehensive Trunk Storm Drainage Plan, in 1980. Its second stormwater plan, developed in 1996 (1996 Plan), evaluated the drainage system's capacity and identified water quality improvement opportunities through model development and watershed analyses.

The 2007 State Highway Basin Plan advanced the work of the 1996 Plan by completing a basin-specific evaluation, the results of which helped in recommending capital projects and programmatic measures intended to improve the deficiencies of the existing State Highway Basin drainage system.

The 2012 Comprehensive Storm Drainage Plan (2012 Plan) was an update to the 1996 Plan that focused on meeting planning updates of the GMA, updating the City's Capital Facilities Plan, advancing stormwater planning for City redevelopment, evaluating Puyallup River backwater impacts to the stormwater system, and ensuring compliance with new Phase II Municipal Stormwater Permit and TMDLs for Clarks Creek and the Puyallup River.

This 2024 Stormwater Comprehensive Plan is an update to the 2012 Plan. It includes:

- Summarizing drainage and water quality problems and identifying capital and programmatic solutions with estimated costs.
- Summarizing existing, improved, and new stormwater management programs.
- Outlining repair and replacement program frameworks for stormwater pump stations, stormwater infrastructure (pipes and structures), and culverts.

2.2 Storm and Surface Water Utility

The City formed a public utility in 1988 to provide maintenance, operation, regulation, and control of storm drainage conditions in the city. The utility was established pursuant to Revised Code of Washington (RCW) Chapters 35A.80 and 35.67, and Article 11, Section 11 of the Washington State Constitution. According to Puyallup Municipal Code (PMC) Title 14, Chapter 26, the utility is responsible for natural and man-made stormwater facilities and conveyances in all City drainage basins.

The City's storm drainage system consists of thousands of structures, including pipes, ditches, culverts, catch basins, manholes, ponds, pump stations, and outfalls. The drainage system connects to natural creeks, ponds, and potholes. Section 4 contains a detailed description of the drainage system.

The following subsections describe the current organizational structure of the storm and surface water utility, its funding mechanisms, and its policies and standards, respectively.

2.2.1 Organizational Structure

The City's storm and surface water utility is administered by the Director of Public Works in accordance with PMC 14.26. The Public Works Department includes the Maintenance and Operations (M&O) Division and the Capital Engineering Division.

The M&O Division has two primary functions, field operations and fleet maintenance. Field Operations is responsible for street maintenance, wastewater collection and treatment, storm drainage, and water services (domestic, commercial, and fire flow). Fleet Maintenance is responsible for the City's vehicles and most major equipment. The Capital Engineering Division provides engineering review and direction for water, sewer, street and stormwater systems, and all major public capital projects.

2.2.2 Funding Mechanisms

The storm and surface water utility needs revenue to pay for:

- O&M expenses
- Capital improvement projects (CIP)
- Debt service
- Transfer payments (none currently projected [2023-2027])
- Taxes (State Business and Occupation tax and City Utility tax)

Currently, storm and surface water rates are the utility's primary source of revenue. Other sources include fees, system development charges (SDC), grants, and revenue bonds (HDR, 2022a). Sections 2.2.2.1 through 2.2.2.4 describe these revenue sources.

2.2.2.1 Rates

The storm and surface water utility charges for service are based on Equivalent Surface Units (ESU), which is a measure of typical hard surface area for a single-family residential parcel (PMC 14.01). For Puyallup, one ESU is equal to 2.800 square feet of hard surface area. Storm and surface water utility rates are based ESU because the hard surface area of a property is directly related to the potential runoff volume. The number of ESU for multifamily and commercial parcels is the total hard surface area of each parcel divided 2,800 square feet. Table 2-1 lists the current (2024) monthly charges for the parcel classifications and service class used by the utility.

Table 2-1. Storm and Surface Water Drainage Monthly Rates

Parcel Type	2024 Monthly Charge per ESU
Single-family residential	$20.08
Disability/Senior	$12.94
Multifamily/Commercial	$20.08

2.2.2.2 Fees

The City has permit fees and connection fees. Permit fees are intended to cover the planning, inspections, checking and preparation of record drawings, and processing of permit information for new connections to the public storm drainage system.

2.2.2.3 System Development Charge

PMC 14.26 requires that each new development within the city pay an SDC. SDCs include pro rata shares of the costs of existing and planned facilities. Revenues from SDCs minimize the impact to existing customers to construct new facilities required to accommodate growth. Each new connection to the stormwater system pays an SDC of $4,013 per equivalent surface unit associated with the property. This SDC rate is based on the City's 2022 *Stormwater SDC Final Report* (HDR 2022b). The SDCs must be paid prior to the issuance of a project's site development permit or building permit. SDC funds can be used only for capacity-building projects.

2.2.2.4 Grants

The City may obtain grants to help pay for storm and surface water management programs and capital improvements. The City has also received State grants to support stormwater quality management activities.

Although the City has been successful in obtaining grants in recent years, future grant funding is uncertain because the availability of grant funding and competition for those funds can vary considerably from year to year.

2.3 Policies and Standards

This section describes the City's policies and standards for its storm and surface water utility.

2.3.1 Level of Service

LOS is generally defined as a community's specific goals or objectives for capital facility infrastructure development, O&M, and other key elements of utility management. LOS goals provide a framework for the utility to prioritize its resources, assess its staffing levels, justify its rate structure, and document its successes. The City has developed LOS for stormwater management components, including water quality, conveyance, direct discharge, and preservation, as described below:

Water Quality and Flow Control. The City's stormwater water quality and flow control policy helps maintain compliance with the Phase II Permit (as described in Section 3.2) through a Permit-required Stormwater Management Program. Stormwater from new development and redevelopment must be treated prior to discharge as required by the Phase II Permit. In addition, the Phase II Permit requires that stormwater discharges from most new development and redevelopment sites must match the flow rates and durations that would have occurred under forested conditions. The City adopted the performance standards for stormwater quality and flow control described in the 2019 *Washington State Department of Ecology Stormwater Management Manual for Western Washington* (2019 Ecology Manual).

Conveyance. The City design standard for sizing new stormwater pipe states that the new pipe must be able to convey the 25-yr storm flow event without overtopping to the surface. Pipe system structures may overtop for runoff events that exceed the 25-year design capacity provided the overflow from a 100-year runoff event does not create or aggravate an existing flooding problem or erosion problem. These standards apply to new development and redevelopment and are documented in the *Engineering and Construction Standards Manual* described in Section 2.3.2.

Since the 2012 Plan, the City updated the event dates associated with design storms based on refined hydrologic and hydraulic models and corrected precipitation data (BC 2023c). The 25-yr storm flow event is October 20, 2003. The 100-yr storm flow event is September 17, 1969. Section

5.3.1 provides additional details on storm flow event analysis. Additional event date-related criteria include:

- The conveyance capacity of storm systems that discharge directly to the Puyallup River should be determined based on the 25-yr storm event and the corresponding river elevations.
- In areas with insufficient conveyance capacity (for the 25-yr storm), new development and redevelopment must either construct stormwater facilities on site or pay a late-comer fee to discharge to existing facilities with capacity.

Direct Discharge. New development and redevelopment sites that discharge directly to large water bodies like the Puyallup River do not need to match forested flow rates and durations, provided that the following criteria are met:

- The discharge does not reduce natural flows to other streams or wetlands.
- The discharge is solely through a stable, man-made stormwater conveyance system that extends to the mean high water line.
- The man-made conveyance system has adequate hydraulic capacity.

Stormwater should be discharged directly to the Puyallup River where feasible, provided that the discharge will not cause downstream flooding problems and is consistent with federal, State, and City regulations governing water quality and peak flow control.

The direct-discharge exemption is anticipated to substantially reduce stormwater management costs for new development and redevelopment in the areas of the city that drain directly to the Puyallup River. However, current City regulations require that new direct discharges to the Puyallup River will be allowed only if the City determines that there is sufficient capacity in its storm drainage system.

The City is actively encouraging redevelopment, particularly in the valley area south of the Puyallup River. Some of this area drains directly to the river via man-made storm drainage systems. The City completed the 15th Ave Diversion project, which expanded the direct-discharge area by diverting flow from the Pioneer Avenue storm drain north to the river. The City is currently constructing the 4th Ave Storm Drain Project (also referred to as the 4th St NW Storm Drain project), which diverts downtown redevelopment areas to the river along 4th St NW from 4th Ave NW near 5th St and along 5th St between 4th Ave and Stewart Ave.

Section 5.3 and Appendix C of this Plan contain additional information regarding conveyance capacities in the direct-discharge areas.

Preservation. City policies call for preservation of existing natural surface water features, such as wetlands and stream channels, to reduce the need for costly and likely less-dependable structural improvements. If natural wetland or stream channel storage or conveyance functions are impaired by development, the impaired functions must be replaced (City of Puyallup, 2015). In addition, the City encourages conservation through sustainable development implementation. These policies are consistent with State and federal regulations.

2.3.2 Engineering and Construction Standards Manual

The Public Works Department and office of the City Engineer provide minimum standards, i.e., the *Engineering and Construction Standards Manual*, for utility construction of public improvements in the right of way, easements, and city properties and on private property as it relates to connections to the City system. The standards manual, which includes design standards and standard details, is updated periodically, most recently April 2024. The Stormwater Management section of the manual includes 13 sections, as defined and described in Table 2-2.

Table 2-2. Summary of City of Puyallup Storm Water Management Engineering and Construction Standards		
Section	**Title**	**Description**
200	General Stormwater Requirements	Lists sources for general requirements such as specifications, city planning documents, and PMC. Includes guidance for discharge connections and infiltration.
201	Stormwater Management Requirements	Identifies reference and adherence to the selected Ecology Stormwater Management Manual and the City's requirements of the Stormwater Site Plan.
202	Low Impact Development	Outline general requirements for LID and more specific requirements for permeable pavement and bioretention cells.
203	Underground Injection Control (UIC)	Provides guidance and regulatory references for the UIC program rule.
204	Conveyance Systems	Lists key elements for conveyance system planning and design, including design flows, general requirements, and pipe system design criteria; requirements for closed systems, culverts, pump systems, vaults, catch basins, and manholes; oil control/spill containment; frames and grates; storm drain stenciling and marking; and outfalls.
205	Stormwater Maintenance and Operation Requirements	Outlines requirements for stormwater facility maintenance, maintenance access road requirements, private maintenance agreements, and development of a project-specific O&M manual.
206	Public Easements and Tracts	Lists requirements for public easements and tracts, including clearances and documentation on drawings.
207	Stormwater Plan Notes	Provides a list of all applicable stormwater notes to be placed on drawing plans.
208	Pollution Prevention	Lists requirements for best management practices (BMP) for enclosures (e.g., garbage, compactors, recycling) to prevent stormwater pollution from commercial development and redevelopment projects.
209	Testing and Inspection	Outlines the requirements and references external standards for new storm pipe construction, including cleaning/flushing, deflection testing, pressure testing, television testing, and acceptance testing.
210	Roof Downspout Controls	Provides general and design-specific requirements for various roof downspout controls, including downspout infiltration trenches, downspout drywells, downspout splash blocks, downspout dispersion trenches, and perforate stub-out connections.
211	Proprietary Stormwater Devices	States proprietary devices without General Use Level Designation or functional equivalent are prohibited.
212	Conventional Stormwater Facilities	Outlines requirements for conventional stormwater facilities (above or below ground) to remove peak flows, prevent flooding, and/or provide limited water quality treatment.

2.3.3 Operation and Maintenance Standards

Stormwater O&M is performed in accordance with City's *Site Management Plan for Stormwater Operations and Maintenance* developed by Aspect Consulting in 2022. The plan is a guide for City staff, vendors, and private property owners to help identify O&M problems, understand maintenance standards and requirements, and perform O&M activities. The plan contains three modules, one for each type of facility owner (i.e., public, private, and residential). The modules provide procedures and standards to help promote shared responsibility in performing maintenance in accordance with the Phase II Permit.

The City's 2023 *Illicit Discharge Detection and Elimination Program Manual* is a comprehensive guidance document for City staff performing illicit discharge detection and elimination (IDDE)-related activities required by the Phase II Permit. These activities include mapping the stormwater system and outfall, and the prevention, detection, characterization, tracing, and elimination of illicit connections and discharges. The manual also includes code summaries from the PMC and maps

related to IDDE, and guidance and forms for staff training, documentation and record keeping, outfall screening, and spill response.

The Puyallup *Vegetation Maintenance Standards* are a set of policies and standards developed by the City Planning Division to "establish uniform policies, procedures, and standards relevant to vegetation management within the rights-of-way, established setbacks, and other lands owned or controlled by the City of Puyallup and all other areas where landscaping or a landscape plan is required by the PMC." For stormwater management, the standards outline soil quantity and quality standards to help promote important soil functions in post-develop landscape, such as infiltration, nutrient, sediment, and pollutant absorption; and sediment and pollutant biofiltration. The standards also include guidelines and resources for understanding and implementing soil related BMPs identified in the 2019 Ecology Manual.

The purpose of the *City of Puyallup Comprehensive Emergency Management Plan* is to "coordinate and organize the public works and building inspection activities and resources of City of Puyallup government for the delivery of services, technical assistance, engineering expertise, construction management, and other support in response to an emergency or disaster." City stormwater utility staff assist with emergency management by provide engineering expertise and knowledge of the storm drainage system and its vulnerabilities relative to the City's flood hazard areas.

Regulatory Considerations

Numerous federal, State, and local regulations can affect stormwater management in the city. This section summarizes the federal and State regulations and programs that often affect municipal stormwater work. The summary is not exhaustive.

The City must establish and maintain programs that comply with State and federal regulations pertaining to surface water, including natural water bodies and the municipal drainage system. The City achieves compliance by incorporating these requirements into its own policies, regulations, and ordinances.

The primary regulatory driver for the City's stormwater drainage is the Phase II Permit issued by Ecology. Another key driver is the U.S. Environmental Project Agency (EPA) Municipal Storm Sewer System (MS4) Permit for discharges to presently submerged lands in the Puyallup River within the PTI's 1873 survey area. The Phase II and EPA MS4 permits allow the utility to discharge stormwater runoff from the City's municipal drainage system into Washington State waters. To do this, the utility implements programs to protect water quality by reducing the discharge of nonpoint source pollutants to the maximum extent practicable through application of permit specified BMPs.

Numerous federal, State, and local regulations can affect stormwater management in the city. Table 3-1 lists the key regulations.

Table 3-1. Federal, State, and City Regulations and Programs Relevant to Puyallup Storm and Surface Water Utility

Title/Source	Regulation or Program	Application to City
Federal		
Clean Water Act (CWA): §402 NPDES Permit	Regulation	The Phase II NPDES Permit, detailed further in Section 3.2, contains a number of requirements that affect stormwater management in the city.
U.S. EPA MS4 Permit	Regulation	The U.S. EPA (MS4 Permit applies to a portion of the city that discharges to presently submerged lands in the Puyallup River within the PTI's 1873 survey area. Section 3.3 details the EPA MS4 Permit.
CWA: §303(d) TMDL listing	Regulation	TMDLs could lead to more-stringent stormwater quality controls in future Phase II NPDES permits.
CWA: §404 permit requirements	Regulation	Some stormwater CIPs can affect wetlands or other "waters of the U.S." §404 permitting and mitigation can increase CIP costs and schedules.
Endangered Species Act (ESA)	Regulation	Stormwater CIPs that involve federal permitting or funding could require consultation with federal agencies under §7 of the ESA. In addition, the federal agencies issued a Biological Opinion (BiOp) in 2008 that affects local floodplain management programs. Section 3.5 details the ESA.
Safe Drinking Water Act (SDWA)	Regulation	UIC (SDWA 147.200) regulates stormwater discharges into groundwater facilities under the Washington State UIC Program Rule (Chapter 173-218 Washington Administrative Code (WAC).
National Flood Insurance Program	Program	The Plan could affect the City's rating under the Community Rating System, which affects flood insurance rates.
GASB Statement 34	Program	Requires accurate inventory of City's stormwater infrastructure. Section 3. 6 details GASB.

Table 3-1. Federal, State, and City Regulations and Programs Relevant to Puyallup Storm and Surface Water Utility

Title/Source	Regulation or Program	Application to City
State		
State Environmental Policy Act	Regulation	Each CIP would require SEPA review prior to implementation unless that project qualifies as exempt. Section 1.2.3 provides more detail on SEPA.
Water quality standards	Regulation	The Phase II NPDES Permit does not authorize discharges that would violate State water quality standards. The State may establish TMDLs for water bodies that violate the standards. As noted previously, the TMDLs can become NPDES Permit requirements.
§401 Water Quality Certification	Regulation	Individual projects that require §404 or other federal permits would also require a 401 certification from the Washington State Department of Ecology. A 401 certification could include site-specific mitigation measures, which could affect CIP design and cost estimates.
Puget Sound Water Quality Management Plan	Program	Plan recommendations should be consistent with the *Puget Sound Water Quality Management Plan*.
Puget Sound Partnership	Program	This is the state agency leading the collective effort to restore and protect Puget Sound and overseeing the implementation of the 2022-2026 Action Agenda to help meet recovery goals. The Partnership identifies preventing pollution from stormwater as a strategic initiative and regional priority in meeting the Action Agenda goals.
GMA and City Comprehensive Plan	Regulation	This Plan is required by the GMA. GMA is discussed in Section 3.1.
State Hydraulic Code	Regulation	CIPs and maintenance activities that involve work in waters of the state would require a hydraulic project approval (HPA) permit. HPA permitting and mitigation measures could affect CIP costs.
Archaeological and cultural coordination	Regulation	If any CIPs are planned for areas with known or suspected archaeological sites, the City will need to coordinate with the Department of Archaeology and Historic Preservation, local Indian tribes, and Pierce County Historic Preservation.
City		
Environmental review	Regulation	Each CIP would be subject to environmental review prior to permitting and construction as prescribed in PMC 21.04.
Critical Areas Ordinance	Regulation	The Plan should avoid CIPs in critical areas (e.g., wetlands, groundwater protection zones, or wildlife habitat). If a CIP must be sited in a critical area, the cost estimate should include costs for mitigation and permitting as prescribed in PMC 21.06.
Stormwater Management Regulations	Regulation	The City's development regulations must be consistent with Phase II NPDES Permit requirements. Section 3.4 details City Stormwater Management Regulations.
Shoreline Master Program	Regulation	Future projects should be located and designed to be consistent with City shoreline regulations (PMC 20.11). Projects within designated shorelines could require permits and mitigation, which could affect project costs and schedules.

Most of the regulations listed in Table 3-1 primarily affect the implementation of specific measures recommended in the Plan. For example, CIPs that could affect wetlands would need to comply with City critical areas regulations and possibly federal CWA Section 404 regulations. However, six of the regulations listed in Table 3-1—the State GMA, the State Phase II NPDES Stormwater Permit, the federal EPA MS4 Permit, the City stormwater management regulations, the federal ESA, and federal GASB Statement 34—directly affect the LOS for this Plan. These regulations are discussed in greater detail in Sections 3.1 through 3.6.

3.1 Growth Management Act

The Washington State Legislature enacted the GMA in 1990 in response to rapid population growth and concerns with suburban sprawl, environmental protection, quality of life, and related issues. The GMA is codified primarily in RCW 36.70A.

Washington State Climate Bill HB 1181, passed in 2023, adds a climate goal to the GMA. The bill requires cities and counties to include a climate element in their comprehensive plans that address resilience and greenhouse gas emissions mitigation.

The GMA provides a framework for regional coordination, and cities planning under the GMA are required to adopt citywide planning policies to guide plan adoption and establish urban growth areas (UGA). Local comprehensive plans must include the following elements: land use, housing, capital facilities, utilities, transportation, economic development, and parks and recreation; counties must also include a rural element. The City is required to include a climate element in its comprehensive plan year 2029. This Plan serves as the capital facilities element for City-owned storm drainage assets.

RCW 36.70A.070 requires capital facilities elements to include:

- An inventory of existing capital facilities owned by public entities, showing the locations and capacities of the capital facilities.
- A forecast of the needs for such capital facilities.
- The proposed locations and capacities of expanded or new capital facilities.
- At least a 6-year plan that will finance such capital facilities within projected funding capacities and that clearly identifies sources of public money for such purposes.
- A requirement to reassess the land use element if probable funding falls short of meeting existing needs and to ensure that the land use element, capital facilities plan element, and financing plan within the capital facilities plan element are coordinated and consistent. Parks and recreation facilities shall be included in the capital facilities plan element.

To facilitate meeting the above requirements, WAC 365-195-315 recommends:

- The selection of LOS or planning assumptions for the various facilities to apply during the planning period (20 years or more) and that reflect community goals.
- A forecast of the needs for such capital facilities based on the LOS or planning assumptions selected and that are consistent with the growth, densities, and distribution of growth anticipated in the land use element.
- The creation of a 6-year capital facilities plan for financing capital facilities needed within that time frame. Projected funding capacities are to be evaluated, followed by the identification of sources of public or private funds for which there is reasonable assurance of availability. The 6-year plan should be updated at least biennially so that financial planning remains sufficiently ahead of the present for concurrency to be evaluated.
- A provision should be made to reassess the land use and other elements of the 6-year plan periodically in light of the evolving capital facilities plan. If the probable funding for capital facilities at any time is insufficient to meet existing needs, the land use element must be reassessed. At the same time, funding possibilities and LOS might also be reassessed. The 6-year plan should require that, as a result of such reassessment, appropriate action must be taken to ensure the internal consistency of the land use and capital facilities portions of the plan. The 6-year plan should set forth how, if at all, pending applications for development will be affected while such a reassessment is being undertaken.

3.2 Phase II Municipal Stormwater Permit

The NPDES Permit program is a requirement of the federal CWA, which is intended to protect and restore waters for "fishable, swimmable" uses. The U.S. EPA has delegated Permit authority to State environmental agencies, and these agencies can set Permit conditions in accordance with and in addition to the minimum federal requirements. In Washington, Ecology is the NPDES-delegated Permit authority.

Phase I of the stormwater NPDES regulation applies to cities and counties that operate MS4s and had populations of 100,000 people or more according to the 1990 census. Phase II of the stormwater NPDES regulation applies to municipalities that operate small MS4s and have populations between 10,000 and 100,000 people.

Ecology issued the NPDES Western Washington Phase II Municipal Stormwater Permit (Phase II Permit) in August 2019. It covers more than 80 cities and portions of six counties in Washington, including the City of Puyallup. The Phase II Permit requires that the City develop and implement a Stormwater Management Program (SWMP). The Phase II Permit also requires the City to submit an annual report by March 31 of each year, in which the City reports progress on the implementation of Phase II Permit requirements. In addition, the City must submit documentation that describes proposed SWMP activities for the coming year. Implementation of various Phase II Permit conditions is staggered throughout the 5-year Phase II Permit term from August 1, 2019 through July 31, 2024. The Phase II Permit will be revised and reissued at the end of this period. The Phase II Permit and associated requirements are described in detail in the City's 2024 SWMP Plan.

The Phase II Permit allows municipalities to discharge stormwater runoff from their municipal drainage systems into the state's water bodies (e.g., streams, rivers, lakes, and wetlands) as long as municipalities implement programs to protect water quality by reducing the discharge of "nonpoint source" pollutants to the "maximum extent practicable" through application of Permit-specified BMPs. BMPs are the schedule of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices that prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State. The BMPs specified in the Phase II Permit are collectively referred to as the SWMP and grouped under the following program components:

- Stormwater planning
- Public education and outreach
- Public involvement
- MS4 mapping and documentation
- IDDE
- Control of runoff from development, redevelopment, and construction sites
- O&M
- Source control
- Monitoring

The Phase II Permit also requires compliance with established TMDLs. Ecology has issued the Clarks Creek dissolved oxygen (DO) and sediment TMDL, Clarks Creek fecal bacteria TMDL, and the Puyallup River fecal TMDL. The TMDL plan determines the pollutant reduction target and load allocation reductions to meet water quality standards. Appendix 2 of the Phase II Permit prescribes the activities the City must take to comply with applicable TMDLs. The City has developed TMDL compliance programs as described in Section 4.5.2 and summarized in Section 6.

3.3 Environmental Protection Agency MS4 Permit

Municipal stormwater discharges to water bodies on federal land or under Tribal jurisdiction in Washington require a permit from the EPA. Stormwater from a portion of the City discharges to submerged lands in the Puyallup River within the PTI's 1873 survey area. Therefore, the City applied to EPA Region 10 for a federal MS4 Permit (City of Puyallup, 2023). The City submitted its application in 2023 and is currently waiting for a draft permit to review.

3.4 City Stormwater Management Regulations

In 2010, the City updated its stormwater management regulations to comply with the requirements of the Phase II Permit. PMC 21.10 adopts the 2019 Ecology Manual and the amendments set forth in Appendix 1 of the Phase II Permit.

In addition to adopting the 2019 Ecology Manual and amendments, PMC 21.10 prescribes:

- Stormwater site planning requirements
- Stormwater permit application procedures and fees
- Stormwater management (new development or redevelopment)
- Latecomer's agreements
- Financial guarantees (e.g., performance bonds, insurance)
- Design criteria
- Low Impact Development
- Local business source control program
- Inspection procedures
- Maintenance responsibilities
- Enforcement and system protection

The City also updated its code related to IDDE (PMC 21.11) to be consistent with Phase II Permit conditions.

3.5 Endangered Species Act

The federal ESA was passed in 1973 to protect species that are endangered or threatened and to conserve the ecosystems on which they depend. Puget Sound Chinook salmon, steelhead, and bull trout have been listed as "threatened." Puget Sound coho has been identified as a "species of concern."

Section 9 of the ESA makes it unlawful to "take" any species listed as threatened or endangered. "Take" means to physically harass, kill, or harm the species or its critical habitat. Thus, the ESA prohibits the City from performing any stormwater management activities that result in "take" of listed species.

Section 7 of the ESA requires that federal agencies consult with federal fisheries services to ensure that actions authorized, funded, or carried out by the agency are not likely to jeopardize the continued existence of any threatened or endangered species, or result in adverse modification or destruction of their critical habitat.

In 2008, the National Marine Fisheries Service (NMFS) performed an ESA Section 7 evaluation of the National Flood Insurance Program (NFIP). NMFS issued a BiOp that stated that continued

implementation of the NFIP in the Puget Sound region adversely affects the habitat of certain threatened and endangered species.

3.6 Governmental Accounting Standards Board

Financial reporting by public utilities must adhere to requirements set by the GASB, which is the agency responsible for developing standards of state and local governmental accounting and financial reporting. Most prominent is GASB Statement 34, "Basic Financial Statements—and Management's Discussion and Analysis—for State and Local Governments," issued in June 1999. The main objective of Statement 34's requirements is to have financial reports that are more comprehensive and easier to understand by the public. Statement 34 consists of several components, which can be seen in full in paragraphs 3–166 of the GASB publication. In summary, Statement 34 requires that the basic financial statements and required supplementary information for general-purpose governments should consist of:

- Management's discussion and analysis: This requirement states that prior to development of the basic financial statements, a discussion providing an analytical overview of the government's financial activities is necessary.
- Basic financial statements, which should include:
  - Government-wide financial statements that include information on net assets (e.g., storm drainage infrastructure) and a statement of activities
  - Fund financial statements that focus on information about the government's major governmental and enterprise funds (e.g., the City's storm and surface water utility), including its blended component units
  - Any notes to financial statements that will enable users to better understand them
- Required supplementary information: this should include budgetary comparison schedules, along with other types of data as required by previous GASB pronouncements.

Consequently, the City needs an accurate inventory of its stormwater infrastructure to comply with GASB 34 requirements.

Drainage System Characteristics

This section describes the city's natural and constructed drainage systems and summarizes its drainage, flooding, and water quality problems.

4.1 Natural Drainage

The City encompasses approximately 14 square miles. The northern portion of the City is located in the Puyallup River valley, while the southern portion extends into the uplands. Topography varies from approximately sea level in the valley to around 500 feet above sea level in the upland areas. The majority of runoff from the city ultimately flows to the Puyallup River— either by way of direct stormwater drainage, creeks or streams, or groundwater.

Creeks and rivers that lie entirely or partially within the city include the Puyallup River, and Clarks, Silver, Meeker, Wapato, and Deer creeks. Eight major drainage basins lie within the city:

- Clarks Creek (which drains Clarks, Silver, Meeker, and Woodland creeks)
- Deer Creek (formerly Shaw Road basin)
- Puyallup River (split into North, South, and Southeast basins that drain to the river)
- Potholes
- Wapato Creek
- State Highway System

All of the creeks within the City eventually drain to the Puyallup River with the exception the internally draining Potholes basin. Each of these major basins can be further delineated into smaller sub-basins based on stormwater drainage system and topography.

The drainage basin areas were delineated in the City's recent Stormwater Management Action Plan (Northwest Hydraulic Consultants [NHC], 2023). Table 4-1 summarizes drainage basin areas within the City and the UGA, and Figure 4-1 shows the drainage basin locations. Section 10 contains more detailed information for each drainage basin.

Table 4-1. Drainage Basin Summary				
Basin	Surface Water Bodies Within the Basin	Total area (acres)	Area Within City Limits (acres, percent)[a]	Area Within City UGA (acres, percent)[b]
Clarks Creek	Clarks Creek, Meeker Creek, Silver Creek, Woodland Creek	5,827	2,657 (46%)	3,343 (57%)
Deer Creek	Deer Creek	1,723	1,461 (85%)	1,630 (95%)
North Puyallup	None	2,283	582 (25%))	1,104 (48%)
South Puyallup	None	1,373	1,271 (93%)	1,373 (100%)
Southeast Puyallup	None	1,130	181 (16%)	227 (20%)
Potholes	None	2,527	691 (27%)	1,077 (43%)
Wapato Creek[c]	Wapato Creek	184	183 (99%)	183 (99%)
State Highway System	Bradley Lake, Willows Pond	2,110	2,097 (99%)	2,097 (99%)

a. Percent represents percent of total basin area within city limits.

b. Percent represents total basin area within UGA.

c. Represents area of Wapato Creek basin that falls within city limits and drains to the diversion to the Puyallup River.

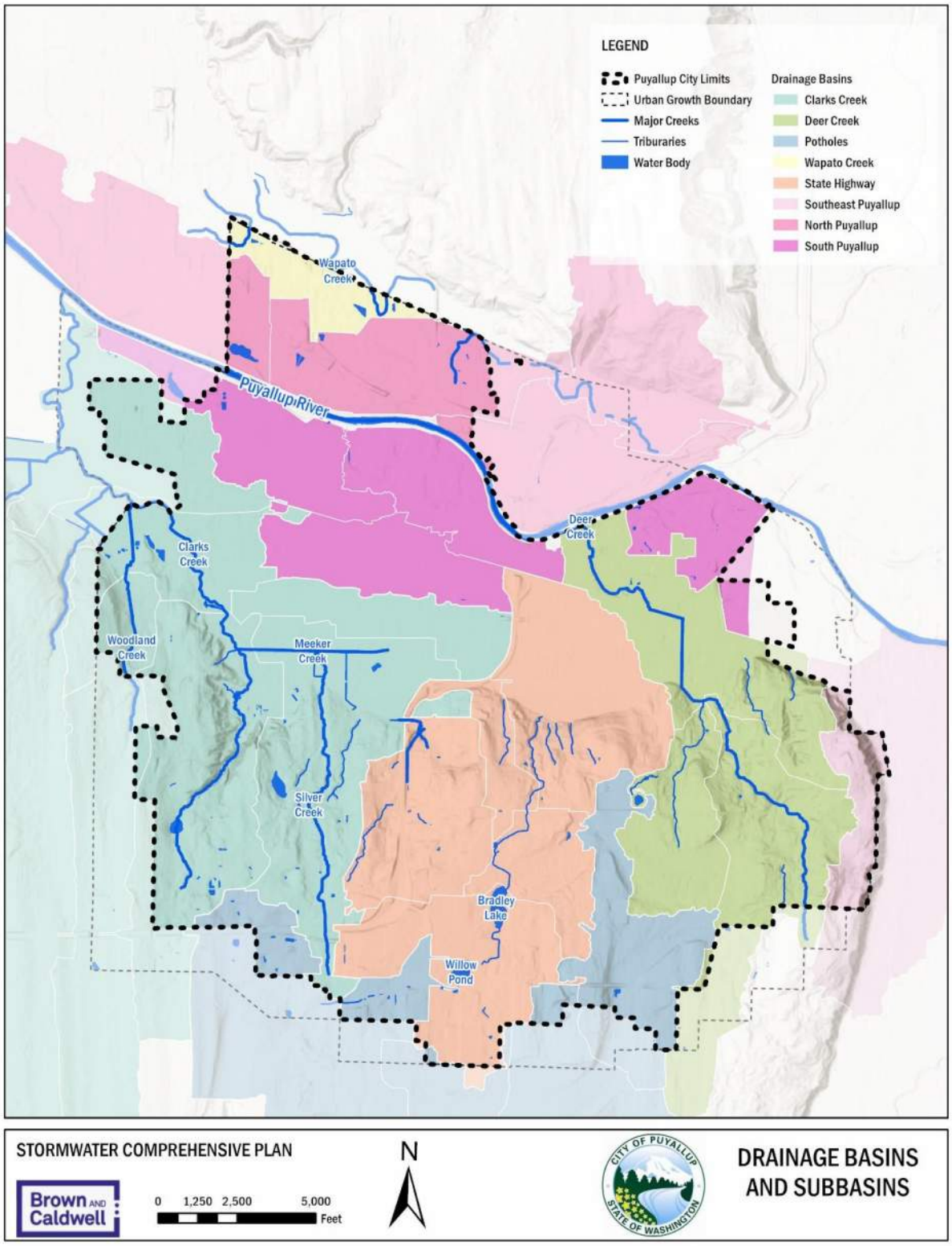

Figure 4-1. Drainage basins and subbasins

4.1.1 Climate

The city is characterized by a temperate marine climate with warm, dry summers, and cool, wet winters (Savoca et al., 2010). Like most areas in western Washington, temperatures in the city are moderated by the Pacific Ocean and the Puget Sound. Mean monthly temperature (average monthly temperature for 1991–2020) ranges from about 42°Fahrenheit (°F) in January to about 67°F in August at the Seattle-Tacoma International Airport north of the city, with similar range at the Tacoma No.1 Station located at the Tacoma Tide flats (National Oceanic and Atmospheric Administration [NOAA], 2024).

Moisture-laden air masses created in the Pacific Ocean typically approach the area from the southwest. Mean annual precipitation (average annual precipitation for 1981–2010) is 39.3 inches at the Seattle-Tacoma International Airport, and 40.8 inches at the Tacoma No.1 Station (NOAA, 2024). The distribution of precipitation varies throughout the year, with around 80 percent of the annual precipitation occurring from October through March.

4.1.2 Geology and Soils

The city's soils and underlying geology are characterized by their diverse origins and properties and shaped by the region's dynamic geological history. The retreat of the Puget Lobe of Laurentide ice sheet about 16,000 years ago formed the Puyallup Valley, a large, relatively flat valley separated by broad, poorly drained upland areas. Much of the city occupies valley floor but also extends to higher elevations south and east, as the land rises gently toward the foothills of Mount Rainier. Conversely, to the west of the city, the elevation gradually descends toward the lower-lying areas of the Puget Sound basin.

The lower elevation areas are underlain by alluvial soils (clay, silt, sand, and gravel) deposited by flowing streams in the river valley. Unconsolidated glacial soils (till and outwash) comprise the upland areas, transported and deposited by a glacier or by glacial meltwater. Sedimentary and volcanic bedrock units underlie these unconsolidated deposits and crop out in the foothills along the southern and southeastern margins of the city.

Figure 4-2 shows the soil types, symbolized by drainage class, within the City (Natural Resources Conservation Service [NRCS], 2024). The lower elevation river valley area of the City is underlain by alluvial soil (sandy loam, silt loam, gravelly loam) deposited by flowing streams in the river valley. Most soils in this area are classified as "well-draining", meaning that they have good aeration, and water table between 75cm and 150cm below ground surface. Unconsolidated glacial soils comprise the upland areas of the City, transported and deposited by a glacier or by glacial meltwater. Soils in these upland areas are primarily classified as "excessively drained", meaning that soils are coarse and steeply sloped, allowing water to move rapidly through them. Sedimentary and volcanic bedrock units underlie these unconsolidated deposits and crop out in the foothills along the southern and southeastern margin of the city. In the foothills and southeastern margin of the city, soils are classified as "poorly drained", meaning that water is removed from the soils slowly due to high groundwater table and convergent topography; in some cases, these are hydric soils that are saturated during much of the year.

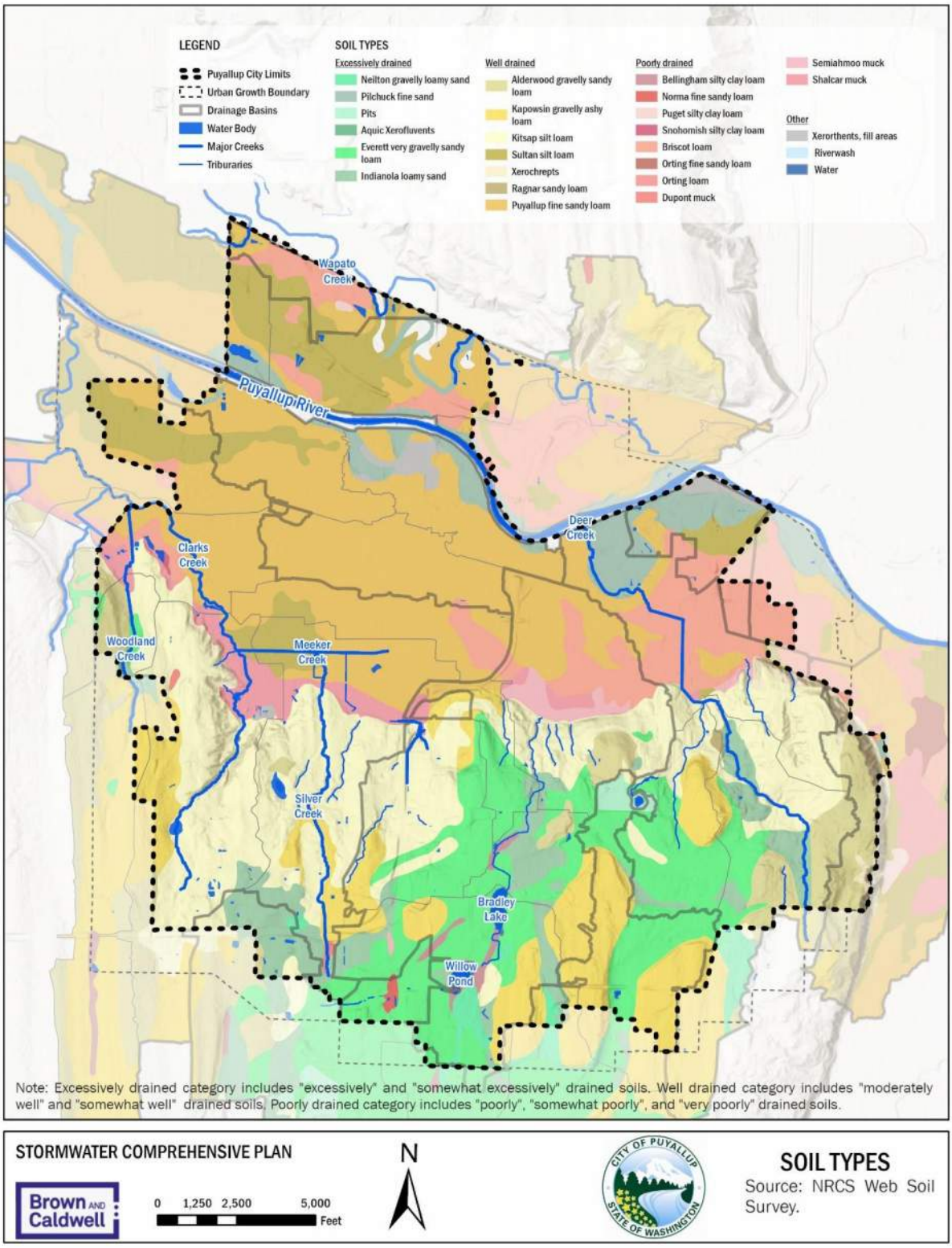

Figure 4-2. Soil types and soil drainage classes

4.1.3 Critical Areas

Critical areas are defined as "wetlands, fish, and wildlife habitat areas; critical aquifer recharge areas; geologically hazardous areas; and frequently flooded areas" (PMC 21.06). The city's critical-areas policies aim to protect designated critical areas identified in the GMA. These critical areas are summarized as:

- **Wetlands:** areas that are often inundated or saturated by surface water or ground water. Wetlands include swamps, marshes, bogs, and similar areas that support vegetation adapted for saturated soil conditions. Wetland buffers are designated areas contiguous or adjacent to wetlands that are required for the continued maintenance, function, and structural stability of the wetland.
- **Fish and wildlife habitat areas:** either freshwater (aquatic) or terrestrial areas that serve a critical role in sustaining needed habitats and species for the functional integrity of the ecosystem. Aquatic habitat areas are described in more detail in Section 4.6.
- **Critical aquifer recharge areas:** areas that are important for recharging aquifers used for potable water. In these areas, groundwater contamination (and subsequent drinking water well contamination) can have a negative impact on public health. Pierce County has delineated aquifer recharge areas that define wellhead protection areas, potential groundwater pollution areas, and the Clover/Chambers Creek aquifer.
- **Geologically hazardous areas:** include areas susceptible to erosion, sliding, earthquake, or other geologic events. The city's proximity to Mount Rainier makes it potentially susceptible to lahar (volcanic mudflow) inundation; areas within the Puyallup River valley lowlands are particularly susceptible (City of Puyallup, 2020). Approximately the northern half of the city is classified as moderate to severe seismic hazard, where there is high risk of damage as a result of earthquake activity (United States Geological Survey [USGS], 1975). Landslide hazard areas are areas that are potentially subject to significant or severe risk of landslides. The hilltops that straddle the Puyallup River valley drop off abruptly to the north and east in places, with slopes ranging from 25 to 50 percent. The steeper slopes are subject to landslide hazards.
- **Frequently flooded areas:** open channel and overbank areas within the 100-yr floodplain that are frequently inundated with flood water. Much of the frequently flooded areas within the city lie along the Puyallup River, Clarks Creek, and Deer Creek areas. The Puyallup River channel is within the floodplain but is controlled by a series of revetments and levees on both sides of the river through Puyallup.

Figure 4-3 shows designated wetland areas, aquifer recharge areas, and the FEMA 100-yr and 500-yr floodplains within the city.

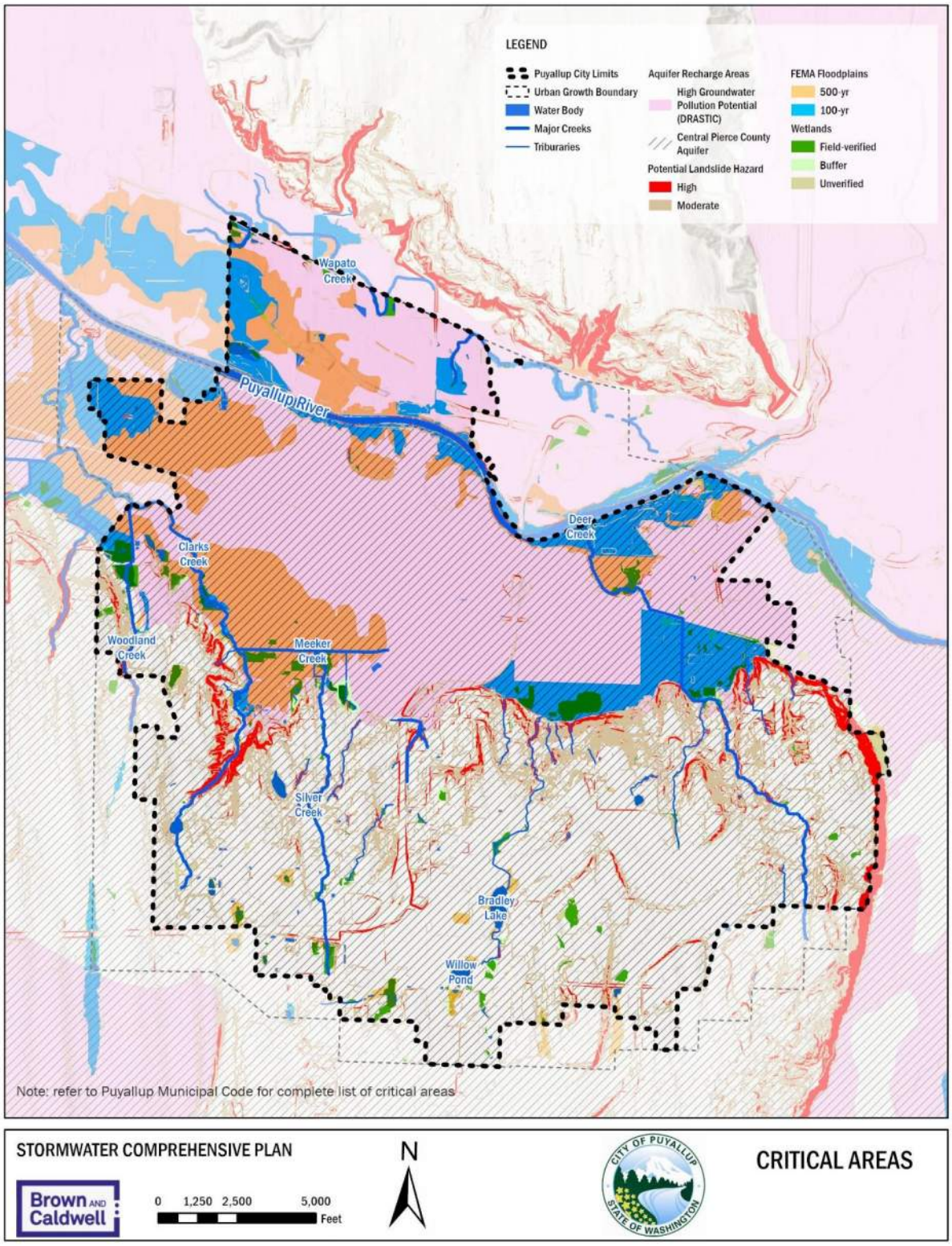

Figure 4-3. Critical areas

4.1.4 Land Use and Development

Urban development allows for economic opportunity and viable businesses, which are essential to community healthy and prosperity. As the population of the City increases, new areas are developed, or existing areas are redeveloped at a higher density. These changes can result in increased stormwater runoff and greater water quality impacts to receiving water bodies. Development regulations and drainage design standards imposed by the City are intended to mitigate these impacts.

Figure 4-4 shows planned future land use designations for the City and its UGA. These planned land use designations will likely require updates in the City's 2023 update to the 2015 Comprehensive Plan in response to recent planning initiatives. Namely, in 2021, the City adopted a Housing Action Plan (HAP) to identify strategies, actions, and policy tools to create a variety of housing options to meet community needs. The City is currently implementing certain HAP strategies related to code requirements for permanent supportive housing, and tax exemptions for multi-family properties. Other HAP strategies that will be implemented as part of the city's 2023 Comprehensive Plan Update include rezoning areas to facilitate higher density and more diverse housing types, and revisions to zoning provisions to consolidate single-family zones.

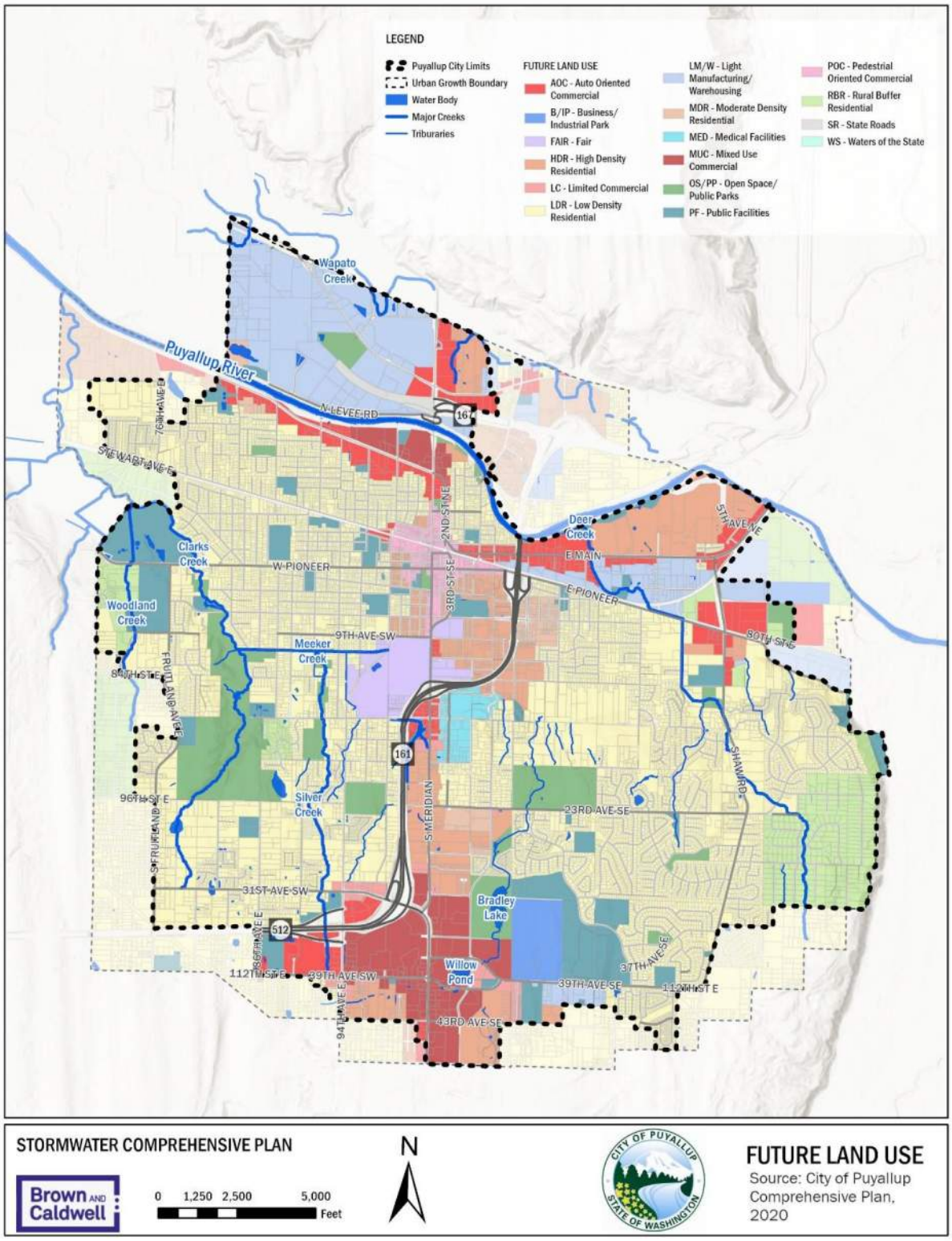

Figure 4-4. Future land use

4.2 Stormwater Infrastructure

The City has approximately 253 miles of City-owned pipes dedicated to conveyance of stormwater, varying in diameter from 2 to 96 inches. The City also owns eight stormwater pump stations, 650 culverts, and 25 miles of ditches and stormwater channels. These conveyance systems generally follow the shortest path to deliver stormwater flows to natural conveyance systems such as Clarks, Meeker, and Deer Creeks, and ultimately to the Puyallup River. There are 18 City-owned stormwater outfalls to the Puyallup River, and 37 outfalls to Clark's Creek below Maplewood Springs and/or Meeker Creek (which carries significant stormwater volumes into Clarks Creek). Figure 4-5 shows the stormwater infrastructure within the city. Section 10 and Appendix F provide additional detail by basin and subbasin, respectively.

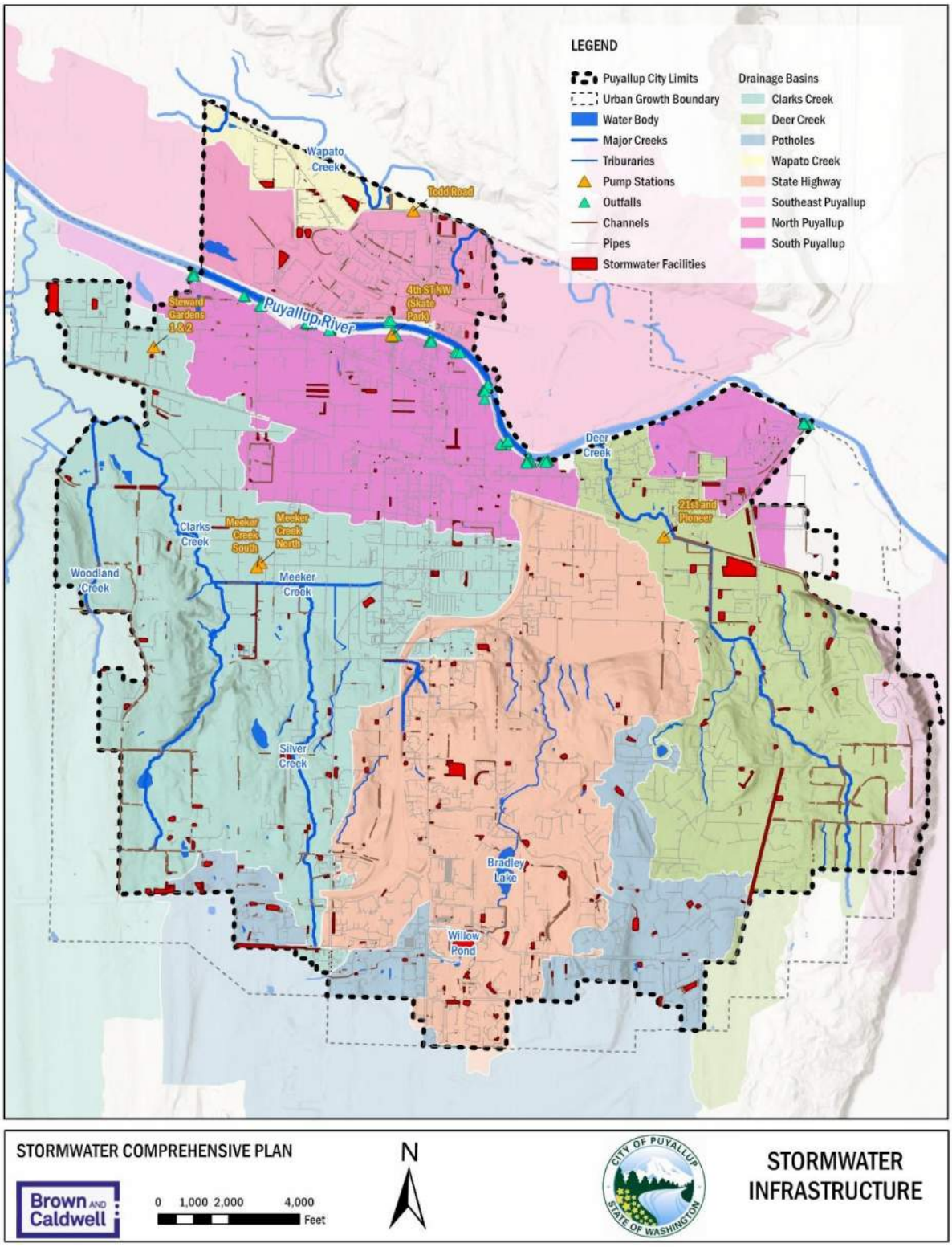

Figure 4-5. Storm infrastructure

4.3 Drainage Problems

City staff compiled a comprehensive list of drainage problems by reviewing past stormwater planning documents, internal communications, and ad hoc problem and project tracking spreadsheets. To help prioritize problems for evaluation, nearly 200 problems were sorted into one of three status categories: 1) removed or resolved by maintenance or lack of reoccurrence, 2) resolved through a completed capital project, and 3) remaining identified problems. All compiled problems are summarized in Appendix B by status. (i.e., removed, Table B-1; completed project, Table B-2; or remaining identified, Table B-3).

The 108 remaining identified problems in Table B-3 are described by problem's solution type, previous problem identification number, and if applicable and available, a solution or project description and cost estimate. Table 4-2 lists the number of problems by solution type and drainage basins. Figure 4-6 shows the distribution of the identified problems within the city by solution type. Section 5 summarizes how problems were prioritized for consideration for a capital project and further hydraulic modeling.

Table 4-2. Drainage and Water Quality Problems per Drainage Basin

Solution Type	Clarks Creek	Deer Creek	North Puyallup	Potholes	SE Puyallup	South Puyallup	State Highway	Wapato	Total
Capacity	8	4	0	0	0	5	9	0	26
Floodplain	2	3	1	0	0	1	2	0	9
Maintenance/Operations	2	7	0	0	0	10	13	0	25
NPDES	1	0	0	0	0	0	0	0	1
Planning	3	0	0	0	0	0	3	0	6
Replacing Aging/Deficient Infrastructure	9	0	2	1	0	8	12	0	39
Expanding Direct Discharge	0	0	0	0	0	2	0	0	2
Total	25	14	3	1	0	26	39	0	108

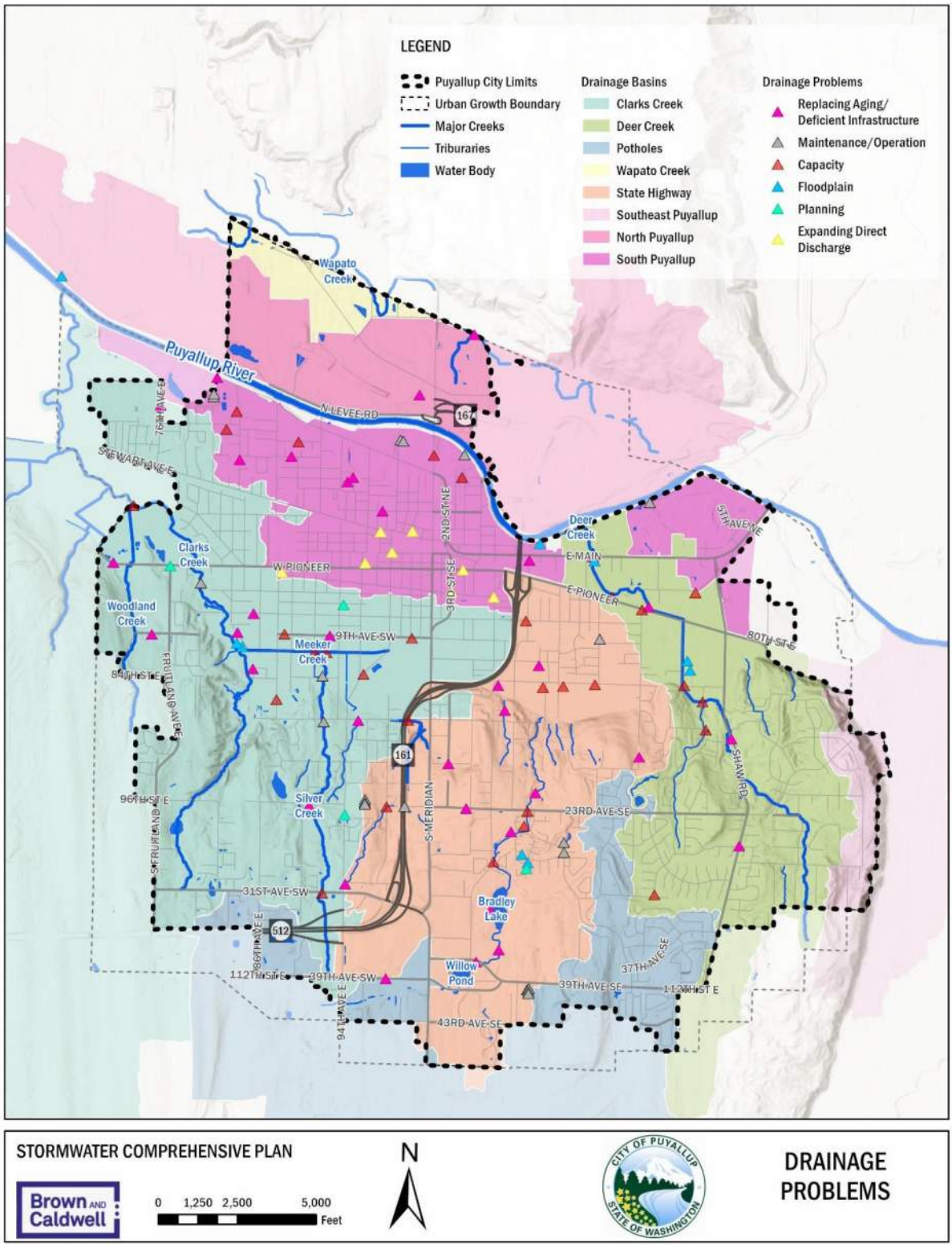

Figure 4-6. Drainage problem locations and types

4.4 Flood Hazards

Puyallup River flows through the northern portion of the City. The Puyallup River drains the southwest flank of Mount Rainier and is joined along its course by the Carbon and White Rivers, which are major tributaries that also drain Mount Rainer.

The entire reach of the Puyallup River within to the city is confined by revetments and levees to reduce flooding and to open the floodplain to rural, industrial, and residential development.

The lower Puyallup River levees were accredited as 100-yr levees when flood mapping was performed in the area in 1987. In 2004, the U.S. Army Corps of Engineers (USACE) de-certified the levees along the lower 8 miles of the Puyallup River, including some levees adjacent to the city. The levees were de-accredited by FEMA because they no longer met the requirement that the top of the levee be at least 3 feet above the predicted 100-yr water levels. This was caused by sediments accumulating along the river bottom that have raised the water surface levels so that the tops of levees are no longer high enough.

The river is the subject of many recent studies due to recent flooding, levee de-certification, and potential future impacts of anticipated aggradation trends. In 2009, Tetra Tech and Pierce County completed the Lower Puyallup River Flood Protection Investigation to evaluate the potential future water surface elevations if no actions are taken. Between 2010 and 2012, the USGS conducted a number of studies on Puyallup River flooding and sedimentation. More recently, Pierce County prepared a Flood Hazard Management Plan, which includes measures to reduce water surface elevations and flood hazards. In 2018, the USACE developed a Draft Puyallup River General Investigation Study. The County and NHC are currently updating flood risk maps for the lower Puyallup River as part of the Canyon Road Regional Connection Project. These studies are summarized below.

Lower Puyallup River Flood Protection Investigation, Without-Project Analysis (Tetra Tech, 2009). This analysis evaluated flood-related conditions along the 500-yr lower Puyallup River floodplain under current and future conditions. The analysis included sediment modeling based on historical sediment loads to predict riverbed levels as sediment accumulates over a 50-yr period. In general, the results indicated that without dredging or other major changes to the bed, the channel will continue progressing toward higher bed elevations, which in turn will result in rising river water levels. At USGS Puyallup River Gage 12101500 (Puyallup River Gage) (river mile [RM] 6.5), the bed elevation was projected to increase 1 foot (relative to 2007 bed elevation) by 2057 (approximately 0.24 inches per year). This increase in bed elevation in turn increases the river levels; the study estimates a 0.6-foot increase in the current 100-yr flood water surface elevation at the Puyallup River Gage by 2057. However, the study did not consider the sediment contribution from shrinking glaciers on Mount Rainier and corresponding availability of additional sediment sources in the terminal moraine.

USGS Puyallup River Floods and Sedimentation Study. Sediment was commonly removed from the river until about the mid-1990s, when this practice largely ceased to protect aquatic habitat. Aggradation's role in recent flooding has many interested in the river's current flood-carrying capacity. It is not known how the change in sediment management has impacted the long-term aggradation/degradation trends and flood-carrying capacity of the lower Puyallup River system as a whole. The USGS has conducted three studies:

- The first study evaluated the channel-conveyance capacity, channel change, and sediment transport in the lower Puyallup, White, and Carbon rivers (Czuba et al., 2010). It showed sediment input to the river systems draining Mount Rainier has resulted in high rates of aggradation on select reaches of the Carbon, Nisqually, White, and Puyallup rivers, which has increased channel migration and reduced their flood-carrying capacity. Between 1984 and

2009, this study estimates that the average channel elevation increased by 1.1 feet at the Puyallup River Gage (approximately 0.5 inches per year).

- The second study evaluated sediment management as a potential river management option (Czuba et al., 2011). The objectives were to better understand the current flood-carrying capacity of the lower Puyallup River system, the flood-carrying capacity for different river-system management options, and the long-term sedimentation trends of the system. This study estimates that the Puyallup River discharges 980,000 tons of sediment per year, which accounts for 15 percent of the total annual sediment load to the Puget Sound (Czuba et al., 2011).
- The third study estimated the sediment input from Mount Rainier (i.e., the downstream transport of this sediment through the Nisqually, Carbon, and White rivers) and evaluated how the rates of sedimentation might continue into the future under climate-change scenarios (USGS, 2012). The USGS conducted this study to inform river-system management efforts to reduce flooding and improve aquatic habitat in the lower Puyallup River, considering the system's flood-carrying capacity and trends in sedimentation. Potential changes in hydrologic conditions over the next 25 to 50 years were simulated to assess possible future effects on bed elevations. To evaluate sensitivity to sediment supply, the study simulated both a 10 percent increase and 10 percent decrease in sediment supply. The study found that the Puyallup River delivers about four times less bedload than the White River and will experience less-severe aggradation compared to the other study rivers. The average difference in bed elevations between a 10 percent increase and decrease in sediment supply was about 0.5 feet after 50 years. The study identifies reaches that tend to accumulate sediment naturally and recommends that sediment management actions be implemented in these reaches.

Puyallup River General Investigation Study (USACE, 2016). This study began in 2010 but was inactivated in 2018. The goal was to recommend a plan that maximizes benefits for flood risk management, minimizes life safety risks, and results in the least amount of environmental impact within the Puyallup River Basin (including the Puyallup, Carbon, and White rivers). The tentatively selected plan includes the following structural flood risk management measures along the lower Puyallup River:

- Levee raising/modification (between RM 0.7 and RM 2.9)
- Levee setback (from RM 2.7 to RM 8.1)
- Floodwall construction (RM 2.9 to RM 7.2)
- Levee extension (RM 7.2 to TM 8.6)

Pierce County's 2023 Comprehensive Flood Management Plan. This plan identifies a number of sediment management strategies and programmatic recommendations (Pierce County, 2023). Of particular relevance is the County's proposal to study sediment transport and aggradation in the mid and lower Puyallup River. In the long term, the County plans to implement site-specific sediment management, guided by technical sediment transport and biological studies. Additional recommended strategies identified in the County's Plan include:

- Update low-level light detection and ranging (LiDAR) or other mapping of river areas on a 3-year cycle.
- Document the extent of flooding and high-water marks along mainstem river corridors (Puyallup, Carbon, White, South Prairie, and upper Nisqually rivers) during major flood events.
- Monitor long-term changes in river channel conditions on a 7-year recurring basis, including river channel cross sections, flood conveyance capacity, and sediment transport and deposition.

Canyon Road Regional Connection Project: Floodplain Mapping. As part of the Canyon Road Regional Connection Project's engineering, NHC and Pierce County are currently conducting a hydrologic and hydraulic analyses for the lower Puyallup River and Clarks Creek. This analysis will provide updated flood risk data for the lower Puyallup River (at the Puyallup River Gage) and Clarks Creek at the confluence with the Puyallup River.

The City is interested in these studies as it has 18 stormwater outfalls to the Puyallup River. Most of these outfalls have flap gates that close when the river level reaches an outfall's elevation, which prevents backwater flooding into the stormwater system. However, while the flap gates are closed, stormwater runoff from the City backs up through the City's storm drainage system. Because the channel cannot migrate, sediment aggradation could further reduce flood conveyance capacity and increase the potential for levee erosion or overtopping. If countermeasures are not implemented to address this increase in flood stage, the City could experience more frequent stormwater flooding.

4.5 Water Quality Characteristics

This section summarizes the City's current water quality conditions and water quality compliance program.

4.5.1 Current Water Quality Issues

Water quality standards are the basis for protecting and regulating the quality of surface waters. Water quality standards are established to protect beneficial uses of a state's waters.

The CWA requires that all states perform a "water quality assessment" of surface waters in the state every 2 years. Ecology performs the water quality assessments for water bodies in the state of Washington. The assessed water bodies are placed into one of five categories that describe water quality:

- Category 1: Meets standards for pollutants tested.
- Category 2: Water of concern; some evidence of a water quality problem, but not enough to show persistent impairment.
- Category 3: Insufficient data.
- Category 4: Impaired water that does not require a TMDL for one of three reasons: already has a TMDL (4a); has a pollution control program similar to TMDL (4b); or impaired is caused by a non-pollutant (4c).
- Category 5: Impaired waterbody violates water quality criteria. TMDLs or other approved water quality improvement projects are required for the water bodies in this category.

Ecology's 2018 Water Quality Assessment is the most recent EPA-approved water quality assessment for freshwater bodies in the state of Washington. The EPA completed and approved the 2018 Assessment in 2022. Table 4-3 summarizes Ecology's 2018 water quality assessment for water bodies in Puyallup. Water bodies with an assessment category of 4 or 5 do not meet the water quality assessment criteria. Water quality problems are described in more detail in Section 10.

Table 4-3. 2018 State Water Quality Assessment for Puyallup Water Bodies [a]

Waterbody Name	Reach Code	2018 Assessment Category	Parameter(s)	Listing ID(s)
Clarks Creek	17110014000641 (Clarks Creek downstream of Meeker Creek)	2: Water of concern	Temperature, pH	35345, 7499
		4a: Has a TMDL	Bacteria - Fecal Coliform, DO, Fine Sediment	45207, 47590, 78997
	17110014015982 (Clarks Creek upstream of Meeker Creek)	4a: Has a TMDL	Fine Sediment	77239
	17110014016641 (Upper Clarks Creek)	4a: Has a TMDL	Fine Sediment	77238
Meeker Creek	17110014015740	4a: Has a TMDL	Bacteria - Fecal Coliform, DO	7507, 7510
		5: Needs TMDL	Temperature, pH	7509, 7511
Unnamed Creek (Trib To Clarks Creek)	N/A	2: Water of concern	Temperature, DO	73816, 77614
Silver Creek	17110014001353	2: Water of concern	Temperature, DO	73824, 77613
		5: Needs TMDL	Fine Sediment [b]	78999
Silver Creek, E.F.	17110014001357 (Wildwood Park to 12st St SE)	4a: Has a TMDL	Fine Sediment	79714
Unnamed Creek	17110014001354 (Trib To Silver Creek)	5: Needs TMDL	Fine Sediment [b]	79712
Deer Creek	17110014001364	4a: Has a TMDL	Bacteria - Fecal Coliform	45616
Puyallup River	17110014000028 (Confluence with Deer Creek to Freeman Rd. E)	2: Water of concern	Lead, DO, Turbidity	8677, 10869, 15914
		5: Needs TMDL	Bacteria - Fecal Coliform, Temperature, Mercury [c]	7498, 10862, 10874
Wapato Creek	17110019020852	4c: Impaired by a non-pollutant	Instream Flow	6189
		5: Needs TMDL	Bacteria - Fecal Coliform, DO	7517, 7518
Woodland Creek	17110014015826	2: Water of concern	Temperature, pH	73832, 80738
		4a: Has a TMDL	Bacteria - Fecal Coliform	46482
		5: Needs TMDL	DO	47736

a. Excludes listings for reaches that fall outside of city limits. Excludes listing 45688 "unnamed trib to Puyallup River," of which only 800 feet fall within the city limits.

b. Silver Creek is tributary to Clarks Creek, which has an established TMDL for fine sediment; therefore, this segment should be in Category 4a (Has a TMDL).

c. Mercury exceedances are unlikely to be related to stormwater discharges from the city.

4.5.2 Water Quality Compliance

The City has a well-developed municipal stormwater system O&M program that uses and provides training on numerous processes and procedures to minimize water quality impacts from municipal operations. The City also actively incorporates stormwater quality BMPs into its municipal activities.

The Phase II Permit requires local governments to manage and control stormwater runoff so that it does not pollute downstream waters. The City is in full compliance with the current (2019) Phase II Permit, which became effective August 1, 2019, and expires July 31, 2024. The City's 2024 Stormwater Management Program Plan contains a summary of Permit requirements and descriptions of the City's current and planned activities for Permit compliance.

The Phase II Permit contains requirements for complying with applicable TMDLs. Applicable TMDLs are those that have been approved by the EPA on or before Permit issuance. This includes TMDLs for:

- Puyallup River Watershed fecal coliform TMDL
- Clarks Creek fecal coliform TMDL
- Clarks Creek DO and sediment TMDL

Appendix 2 of the Phase II Permit prescribes the activities the City must take to comply with applicable TMDLs. The City's TMDL compliance programs are described below.

4.5.2.1 Puyallup River Fecal Bacteria TMDL

This Ecology-mandated program seeks to reduce fecal indicator bacteria levels in the Puyallup River and its tributaries, as well as implement projects to mitigate this water quality issue. Fecal indicator bacteria (e.g., fecal coliform, *E. coli*) are used to evaluate the presence of animal or human waste in our water bodies. Potential sources of fecal coliform include leaking septic systems, stormwater runoff, or cross-connections between the sewer and stormwater systems. Water quality samples collected from Puyallup River tributaries such as Deer Creek contained fecal coliform concentrations that exceeded state water quality criteria for recreational water users.

For Deer Creek the City has continued to acquire land that would create a large corridor of City ownership along Deer Creek. This corridor will support a future stream restoration project to improve wetland function and natural stream channel meandering to reduce localized flooding. This project may also provide water quality improvements.

Appendix 2 of the Phase II Permit requires the City to designate areas discharging via the MS4 to Deer Creek as high-priority areas for illicit discharge and elimination.

4.5.2.2 Clarks Creek Fecal Bacteria TMDL

For Clarks Creek and tributaries like Meeker Creek, the City's approach has been multi-faceted and includes a pet waste program, riparian plantings, restoration of streamside properties (public and private), management of City-owned shoreline properties, signage, and education and outreach to discourage the feeding of waterfowl in DeCoursey Park. The City also coordinates with Puyallup Fair Grounds staff to limit animal waste entering storm drains by allowing catch basins to drain to the sanitary sewer during fair events.

Appendix 2 of the Phase II Permit requires the City to designate areas discharging via MS4 to Meeker Creek as high-priority areas for illicit discharge and elimination.

4.5.2.3 Clarks Creek DO and Sediment TMDL

Ecology issued the Clarks Creek DO and sediment TMDL in 2014. To meet the TMDL targets, the Phase II Permit requires the City to treat and/or remove stormwater runoff to improve DO levels in the Creek, and implement measures (e.g., stormwater filters, street sweeping) to reduce sediment loads in MS4 discharges to the creek. In addition, Ecology Administrative Order 16591 requires the City to implement channel and bank stabilization measures to reduce sediment loads from bed and bank erosion.

The City published the *Clarks Creek Retrofit Plan Update for 2024–2029 (Retrofit Plan 2024-2029)* (BC, 2023b) which, in part, identified programs the City will or has implemented to address DO and sediment targets. These programs include the Green Puyallup Partnership's (GPP) riparian planting, interpretive sign repair and replacement, and street sweeping.

Ecology's Clarks Creek Sediment and DO TMDL study called for the City and County to reduce *Elodea* coverage by as much as 75 percent. The TMDL study also issued a requirement for increasing riparian canopy cover (planting) to help suppress *Elodea* growth through shading.

The Elodea Management Program organizes and implements efforts to reduce *Elodea* from Clarks Creek with the intent of lowering creek levels, reducing flooding, and reducing DO demands on Clarks Creek. Currently, the short-term solution for *Elodea* management is hand cutting. Long-term solutions include activities that will provide riparian shading to limit growth through the GPP habitat stewardship and restoration volunteer programs. These programs make riparian plants available to streamside residents to plant along the banks of the creek to try to combat this issue. In addition, the City has worked with the Pierce Conservation District (PCD) and Washington Conservation Corps crews to perform much-needed planting along the banks of properties that the City has purchased along the creek. The City, with the help of the PCD, has increased these efforts in the past couple of years and now offers crews that will plant and maintain vegetation on private property along the creek to provide much-needed canopy cover over the creek.

4.6 Aquatic Habitat

The abundance of waterbodies (lakes, rivers, and creeks) in the city provides important freshwater aquatic habitat. Anadromous fish species found in creeks and rivers throughout the City include coho, chinook, and chum salmon, and steelhead. Naturally occurring or established species include largemouth bass, brown bullheads, bluegill, and black crappie. Clarks Creek, in particular, is a salmon-bearing stream supporting chinook, coho, and chum salmon, steelhead, and cutthroat trout. Clarks Creek is also home to a number of salmon hatcheries. The Puyallup Hatchery is located just east of Decoursey Pond along the mainstem of Clarks Creek. The Puyallup Hatchery is operated by

the Washington State Department of Fish and Wildlife (WDFW) and raises over 700,000 Chinook per year to help with salmon recovery, along with Coho and trout. Further downstream, the Puyallup Tribe of Indians operates the Clarks Creek Hatchery and Diru Creek Hatchery, located outside of the city boundaries. Between these two hatcheries, the Puyallup Tribe raises chum smolts, winter steelhead, Fall Chinook, and Coho salmon with the goal of rebuilding depressed Chinook and steelhead stocks in the watershed.

The "designated use" of a waterbody defines the uses to be protected by established water quality criteria. Designated uses are based on the species (salmonid species or warm water species) and life stages (spawning or rearing) present. For example, salmon spawning and incubation requires sufficient gravel, adequate flows, and good water quality. Washington Administrative Code (WAC) lists the use designations for freshwaters in the state of Washington. Table 4-4 summarizes the designated aquatic life uses and documented fish species for creeks and rivers within the city.

Table 4-4. Designated aquatic life use and documented fish species in Puyallup

Creek(s)	Designated aquatic life use[a]	Documented Fish Species [b]								
		Fall Chum	Fall Chinook	Spring Chinook	Pink Odd Year	Sockeye	Coho	Winter Steelhead	Cutthroat Trout	Bull Trout
Puyallup River	Core Summer Salmonid Habitat	X	X	X	X	X	X	X	X	X
Clarks, Woodland, and Meeker Creeks	Core Summer Salmonid Habitat	X	X		X		X	X		
Deer Creek	Core Summer Salmonid Habitat	X	X		X		X	X		
Wapato Creek	Salmonid Spawning, Rearing, and Migration		X		X		X	X		
Silver Creek	Core Summer Salmonid Habitat		X							

a WAC 173-201A-600 or WAC 173-201A-610

b. WDFW SalmonScape

The City has led a number of restoration projects to improve aquatic habitat along Clarks Creek, Meeker Creek, Silver Creek, and Deer Creek. The Clarks Creek Channel and Bank Stabilization Project, completed in 2018, stabilized and roughened an incised portion of upper Clarks Creek to improve downstream transport of sediment. In 2015, the City completed the Meeker Creek restoration project, which replaced 1,000 linear feet of trapezoidal ditch with natural, meandering stream channel. Silver Creek, another tributary to Clarks Creek, which once was ditched along 12th Ave SW and 11th Street SW, has also been returned to its natural stream channel. Additional stabilization projects along Silver Creek will be considered in the future as funding opportunities become available.

Drainage System Evaluation

This section summarizes the drainage system evaluation. This evaluation includes three main components: (1) identification of existing drainage problems; (2) hydrologic and hydraulic modeling; (3) review and synthesis of future climate and Puyallup River conditions. These three components were used to develop recommendations for potential future flow monitoring, modeling, and studies. Specifically:

- Section 5.1 describes the screening process to determine how drainage problems would be evaluated.
- Section 5.2 describes the development of the hydrologic and hydraulic modeling tools used to identify the City's LOS event and evaluate the stormwater system's capacity.
- Section 5.3 describes the modeling results, with implications for CIP development.
- Section 5.4 describes applicable climate change impacts and future Puyallup River conditions that could impact the City's future stormwater system capacity.
- Section 5.5 describes suggestions for potential future flow monitoring, modeling, and studies.

5.1 Problem Screening and Project Prioritization

As discussed in Section 4.3, City staff sorted drainage problems into one of three categories: removed, resolved by a project, or remaining identified (listed in Tables B-1, B-2 and B-3 in Appendix B, respectively). To help expedite the problem screening process, City staff again sorted the approximately 100 remaining identified problems to develop a list of approximately 50 problems to evaluate for a capital project with a prioritization criteria matrix. The prioritization matrix, which includes prioritization criteria, ranking, and weights, is shown in Table B-4 in Appendix B.

Using the initial sorting prioritization matrix, the City developed the following capital project groups:

- Priority projects are solutions for the highest-ranked problems. The City selected the nine highest ranked problems for the Priority category. Section 8 provides details for the Priority projects.
- Second Tier projects are solutions for the next highest-ranked problems. The City selected 36 problems for this category. Section 8 summarizes the Second Tier projects.
- Low priority problems are the remaining 60 problems. These problems ranked the lowest of the nearly 100 problems evaluated. These projects are listed in Table B-3 in Appendix B and noted as "Low" in the "Ranking Category" column in the table.

5.2 Hydrologic and Hydraulic Modeling Summary

The hydrologic and hydraulic modeling analysis was performed to:

- Identify the City's LOS storm event.
- Evaluate the current conveyance capacity of the system in known problem areas.
- Support development of recommendations to address high-priority problems.

The modeling effort leveraged existing hydrologic and hydraulic models and focused on direct discharge areas to Puyallup River and Clarks Creek. For this analysis, two modeling programs were

used in unison to evaluate the storm drainage system: HSPF[1] for hydrology and SWMM[2] for hydraulics. HSPF was used to estimate stormwater runoff rates and SWMM was used to simulate the movement of this runoff through the city's conveyance system by calculating water levels and flow velocities at all pipes. The following sections describe the specific activities, data sources, and key assumptions used to develop the HSPF and SWMM models.

5.2.1 Review of Existing Models

Hydrologic models simulate hydrologic processes (runoff, infiltration, losses) in response to meteorological drivers (precipitation). The USGS developed an HSPF hydrologic model for the State Highway Basin Plan in 2007 (Brown and Caldwell [BC], 2007). In 2012, BC updated the HSPF model for the 2012 Comprehensive Storm Drainage Plan (CSDP) to include more recent meteorological data and areas of interest for the 2012 CSDP (BC, 2012). In 2023, NHC updated and expanded the HSPF model domain to include all basins within the UGA (NHC, 2024). NHC also extended the model simulation period through June 2023. In addition, NHC replaced the precipitation on October 8, 2003, which has been identified as an anomaly in previous studies (Tetra Tech, 2012 and BC, 2023c), with a value of 0 inches from the gage-recorded 4.85 inches.

Hydraulic models simulate how water moves through a system, either natural or built, from streams and lakes to culverts and storm drains. Hydraulic models require substantial levels of information about drainage infrastructure to accurately simulate water levels throughout the drainage network (e.g., pipe invert elevations, diameters, ground surface elevations at manholes). As a result, hydraulic modeling efforts are often conducted on an "as-needed" basis, or in specific high-priority areas. The City has undertaken a number of hydraulic modeling efforts. The 2012 CSDP developed a SWMM hydraulic model of three areas: Backwater, Downtown, and Willows Pond (BC, 2012). Due to limited calibration data, the 2012 CSDP SWMMM model was adjusted to reproduce anecdotal flooding observations at four locations. The 2012 CSDP recommended flow monitoring activities to better characterize the hydrologic and hydraulic performance of the stormwater drainage system.

Since 2012, BC updated to the City's SWMM models as part of the 4th Avenue Storm Drain Project:

- In 2014, BC developed a "combined existing conditions model" by combining the Backwater and Downtown models from the 2012 CSDP. These models were updated to simulate 2014 land use (impervious coverage) and stormwater infrastructure conditions. The 2014 combined existing conditions model was calibrated using data from seven flow monitoring locations (BC, 2014).
- In 2021, BC updated the 2014 combined existing conditions model with survey data from 2019 collected along the 4th Ave Storm Drain Project alignment. BC calibrated additional subcatchments using data from six flow monitoring locations (BC, 2023c).

5.2.2 Model Development

This section summarizes the development of the hydrologic and hydraulic models. More detailed information regarding model development is provided in Appendix C.

[1] HSPF or Hydrologic Simulation Program-Fortran is a physically based hydrologic modeling program that is maintained and distributed by the EPA. HSPF translates rainfall into runoff and other hydrologic processes that generate stormwater flow. HSPF has been widely used throughout the country for more than 3 decades and was the modeling platform used for the City's State Highway Basin Plan.

[2] SWMM or Storm Water Management Model is also maintained and distributed by the EPA and has been in wide use for more than 3 decades. SWMM contains a rigorous method for solving the dynamic hydraulic equations for flow (St. Venant equations) and simulating complex hydraulic phenomena, such as backwater, two-directional flow, and surcharging.

The hydrologic and hydraulic modeling for this Plan focused on areas within the City that discharge directly to the Puyallup River and Clarks Creek. BC made the following updates to the HSPF and SWMM models for this Plan:

- BC based the HSPF hydrologic model on the most recent NHC HSPF model (NHC, 2024). BC modified the NHC HSPF basin delineation for consistency with the updated SWMM model (described below) but retained the 2024 NHC HSPF model parameters.
- BC based the SWMM hydraulic model on the most recent combined existing conditions SWMM model developed for the 4th Ave Storm Drain Project. BC updated the SWMM model based on 2023 City GIS pipe data and 15th Street NW Storm Drain Extension Phase 2 plans and details.

The SWMM model is comprised of 97 subcatchments; 73 are calibrated subcatchments and 24 are uncalibrated. For calibrated catchments, BC used SWMM-generated runoff as input to the SWMM hydraulic model. For uncalibrated catchments, BC used HSPF-generated runoff as input to the SWMM hydraulic model. Figure 5-1 shows the modeling status of the City's drainage basins.

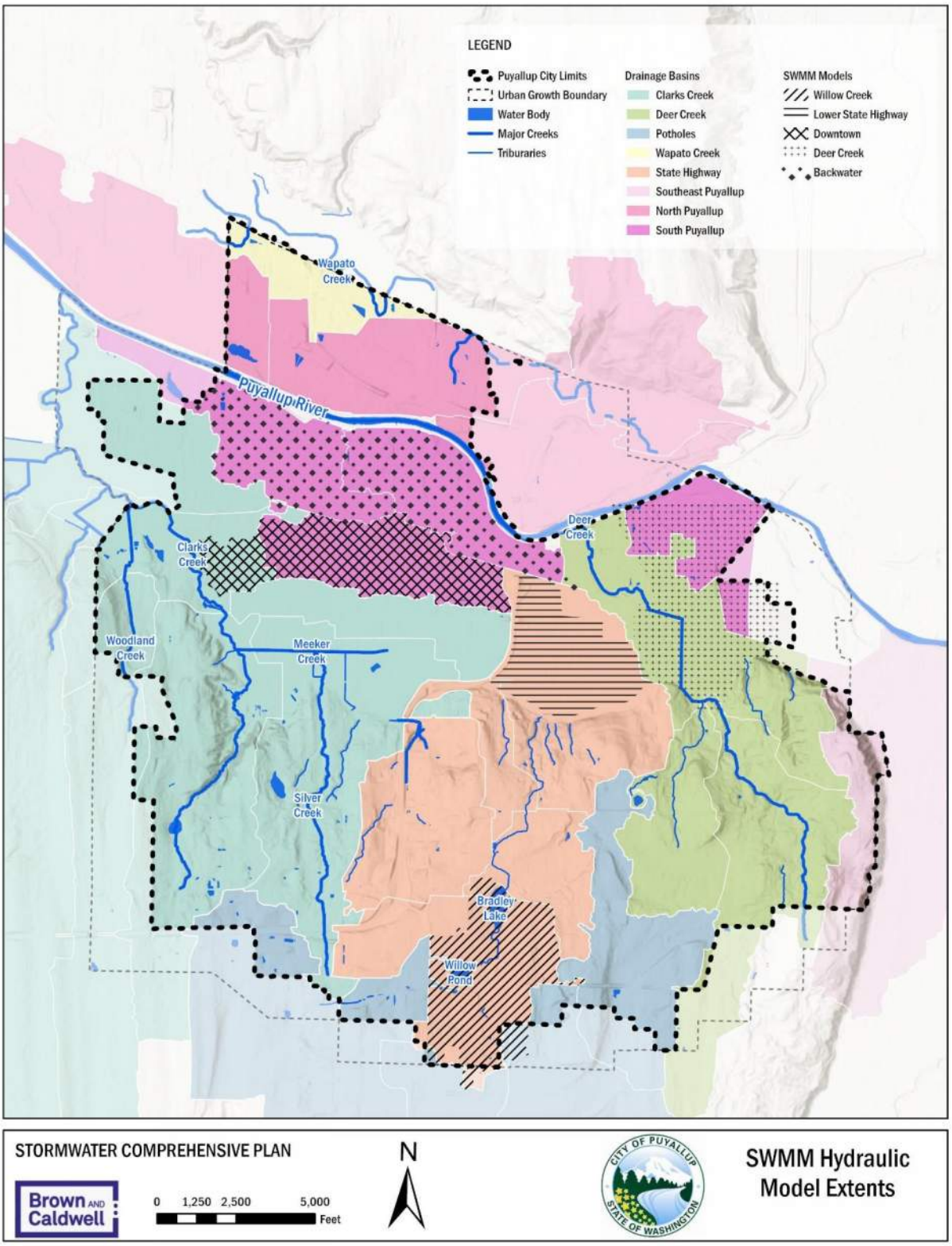

Figure 5-1. SWMM hydraulic model extents within the City

5.3 Modeling Analysis

The hydrologic and hydraulic modeling analysis was performed to determine the LOS event and evaluate the current available conveyance capacity of the system during the LOS event. The analysis focused on the direct discharge areas to the Puyallup River and Clarks Creek.

5.3.1 Level of Service

The City requires stormwater drainage systems to have sufficient conveyance capacity so that water levels do not rise above rim elevations during the 25-yr storm flow event. Pipe system structures may overtop for runoff events that exceed the 25-year design capacity provided the overflow from a 100-yr runoff event does not create or aggravate an existing flooding problem or erosion problem. BC identified the LOS events by simulating precipitation in a subset of the SWMM model (LOS SWMM model). The LOS SWMM model included calibrated subcatchments and subcatchments to the east of the 15th Street Diversion; uncalibrated subcatchments and those west of the 15th Street Diversion were excluded from the LOS analysis. The LOS SWMM model was further subdivided into three submodels ("NE", "NW" and "S") to expedite long-term simulations. For the long-term simulations, BC eliminated flow restrictions by increasing pipe diameters and allowing free discharge at outfalls. These modifications allowed all runoff to be conveyed without substantial system storage and attenuation.

BC used precipitation timeseries from 1948–2023 (NHC, 2024) in three LOS SWMM sub-models. Precipitation data are available at a 60-minute time step prior to October 1999, and at a 15-minute time step after October 1999. To enable use of the entire precipitation dataset, BC aggregated the 15-minute precipitation data to a 60-minute time step.

BC developed peak flow frequency estimates for each LOS SWMM sub-model. BC first selected event peak flows from each LOS SWMM sub-model using two event-based criteria: (1) a minimum inter-event time (time between peak storms) of 12 hours, and (2) a submodel-specific peak flow threshold. BC then ranked these peak flows and fit a theoretical probability distribution using Cunnane plotting position estimators. Finally, BC identified the corresponding historical storm events and simulated peak flows (LOS events) for the 25-yr and 100-yr return period events for each sub-model, as shown in Table 5-2.

Table 5-2. 25-yr and 100-yr LOS Events Using 60-minute Precipitation

Return Period (yr)	Submodel	Return Period Peak Flow (cfs)	LOS Event	LOS Peak Flow (cfs)	Total LOS Flow (cf)
100	S	53.3	9/17/1969	53.8	337,300
	NW	13.9	9/17/1969	14.0	92,990
	NE	28.8	10/20/2003	29.0	494,000
25	S	47.0	10/20/2003	48.8	1,038,000
	NW	12.6	10/20/2003	13.4	275,200
	NE	23.6	8/24/2004	25.9	201,700

cf = cubic feet

cfs = cubic feet per second

As shown in Table 5-2, LOS events vary by submodel. To determine which LOS event is the most representative of the three submodels (and the City overall), BC compared total flood volume, total hours of flooding, and total flooded model junctions resulting from the LOS events using both 15- and 60-minute precipitation data. This analysis resulted in selecting the October 20, 2003, event as the 25-yr LOS event and the September 17, 1969 as the 100-yr LOS event.

The LOS events have changed since the 2012 CSDP because of a change in the published precipitation record. The storm that generated the 100-year flows reported in the 2012 CSDP (October 8, 2003) has been suspect of error and reported as likely incorrect shortly after the 2012 CSDP was published (Tetra Tech, 2012). This event was recorded at the WSU Puyallup rain gauge and has been determined to be erroneous. Since discovering the error, BC and NHC have excluded the event from analysis or removed the event from the precipitation timeseries (BC, 2023).

5.3.2 Capacity Analysis

BC evaluated storm drainage system capacity by simulating the 25-yr LOS event in the full SWMM model. BC used a 15-minute time step for the precipitation time series and the HSPF simulated runoff time series. Boundary conditions in the SWMM model were established based on outfall discharge locations to the Puyallup River. For each outfall, BC set discharge elevations to the average water surface elevation in the Puyallup River during the 25-yr LOS event. Boundary conditions and pipe capacity calculations are provided in Appendix C. Table 5-3 summarizes the available capacity for pipes to convey the 25-yr LOS event.

Table 5-3. Summary of Pipe Capacity Analysis Results for 25-yr LOS event

Available Capacity (cfs)	Pipe Count[a]	Pipe Percentage
< 1	272	64%
1–15	102	24%
15–30	29	7%
30–50	10	2%
> 50	12	3%
Total	425	100%

a. *Excludes 15 pipes in the calibrated SWMM that are located at the upstream end of pipe runs and did not simulate flow.*

5.4 Future Climate Conditions

Climate change could impact the City's stormwater system in the future. Table 5-4 summarizes the potential climate change impacts on the hydrological components that affect the City's stormwater system. Additional detail and context for these climate change impacts is provided in Appendix C.

Table 5-4. Climate Change Projections and Potential Impacts on Stormwater System

Hydrologic component	Predicted change	Potential Impacts to City's Stormwater System
Precipitation	• Regionally increased frequency and intensity of heavy precipitation events [a] • For Puyallup, projections indicate a 19 percent increase in 25-yr, 24-hour rainfall intensity by the 2050s, and 29 percent increase by the 2080s (median value, RCP 8.5)[b]	• Increased flooding due to lower available capacity in the stormwater system • Reduced performance of stormwater management facilities

Streamflow Timing and Quantity	• Regional shift to precipitation-dominated regimes expected to decrease April 1 snowpack (by 55 percent on average)[a], leading to:
	  • Decreased peak flows in the spring
	  • Decreased baseflow in the summer
	  • Increased peak flows in the winter
	  • Increase in extreme storm flood volumes
	• For Puyallup River, projections indicate a 37 percent increase in the extreme (100-yr) flood volume by the 2080s [a]
		• Increased backwater flooding if water levels in the Puyallup River increase
		• Water quality and ecological impacts of reduced summer baseflow and increased stream temperatures

Sea level rise (SLR)	• At the mouth of the Puyallup River, projections indicate 0.9 feet of relative SLR by 2050, and 2.5 feet by 2100[c]	• Increased flood risk due to SLR and sedimentation

a. Mauger et al., 2015. Based on RCP 6.0 (moderate emissions).

b. Mauger et al., 2018; Mauger and Won, 2020. Represents median projection based on RCP 8.5. Note that there is wide variability in predicted change depending on climate model, event duration, emissions scenario, and timeframe.

c. Miller et al., 2018. Represents 50 percent probability SLR scenarios based on RCP 8.5.

These climate change projections could result in increased flooding, reduced performance of stormwater infrastructure, and negative impacts on water quality and ecology. Sedimentation in the Puyallup River (from ongoing aggradation and potential SLR) would reduce the available capacity in the River to receive stormwater discharge from the City and could exacerbate flood risk. As discussed in Section 4.4, most of the City's outfalls to the Puyallup River have flap gates that close when the river level reaches the elevation of the outfall to prevent backwater flooding into the City's stormwater system. However, while the flap gates are closed, stormwater runoff from the City backs up through the City's storm drainage system. If countermeasures are not implemented to address this increase in flood stage, the City could experience more frequent backwater flooding.

5.5 Recommendations

This section provides recommendations for potential future flow monitoring, modeling, and studies.

5.5.1 Flow Monitoring and Modeling

Based on review of the capacity-related drainage problems and City-identified areas of interest, BC developed recommended flow monitoring and modeling projects. In general, the recommended projects include one or more of the following activities:

- Flow monitoring
- Model development
- Model calibration
- System evaluation

Table 5-5 summarizes the recommended flow monitoring and modeling (MM) projects. Projects have been assigned a priority from 1 (high priority) to 3 (lower priority) based on associated capital project priority (if applicable) and input from City staff. Refer to Section 9 for additional detail on implementation and costs of these projects.

Table 5-5. Recommended Flow Monitoring and Modeling Projects

Basin	Priority[a]	Recommended Project ID	Project Name
Citywide	1	MM-3	GIS attributes update
Clarks Creek	3	MM-7	14th St SW Lateral Replacement Phase II
	3	MM-8	9th St SW Capacity Evaluation
Deer Creek	3	MM-9	31st Ave SE and Cherokee Blvd Flooding
North Puyallup	1	MM-2	North Puyallup Basin Model Development
South Puyallup	2	MM-4	South Puyallup Direct Discharge Model Expansion
	3	MM-6	18th St NW Drainage Improvements
	3	MM-11	9th Ave NE Flooding
State Highway	1	MM-1	WSDOT Storm Pipe Capacity Evaluation
	2	MM-5	Willows Pond and Bradley Lake System Evaluation
	3	MM-10	Lower State Highway Capacity Evaluation

a. *Project priority ranges from 1 (high priority) to 3 (lower priority) based on associated capital project priority (if applicable) and input from City staff.*

5.5.2 Rainfall and Climate Change Analysis

Projected changes to precipitation intensity and frequency can impact stormwater infrastructure performance. The objective of this recommended study would be to evaluate the latest climate projections and changes in rainfall patterns to support climate impact assessments and resilient stormwater design. The results of this study would provide critical analysis, tools, and data to inform City decisions related to stormwater planning and development. This proposed study also aligns with the City's proposed action in the ESAP to use climate change projections for sizing stormwater infrastructure (City of Puyallup, 2023).

This project would develop a continuous precipitation time series adjusted for future climate conditions. These adjusted time series could be applied to the City's existing hydrologic models to evaluate impact to its stormwater system and/or to make recommendations for design standards.

5.5.3 Puyallup River Backwater Study

Peak rainfall events, peak water surface elevation in the Puyallup River, or a combination of the two, can contribute to flooding in areas of the City with stormwater drainage connected directly to the river. Flap gates installed on the City's outfalls to the Puyallup River prevent the river from backwater flooding into the City's stormwater system. However, if a high water surface elevation on the Puyallup River coincides with a peak rainfall event, stormwater runoff from the City backs up through the City's stormwater network. There is likely an increased risk of this backwater flooding in the future, given projected increases in extreme precipitation (frequency and intensity) and to the Puyallup River flood stage.

The objective of this recommended study would be to evaluate the flood risk associated with a high Puyallup River stage and peak rain event. The study would use existing City models and datasets to assess flooding thresholds, including relevant peak water surface elevations and storm volumes within each direct discharge basin. These flooding thresholds would then be used to assess the joint probability of high Puyallup River water surface elevations and peak rain events. The overall flood risk would be estimated as a combination of flood consequence and flood probability. This analysis could be replicated under different future climate and river scenarios. Results of this study could be used to inform future project design (e.g., pump station capacity) and long-term planning initiatives.

Stormwater Management Programs

Stormwater management programs are coordinated and planned activities designed to help the City meet LOS and address regulatory requirements. Programs entail long-term or ongoing work activities that are supported by City staff and funded through the operations budget.

The City currently implements 34 stormwater management programs and recommends changes to some of the programs and developing new programs required by the Phase II Permit. Table 6-1 summarizes the City's stormwater management programs and their status. Program status is defined as:

- Update – Program or activity has been implemented and is changing to meet progressive regulatory requirements
- Improve – Program or activity is changing voluntarily for program efficiencies or to improve overall asset management
- Existing – Program is currently implemented and will continue to be implemented as-is
- New – Program or activity has not been implemented and will be implemented as staff and resources are available and regulatory deadlines approach

.

Table 6-1. Stormwater Management Program Summary and Status				
Program Name	**Description**	**Regulatory or Best Management Practice**	**Status**	**Recommended Action**
Planning and Retrofitting				
Stormwater Management Action Planning	Plans targeted actions for a high-priority catchment, Deer Creek (Shaw Road) Basin, to improve water quality using a combination of land use and/or policy initiatives, retrofitting stormwater facilities, and O&M procedures.	Required Phase II Permit (S5.C.1, Stormwater Planning)	Update	Update existing program according to new Phase II Permit requirements and specified deadlines.
Stormwater Management for Existing Development	Plans and implements retrofits for publicly owned stormwater facilities that are on City-owned parcels. Enhancement to existing Stormwater Facility Rehabilitation and Retrofit Program.	Anticipated Requirement 2024 Phase II Permit (S5.C.7 Stormwater Management for Existing Development)	New	Develop new program according to new Phase II Permit requirements and specified deadlines.
UIC Program	Tracks, assesses, and registers UIC wells within the city. Plans UIC retrofits as needed to protect groundwater.	Required Chapter 173-218 WAC (Safe Drinking Water Act)	Improve	Improve existing program to be compliant with WAC Chapter 173-218.
Public Education and Outreach				
Rain Garden	Promotes and provides funding incentives for site stormwater management for single-family properties. Guides and assists owners on installing rain gardens, permeable pavement, and rain barrels.	Required Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program.
Green Stormwater Infrastructure (GSI) Mini Grant	Promotes and provides funding incentives in partnership with PCD to support GSI, including rain gardens, habitat creation, pavement removal, and rain tank installation for residents, businesses, and community groups.	Supports Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program as an extension of the Rain Garden Program.
Porous Alley Initiative	Promotes replacement of existing compact gravel alleys with porous asphalt or porous gravel sections by providing information to homeowners and funding to the Street Department, which performs replacement and retrofit work as part of regularly scheduled maintenance.	Supports Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program.
Stormwater Calendar	Organizes youth to create illustrations based on stormwater and environmental themes in partnership with PCD for use in a yearly calendar made available free to the public. Provides stormwater education to school-aged children.	Supports Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program.
Fish-friendly Car Wash	Encourages fundraising by providing links to local businesses that wash cars in an environmentally conscious manner. Provides information on the potential pollution from car washing as well as BMPs for residents washing their own cars. Car wash coupons are handed out as an incentive to use a commercial car washes.	Supports Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program.

Table 6-1. Stormwater Management Program Summary and Status

Program Name	Description	Regulatory or Best Management Practice	Status	Recommended Action
GPP Programs	Provides funds for water quality projects and volunteer opportunities in partnership with PCD and Washington Conservation Corps to protect and maintain riparian and critical areas within the City. The GPP supports three programs.	Supports Phase II Permit (S5.C.2, Education & Outreach, S5.C.3, Public Involvement) Supports TMDL Requirements (Appendix 2)	Existing	Continue to implement existing program.
GPP - Public Riparian and Critical Area Planting	Provides plantings, removes invasive and noxious plants, and financially supports crews to perform work in natural open areas and critical areas owned by the City. Planting provides shade goals for Clarks Creek sediment and DO TMDL. Uses grant funding through Ecology.			
GPP - Private Streamside Planting	Engages citizens that live alongside urban streams to implement habitat improvement on private property. Streamside improvements help meet shade goals for Clarks Creek sediment and DO TMDL.			
GPP - Habitat Site Steward/Restoration Volunteer	Offers free technical assistance to site Stewards and volunteer groups in restoring a site, as well as free educational trainings on conservation of streamside habitat.			
Interpretive and Education Sign Replacement and Inspection	Manages the development, placement, and maintenance of interpretive and educational signs for stormwater management.	Supports the Phase II Permit (S5.C.2, Education & Outreach and Appendix 2 TMDL Requirements)	Improve	Improve existing program to include new sign inventory and scheduling repair and replacement.
Dumpster Outreach	Provides educational resources and promotes awareness on BMPs to businesses within the MS4 for dumpsters, including not overfilling, keeping lids closed, and proper maintenance.	Required the Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program.
Pollution Prevention Assistance	Distributes resources and technical assistance to local businesses aimed at reducing and preventing pollution. Receives funding from Ecology's Pollution Prevention Assistance program.	Supports Phase II Permit (S5.C.2, Education & Outreach; S5.C.8 Source Control Program for Existing Development)	Existing	Continue to implement existing program.
Private Catch Basin Marking	Offers public involvement volunteer opportunities in partnership with PCD to mark catch basin inlets on private property with educational decal messaging "Only Rain Down the Drain." Provides stormwater protection messaging to the public.	Supports Phase II Permit (S5.C.3, Public Involvement)	Existing	Continue to implement existing program.

Table 6-1. Stormwater Management Program Summary and Status

Program Name	Description	Regulatory or Best Management Practice	Status	Recommended Action
Business Outreach				
Business Source Control	Organize inspections and implementation of source control BMPs to businesses identified as likely generating pollution. Implements enforcement of pollution prevention ordinances.	Required Phase II Permit (S5.C.8, Source Control Program for Existing Development)	Existing	Continue to implement existing program.
Controlling Runoff from New Development, Redevelopment, and Construction Sites				
Controlling Runoff from New Development, Redevelopment, and Construction Sites	Reduces pollutants in stormwater runoff to the MS4 from new development, redevelopment, and construction site activities. Enforces ordinances that control runoff from sites covered by stormwater permit.	Required Phase II Permit (S5.C.6, Controlling Runoff from New Development, Redevelopment and Construction Sites)	Existing	Continue to implement existing program.
Illicit Discharge Detection and Elimination				
IDDE	Plans and implements IDDE activities, including screening and detection, source tracing, a hotline for reporting spills or non-stormwater discharges, as well as best management practices for responding to IDDEs.	Required Phase II Permit (S5.C.5, Illicit Discharge Detection and Elimination)	Existing	Continue to implement existing program.
Operations and Maintenance				
Porous Alley Initiative	Promotes replacement of existing compact gravel alleys with porous asphalt or porous gravel sections by providing information to homeowners and funding to the Street Department, which performs replacement and retrofit work as part of regularly scheduled maintenance.	Supports Phase II Permit (S5.C.2, Education & Outreach)	Existing	Continue to implement existing program.
Stormwater Training	Provides trainings and the frequencies required for various job levels within the City. All staff in Public Works and Development and Permitting Services are required to take Puyallup Stormwater 101 within 1 month of hire.	Anticipated Updated Requirements 2024 Phase II Permit (S5.C.4, S5.C.5, S5.C.6, S5.C.7, S5.C.8, S5.C.9)	Update	Update program materials to include 2024 Permit requirements and provide follow up training to City staff as needed.
Stormwater Fencing	Tracks and plans maintenance and construction of perimeter fencing for stormwater features that pose risks to pedestrians and vehicular traffic, as well as trespassing incidences.	Asset management best management practice. General public safety.	Existing	Continue to implement existing program.

Table 6-1. Stormwater Management Program Summary and Status

Program Name	Description	Regulatory or Best Management Practice	Status	Recommended Action
Municipal (Public) Stormwater Facility	Tracks and plans inspection, condition assessment, maintenance, repair, and replacement of municipal stormwater facilities using the City's Site Management Plan for Stormwater Operations and Maintenance.	Required Phase II Permit (S5.C.7, Operations and Maintenance)	Improve	Improve program elements such as documentation and inspection requirements.
Private Stormwater Facility	Tracks and inspects private stormwater facilities to ensure maintenance and functionality and provides owners with information on property maintenance and summary of corrections if needed. Facilities are maintained in accordance with the City's Site Management Plan for Stormwater Operations and Maintenance.	Required Phase II Permit (S5.C.7, Operations and Maintenance)	Existing	Continue to implement existing program.
Street Sweeping	Reduces sediment and pollutants from entering MS4 by sweeping all streets outside the downtown area monthly and the downtown and central business district weekly.	Anticipated Requirement 2024 Phase II Permit (S5.C.9, Operations and Maintenance)	Existing	Continue to implement existing program. City program meets anticipated requirements.
Integrated Pest Management Plan	Identifies pests within the City and corresponding strategies to monitor, and if needed control, pest populations using cultural, mechanical, biological, or chemical controls.	Required Aquatic Mosquito Control General Permit (if needed to control mosquitos)	Update	Update plan to be current with changes in stormwater management and water quality research since 2010.
Beaver Management	Discourages beaver activity in critical water bodies and areas where beaver damming could cause local flooding issues using "beaver deceivers" and other BMPs. Relocates of beavers, if necessary.	Asset management best management practice	Improve	Improve program to document when certain activities trigger trapping.
Elodea Management for Flood Reduction	Organizes and implements the reduction of *Elodea* from Clarks Creek with the intent of lowering creek level and reducing flooding.	Asset management best management practice	Existing	Continue to implement existing program.
TMDL Compliance				
Puyallup River Fecal TMDL	Focuses IDDE program elements in Deer Creek.	Ecology Fecal TMDL	Existing	Continue to implement existing program.
Clarks Creek Fecal TMDL	Focuses IDDE program elements in Meeker Creek. Encourages participation in other stormwater management programs, including a pet waste program, increasing riparian plantings (to reduce non-migratory duck usage), and education and outreach on the harms of feeding waterfowl in DeCoursey Park.	Ecology Fecal TMDL	Existing	Continue to implement existing program.
Clarks Creek DO and Sediment TMDL	Implement water quality implementation plans to reduce sediment loads and treat or remove 21.4 million gallons of stormwater. Document reductions in reporting ledger. Update the Clarks Creek Retrofit Plan for 2024-2029. Participates in street sweeping and public education and outreach programs. Reduce *Elodea* with riparian plantings (providing shade). Near-term removal with	Ecology DO & Sediment TMDL	Existing	Continue to implement existing program.

Table 6-1. Stormwater Management Program Summary and Status				
Program Name	**Description**	**Regulatory or Best Management Practice**	**Status**	**Recommended Action**
	harvesting (seasonal impact). Plan and implement channel maintenance and stabilization projects to reduce sediment loads per Ecology Administrative Order 16591.			
Asset Management Programs				
Geographic Information System and Asset Management	Maintains a computerized maintenance management system (CMMS) and GIS inventory; provides mapping and data management support; plans and coordinates efforts of asset management programs; and inspects, inventories, and provides condition assessment of existing infrastructure.	Anticipated Updated Requirements Supports Phase II Permit (S5.C.4, MS4 Mapping) Asset management BMP	Update	Update existing program to new Phase II Permit requirements and specified details. Enhance existing program with additional staff to record data and planning efforts from new R/R programs.
Stormwater Infrastructure Rehabilitation and Repair (R/R) Program	Inspects and perform condition assessment of stormwater pipe to help plan and implement monitoring, maintenance, repair, rehabilitation, or replacement of stormwater pipes.	Asset management best management practice	New	Develop and evaluate staffing and resources for new program.
Pump Station R/R Program	Inspects and perform condition assessment of pipes, manholes, and inlets to help plan and implement monitoring, maintenance, repair, rehabilitation, or replacement of pump station assets.	Asset management best management practice	New	Develop and evaluate staffing and resources for new program.
Culvert R/R Program	Prioritizes culverts for repair and replacement based on fish barrier removal.	Asset management best management practice	New	Develop and evaluate staffing and resources new program.

Repair and Replacement Programs

As part of the Stormwater Comprehensive Plan project and an expansion of the City's overall asset management program, the City developed frameworks for three new R/R programs:

- Stormwater infrastructure (pipes and structures)
- Stormwater pump stations
- Culverts

Each framework identified a prioritization methodology, near-term activities and ongoing work.

These programs will enable the City to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing assets. Asset-management-based approaches for O&M of stormwater assets increases resource efficiency and help achieve desired LOS. A risk-based approach allows limited resources to be focused on critical assets and provides an understanding of the impact of decision making.

7.1 Stormwater Infrastructure Repair and Replacement

The City is developing a program to assess the condition of stormwater pipes that will enable the City's stormwater team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing these assets. The program will include closed-circuit television (CCTV) inspections of stormwater pipes in the City and determine the likelihood of failure (LoF) and consequence of failure (CoF) for each asset inspected. The program will also provide maintenance, rehabilitation, and replacement recommendations to improve the effectiveness of the stormwater management program. This initiative will ultimately benefit the City's residents and protect local waterways from pollution and flooding.

The program framework includes a cyclical process of understanding and inspecting the system, performing condition assessment, and scheduling repair, replacement, or maintenance based on condition and a consequence-based risk assessment. The City completed the inventory of known assets and prioritized pipes for inspection based on drainage basin priority. The City plans to begin the program by inspecting 2 miles of pipe in the Clarks Creek Basin in 2024, and an additional 2 miles of pipe in the Deer Creek (Shaw Road) Basin in 2025. These first 2 years will help the City work through the program and establish ongoing staffing, methodology, and processes. Starting in 2026, the City plans to inspect 5 miles per year through 2030, ramping up to a goal of 10 miles per year in 2031 and beyond. Consistently inspecting 10 miles of pipe per year will equate to approximately a 15-year inspection cycle.

The program framework description and workflow diagrams for inspection, data management, and condition assessment are provided in Appendix D.

7.2 Pump Station Repair and Replacement

The City is developing a program to assess the condition of its eight stormwater pump stations and prioritize pump station repair, replacement, and maintenance under a consistent, standards-driven approach. Regular condition assessment using a consistent approach provides a clear

understanding of the current state of the assets and identifies R/R needs with enough time to plan and schedule repairs.

The framework includes:

- Risk Management: criteria to establish LoF, CoF, and risk
- Condition Assessment: standardized approach to condition assessment
- CMMS: recommendations for CMMS use
- R/R Framework: key components for R/R planning

In developing the pump station R/R framework, the City developed a risk score for each pump station based on LoF and CoF through a desktop study and interviews with City staff familiar with pump station conditions. LoF is defined as the chance of something occurring, and CoF is defined as the impact that failure has on the overall LOS, Public Works Department, customers, or the public. Risk is the product of LoF and CoF and is used to determine the R/R approach. The City plans to update the pump station risk score in 2024 with condition assessment information gathered from inspections. The City inspected one high-priority pump station in April 2024 and updated the condition score. Once risk scores are updated, the City will identify and schedule R/R needs.

The program framework description, risk assessment, condition assessment form template and pump station attribute summary are provided in Appendix D.

7.3 Culvert Repair and Replacement

The City developed a culvert data inventory, prioritization methodology, and potential project costing methodology as a basis for a new culvert R/R program framework. The potential program will prioritize culverts for repair and replacement based on fish barrier removal. The culvert data inventory was developed via a desktop study using GIS information from the City, Pierce County, and WDFW. Culvert prioritization or scoring for R/R approaches was based on numerous scoring parameters, including the number of downstream barriers, WDFW priority score, and lineal upstream habitat gain. The data inventory and prioritization methodology and results are documented in a Microsoft Excel tool. Recommendations for further program development include planning- level cost estimates and culvert field surveys.

Recommended Improvements

This section describes recommended improvement projects for the City of Puyallup storm and surface water utility.

8.1 Capital Project Improvements

8.1.1 Ongoing Projects

Ongoing projects have already been funded by the City and execution is underway. These projects must continue to receive funding under the CIP plan until completion and have been included in this document to provide this continuity. The ongoing drainage projects are summarized in Table 8-1.

Table 8-1. On-going Projects

Problem ID	Problem/Project Name	Problem Type	CIP / Project ID	Project Location	Project Cost (2024 dollars)
CC-12	11th St SW Culvert Replacement	Capacity	19-022	11th St SW and Meeker Creek	$852,493
SH-17	State Highway Basin Floodplain Study	Planning	N/A	State Highway Basin	$44,087
SP-01	4th St NW Storm Upgrades for Downtown Revitalization -Phase N-1	Expanding Direct Discharge	14-026	4th St NW from River Rd to 3rd Ave NW	$8,88,6000

8.1.2 Priority Projects and Studies

As discussed in Section 5, City staff prioritized problems to be considered for a capital project. The recommended Priority projects are listed in Table 8-2.

Table 8-2. Priority Projects

Problem ID	Problem/Project Name	Problem Type	CIP ID	Project Location	Project Cost (2024 dollars)
CC-01	23rd Ave SW Culvert	Replacing Aging/Deficient Infrastructure	Not Assigned	23rd Ave SW near 13th St SW	$10,650,000
CC-04	Clarks Creek TMDL WQ IP	NPDES	Not Assigned	Clarks Creek Basin	TBD
DC-01	Deer Creek Realignment	Replacing Aging/Deficient Infrastructure	Not Assigned	Deer Creek from 12th Ave to Pioneer Ave SE	$4,340,000
DC-02	Deer Creek/Shaw Creek Emergency Culvert Replacements	Capacity	19-013	Shaw Creek Crossings at 27th St SE and Deer Creek Crossings at 12th Ave SE	$11,950,000
DC-03	East Main Deer Creek Crossing	Capacity	14-060	East Main at Deer Creek Crossing	$15,025,000
DC-04	21st St. Deer Creek RR Crossing	Replacing Aging/Deficient Infrastructure	Not Assigned	Deer Creek Railroad Crossing near 21st St SE	$15,340,000
DC-05	Shaw Rd Improvements	Capacity	16-027	Shaw Rd from 25th Ave Ct SE to Pioneer	$30,020,000
SP-01	4th St NW Storm Upgrades for Downtown Revitalization-Phases N-2/N-3, N-4/N-5, and 4th St Pump Station	Expanding Direct Discharge	23-008	5th St SW from 4th Ave SW to 3rd Ave NW & 4th Ave SW from 5th St SW to 2rd St SE; 4th Ave SW from 2nd St SE to 5th St SE, 3rd St SE 412 LF North of 4th Ave SE & W Stewart St from 6th St SW to 2nd St NW	$16,380,000
SP-02	Drainage Improvements on 10th-7th Ave NW	Replacing Aging/Deficient Infrastructure	Not Assigned	10th Ave NW from 18th St NW to 11th St NW, 9th, 8th, and 7th Ave NW from 15th St NW to 11th St NW	$2,495,000

The City identified two Priority studies that would provide critical analysis, tools, and data to inform City decisions related to Priority projects. The studies are listed in Table 8.3

Table 8-3. Priority Studies

Study ID	Study Name	Basin	Associated Problem (s)	Study Cost (2024 dollars
STUDY-1	Rainfall and Climate Change Analysis	City Wide	SP-01	$140,000
STUDY-2	Puyallup River Backwater Study	South Puyallup; North Puyallup	SP-01	$130,000

8.1.3 Second Tier Projects and Studies

The recommended Second Tier projects are listed in Table 8-2.

Table 8-4. Second Tier Projects

Problem ID	Problem/Project Name	Problem Type	CIP ID	Project Location	Project Cost (2024 dollars) [a]
CC-02	Meeker Creek N. Stormwater Pump Station	Capacity	15-017	10th Ave SW and 14th St SW PS	$8,318,000
CC-03	Silver Creek Bank Stabilization	Maintenance/ Operation	Not Assigned	19th Ave SW to 10th Ave SW	No Estimate
CC-05	9th St SW Roadway Improvements	Planning	21-016	9th ST SW from 15th Ave SW to 31st Ave SW	No Estimate
CC-06	WSU LID Frontage Improvements Phase 2	Planning	22-006	Fruitland from W Pioneer Ave to 9th Ave SW	$1,623,000
CC-07	15th Ave SW Culvert	Replacing Aging/Deficient Infrastructure	Not Assigned	15th Ave SW near 7th St SW	No Estimate
CC-08	Clarks Creek Outfall Backflow Prevention	Replacing Aging/Deficient Infrastructure	Not Assigned	Clarks Creek	$250,000
CC-09	Clarks Creek Stream Bank Erosion	Planning	Not Assigned	Clarks Creek - River Mile 2 to 4	No Estimate
CC-10	9th Ave SW Storm Main	Planning	Not Assigned	9th St SW from 9th St SW to 13th St SW	No Estimate
DC-06	East Pioneer Drainage Improvements	Replacing Aging/Deficient Infrastructure	Not Assigned	E Pioneer from 25th St to Pioneer S Curves	No Estimate
DC-07	21st St SE Stormwater Pump Station Removal and Drainage Rerouting	Replacing Aging/Deficient Infrastructure	Not Assigned	E Pioneer Ave and 21st St SE	No Estimate
DC-08	Flooding at 31st Ave SE and Cherokee Blvd	Capacity	Not Assigned	31st Ave SE and Cherokee Blvd	No Estimate
NP-01	Wapato Creek Diversion Repair	Replacing Aging/Deficient Infrastructure	14-067	Wapato Creek Diversion from Puyallup River to Kia Dealership	$9,715,000
NP-02	Wapato Creek Culvert at Todd Rd	Replacing Aging/Deficient Infrastructure	Not Assigned	Eastern Culvert at Todd Road and Wapato Creek	$171,000
PO-01	39th Ave SW and 5th St SW Drainage (Drywell)	Replacing Aging/Deficient Infrastructure	Not Assigned	39th Ave SW and 5th St SW	No Estimate
SH-01	Bradley Lake Dam Safety and Outfall Improvements	Replacing Aging/Deficient Infrastructure	20-017	Bradly Lake Park	$178,000
SH-02	Wildwood Park Stormwater Diversion	Replacing Aging/Deficient Infrastructure	16-030	Wildwood Park	$171,000

Table 8-4. Second Tier Projects

Problem ID	Problem/Project Name	Problem Type	CIP ID	Project Location	Project Cost (2024 dollars) [a]
SH-03	Storm Sewer Replacement - 12th Ave SE	Capacity	Not Assigned	12th Ave SE from 21st St SE to 13th St SE	$961,000
SH-04	Puyallup Downs Wetland Outfall	Replacing Aging/Deficient Infrastructure	16-021	Puyallup Downs Wetland - Olympic Blvd and Parkwood Blvd	$171,000
SH-05	12th Ave SE and 13th St SE Flooding	Capacity	Not Assigned	13th St SE and 12th Ave SE	No Estimate
SH-06	PW Facility Covered Storage for Outdoor Stockpiles	Maintenance/ Operation	Not Assigned	State Highway Basin	$656,000
SH-07	21st St Roadside Ditch	Replacing Aging/Deficient Infrastructure	Not Assigned	21st St SE south of Vista Dr	No Estimate
SH-08	17th St SE Pipe Rehabilitation	Maintenance/ Operation	Not Assigned	17th St SE, north of 9th Ave SE	No Estimate
SH-09	23rd Ave SE Culvert	Capacity	Not Assigned	Wildwood Creek 23rd Ave Culvert Crossing	$38,000
SP-04	12th Ave NW Drainage Improvements	Capacity	Not Assigned	12th Ave NW from 15th St NW to 11th St NW	$948,000
SP-05	Linden Golf Course Setback Levee	Maintenance/ Operation	Not Assigned	Left Bank - RM 9.6 to 10.5	$9,058,000
SP-06	Flashcube Building/Puyallup Executive Park Flood Wall		Not Assigned	Left Bank – Rm 9.1 to 9.25	$273,000
SP-07	5th Ave NW Improvements	Replacing Aging/Deficient Infrastructure	17-021	5th Ave NW from 4th St NW to 7th St NW	$3,273,000
SP-08	9th Ave NE Main Replacement	Capacity	Not Assigned	9th Ave NE from the Puyallup River to 2nd St NE	$1,477,000
SP-09	Flooding at 13th Ave NW and 20th St NW	Capacity	Not Assigned	20th St NW - 13th Ave NW to 10th Ave NW	$85,000
SP-10	Tiffany's Skate Inn/Riverwalk Flood Wall	Maintenance/ Operation	Not Assigned	Left Bank - River Mile 8.1 to 8.6	$7,691,000
SP-11	8th Ave NW Road Reconstruction and Sidewalks	Replacing Aging/Deficient Infrastructure	17-019	8th Ave NW from 9th St NW to 8th ST NW	$120,00
SP-12	Parks Maintenance Facility Covered Storage for Outdoor Stockpiles	Maintenance/ Operation	Not Assigned	South Puyallup Basin	$132,000
SP-13	Maintenance Facility Containment and WQ for Loading/Unloading Areas	Maintenance/ Operation	Not Assigned	South Puyallup Basin	No Estimate

Table 8-4. Second Tier Projects					
Problem ID	Problem/Project Name	Problem Type	CIP ID	Project Location	Project Cost (2024 dollars) [a]
SP-14	WWTP Covered and Contained Fueling Station	Maintenance/ Operation	Not Assigned	South Puyallup Basin	No Estimate
SP-15	WWTP Containment and WQ for Loading/Unloading Areas	Maintenance/ Operation	Not Assigned	South Puyallup Basin	No Estimate
SP-16	N Meridian Drainage Improvements	Capacity	Not Assigned	N Meridian from River Rd to King Family Mini Golf Entrance	$503,000

a. Costs escalated to Seattle Construction Cost Index [CCI] for February 2024 (Engineering News Record [ENR], 2024)

Table 8-5 lists the monitoring and modeling studies recommended to assist the planning and design of projects to resolve the Second Tier capacity and flooding problems.

Table 8-5. Second Tier Studies				
Study ID	Study Name	Basin	Associated Problem(s)	Study Cost (2024 dollars
MM-1	WSDOT Storm Pipe Capacity Evaluation	State Highway	SH-05	$220,000
MM-2	North Puyallup Basin Model Development	North Puyallup	NP-01, NP-02	$120,000
MM-3	SW GIS Attribute Update	City Wide	-	NA
MM-4	South Puyallup Direct Discharge Model Expansion	North Puyallup	NP-01, NP-02	$90,000
MM-5	Willows Pond and Bradly Lake System Evaluation	State Highway	SH-01, SH-02	$260,00
MM-6	18th St NW Drainage Improvements	South Puyallup	SP-02	$40,000
MM-7	14th St SW Lateral Replacement Phase II	Clarks Creek	CC-14	$40,000
MM-8	9th St SW Capacity Evaluation	Clarks Creek	CC-05	$40,000
MM-9	31st Ave SE and Cherokee Blvd Flooding	Deer Creek	DC-08	$40,000
MM-10	Lower State Highway Capacity Evaluation	State Highway	SH-06	$40,000
MM-11	9th Ave NE Flooding	South Puyallup	SP-08	$20,000

8.1.4 Low Priority Problems

8.2 Other Planned City and Public Works Projects

8.3 Program Improvements

The Plan recommends 13 programmatic measures that are related to current ongoing programs, revising design standards, revising development standards, TMDL implementation activities, or operational policies. The new, updated, or improved programs are listed in Table 8-6.

Table 8-6. Updated, Improved and New Programs

Program Name	Program Status	Recommendations	
		FTE	Contracted Services
Stormwater Management Action Planning	Update		
Stormwater Management for Existing Development	New		
UIC Program	Improve		
Interpretive and Education Sign Replacement and Inspection	Improve		
Stormwater Training	Update		
Municipal (Public) Stormwater Facility	Improve		
Beaver Management	Improve		
Geographic Information System and Asset Management	Update		
Stormwater Infrastructure R/R	New		
Pump Station R/R	New		
Culvert R/R	New		
New NPDES Program	New		
Updated NPDES Program	Updated		

Implementation Plan

9.1 Financial Status of Storm and Surface Water Utility

9.2 Implementation of CIP and Programmatic Measures

Drainage Basin Summaries

This section describes the drainage basins contributing flow to the City of Puyallup surface and stormwater systems.

10.1 Clarks Creek Basin

10.1.1Existing Drainage System

Clarks Creek Basin is the largest contributing area in the city. Approximately 3,434 acres or 57 percent of the Clarks Creek drainage basin is within the City UGA. The surface waters in this basin, particularly Clarks Creek, receive substantial groundwater input. Maplewood Springs is a location where groundwater discharge occurs year-round. Clarks Creek discharges to the Puyallup River outside of city limits. The basin contains a mixture of high-density development in the southeast and northeast of the basin, and rural, low-density development in the western portion of the basin.

The Clarks Creek Basin includes Silver Creek, which flows into Meeker Creek, which joins Clarks Creek at 10th Avenue SW at Clarks Creek Park. The drainage basin consists of five subbasins: Silver Creek, Upper Clarks Creek, Middle Clarks Creek, Lower Clarks Creek, and Woodland Creek. Appendix F includes maps of each subbasin. The Clarks Creek basin includes four stormwater pump stations: Meeker Creek North and South, and Stewart Gardens 1 and 2.

Figure 10-1 shows the Clarks Creek Basin delineation, stormwater conveyance and facilities, stormwater pump stations, and the basin creeks and water bodies.

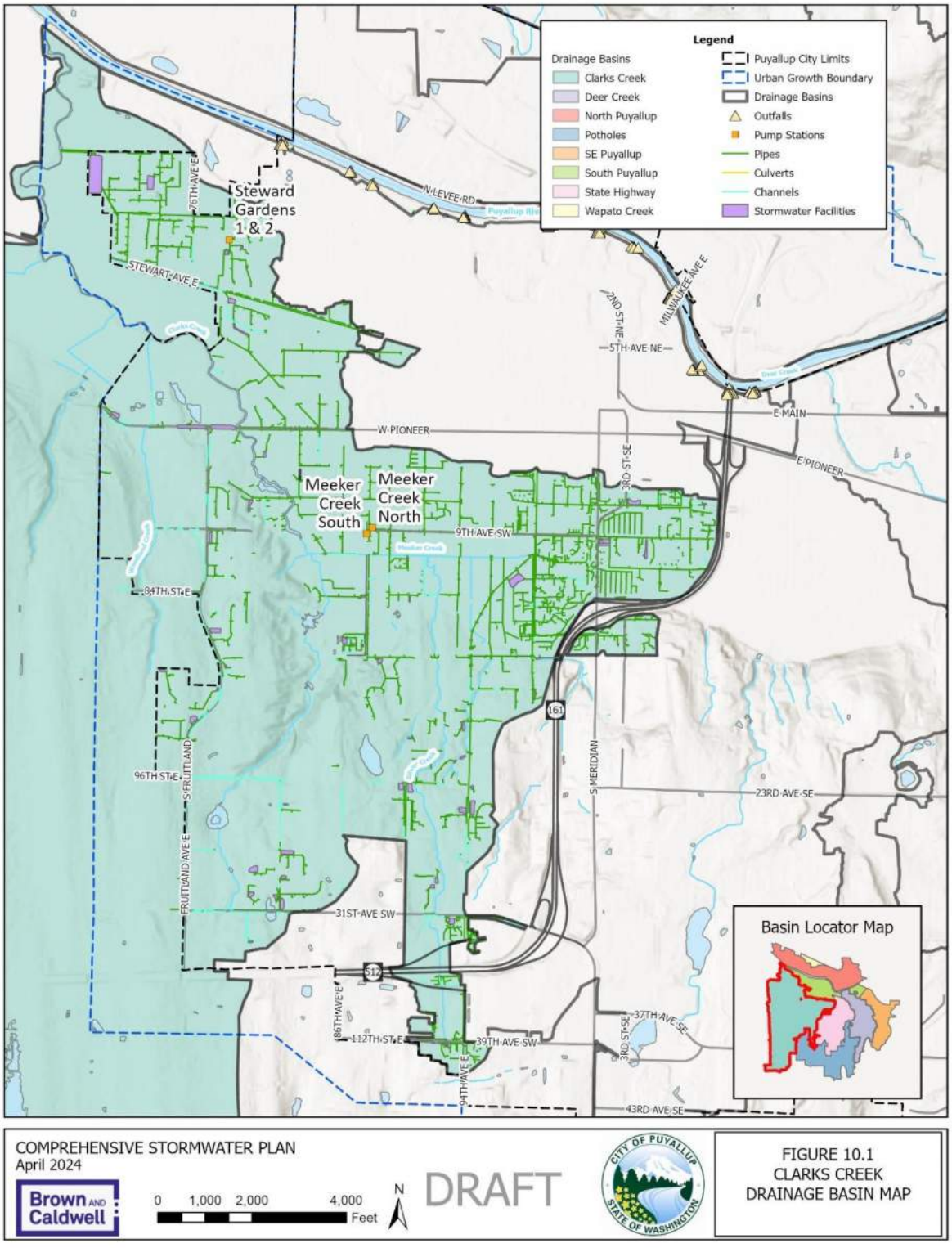

Figure 10-1. Clarks Creek drainage basin map

Ecology issued the Clarks Creek DO and sediment TMDL in 2014. The TMDL plan determines the pollutant reduction target and load allocation reductions to meet water quality standards. To meet the TMDL targets, the Phase II Permit requires the City to treat and/or remove stormwater runoff to improve DO levels in the Creek, and implement measures (e.g., stormwater filters, street sweeping) to reduce sediment loads in MS4 discharges to the Creek. In addition, Ecology Administrative Order 16591 requires the City to implement channel and bank stabilization measures to reduce sediment loads from bed and bank erosion.

The City published the Clarks Creek Retrofit Plan Update for 2024–2029 which, in part, identified programs the City will or has implement to address DO and sediment targets, including programmatic efforts such as riparian planting, interpretive signage, and street sweeping.

The City also implements the Elodea Management Program, which also serves to reduce flooding to property adjacent to Clarks Creek and helps improve DO levels. Ecology issued the Clarks Creek sediment and DO TMDL study, which called for the City and Pierce County to reduce Elodea coverage by as much as 75 percent. The TMDL study also issued a requirement for increasing riparian canopy cover (planting) to help suppress Elodea growth through shading.

The Elodea Management Program organizes and implements effort to reduce *Elodea* from Clarks Creek with the intent of lowering creek levels, reducing flooding, and reducing DO demands on Clarks Creek. Currently, *Elodea* management includes activities through the GPP habitat stewardship and restoration volunteer programs that will provide riparian shading to limit growth. These programs make riparian plants available to streamside residents to plant along the banks of the creek to try to combat this issue. In addition, the City has worked with the PCD and Washington Conservation Corps crews to perform much-needed planting along the creek banks of properties that the City has purchased. The City, with the help of the PCD, has increased these efforts in the past couple of years and now offers crews that will plant and maintain vegetation on private property along the creek to provide much-needed canopy cover over the creek.

10.1.2 Aquatic Habitat

Clarks Creek Basin has two fish hatcheries. WDFW operates one. The other, a salmon hatchery, is owned and operated by the PTI. The hatchery, in operation for approximately 18 years, continuously withdraws approximately 12 cfs from Clark Creek. Most of the intake water is routed through raceways and rearing ponds within the hatchery before flowing back into the creek. A small portion (about 0.54 cfs, or 200 gallons per minute) of the intake water is treated in a 30-micron drum filter and conveyed to the hatchery's incubation room.

10.1.3 Basin and System Evaluation and Recommendations

The City compiled, prioritized, and categorized drainage-related problems from numerous planning documents (KCM, 1996; BC, 2007; BC, 2012; Puyallup, 2023). The problems were placed into one of three categories for capital project planning consideration (Priority, Second Tier, Low). The 25 Clarks Creek Basin problems were categorized as one on-going, two Priority, nine Second Tier, and 14 Low priority. The problems and associated project information are listed in Table 10-1.

The problems are shown by priority category in Figure 10-2. Problem CC-04 Clarks Creek TMDL WQ IP represents the City's need to remove City's stormwater contribution to Clarks Creek to help meet DO TMDL targets by 2034. The problem does not have a specific location within the basin and is, therefore, not shown on the figure.

Table 10-1. Clarks Creek Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
CC-01	23rd Ave SW Culvert	23rd Ave SW near 13th St SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Priority	$9,270,000
CC-02	Meeker Creek N. Stormwater Pump Station	10th Ave SW and 14th St SW PS	Capacity	15-017	Second Tier	$486,700
CC-03	Silver Creek Bank Stabilization	19th Ave SW to 10th Ave SW	Maintenance/ Operation	Not Assigned	Second Tier	No Estimate
CC-04	Clarks Creek TMDL WQ IP	TBD	NPDES	Not Assigned	Priority	TBD
CC-05	9th St SW Roadway Improvements	9th ST SW from 15th Ave SW to 31st Ave SW	Planning	21-016	Second Tier	No Estimate
CC-06	WSU LID Frontage Improvements Phase 2	Fruitland from W Pioneer Ave to 9th Ave SW	Planning	22-006	Low	$2,750,000
CC-07	15th Ave SW Culvert	15th Ave SW near 7th St SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	No Estimate
CC-08	Clarks Creek Outfall Backflow Prevention	Clarks Creek	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	No Estimate
CC-09	Clarks Creek Stream Bank Erosion	Clarks Creek - River Mile 2 to 4	Maintenance/ Operation	Not Assigned	Second Tier	No Estimate
CC-10	9th Ave SW Storm Main	9th St SW from 9th St SW to 13th St SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	No Estimate
CC-11	7th Ave SW Roadway Settling	7th Ave SW from 18th St SW to 14th St SW	Replacing Aging/Deficient Infrastructure	21-033	Low	$2,660,000
CC-12	11th St SW Culvert Replacement	11th St SW and Meeker Creek	Capacity	19-022	On-going	$852,493
CC-13	14th St SW Lateral Replacement Phase II	14th St SW - 15th Ave SE to 12th Ave SE	Capacity	-	Low	$414,000
CC-14	Purchase of Properties within Clarks and Meeker Creek 100-YR Floodplain	Clarks Creek and Meeker Creek Floodplains	Floodplain	Not Assigned	Low	No Estimate
CC-15	Meeker Creek Regional Detention Facility	Meeker Creek between 9th St SW and 11th St SW	Capacity	Not Assigned	Low	No Estimate
CC-16	Elevation of Structures in Meeker Creek 100-YR Floodplain	Clarks Creek and Meeker Creek Floodplains	Floodplain	Not Assigned, Private Property	Low	No Estimate
CC-17	5th St SW Stormwater Main Replacement	5th St SW from Meeker Creek to 15th Ave SW	Capacity	Not Assigned	Low	No Estimate
CC-18	Silver Creek Culvert Replacement - 31st Ave SW	Silver Creek Crossing at 31st Ave SW	Capacity	Not Assigned	Low	No Estimate

Table 10-1. Clarks Creek Problem and Associated Project Summary						
Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
CC-19	Woodland Creek Outfall and Pipe Replacement	Woodland Creek Outfall to Clarks Creek	Capacity	Not Assigned	Low	No Estimate
CC-20	WSU LID Frontage Improvements Phase 3	W Pioneer and S Fruitland Intersection	Planning	14-023	Low	No Estimate
CC-21	9th Ave SW Fair Blvd	9th Ave SW from S Meridian to 5th St SW	Capacity	14-040	Low	No Estimate
CC-22	WSU LID Frontage Improvements Phase 4C	Pioneer Way E from Woodland Creek Crossing to Western City Limits	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	No Estimate
CC-23	WSU LID Frontage Improvements Phase 5	9th Ave SW from Fruitland Ave E to Woodland Creek	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	No Estimate
CC-24	18th St SW Drainage Improvements	18th St SW from 7th Ave SW to 10th Ave SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	No Estimate
CC-25	26th ST NW Drainage Improvements	26th St NW from 13th Ave NW to 16th Ave NW	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	No Estimate

Hydrologic and hydraulic modeling efforts can help evaluate capacity and flooding problems. The Clarks Creek basin includes several of these types of problems, but the extent of the City's current set of hydraulic models does not cover problem locations. Figure 10-2 shows the extent of the City's hydraulic models developed in the SWMM platform. Table 10-2 lists recommendations for flow monitoring and model development to address problems in the Clarks Creek Basin.

Table 10-2. Planning Recommendations for Clarks Creek Basin					
Type	SWCP ID	Problem ID	Problem Name	City CIP Num	Cost
Study	Study-MM-7	CC-14	14th St SW Lateral Replacement Phase II	Not Assigned	$40,000
Study	Study-MM8	CC-05	9th St SW Capacity Evaluation	Not Assigned	$40,000

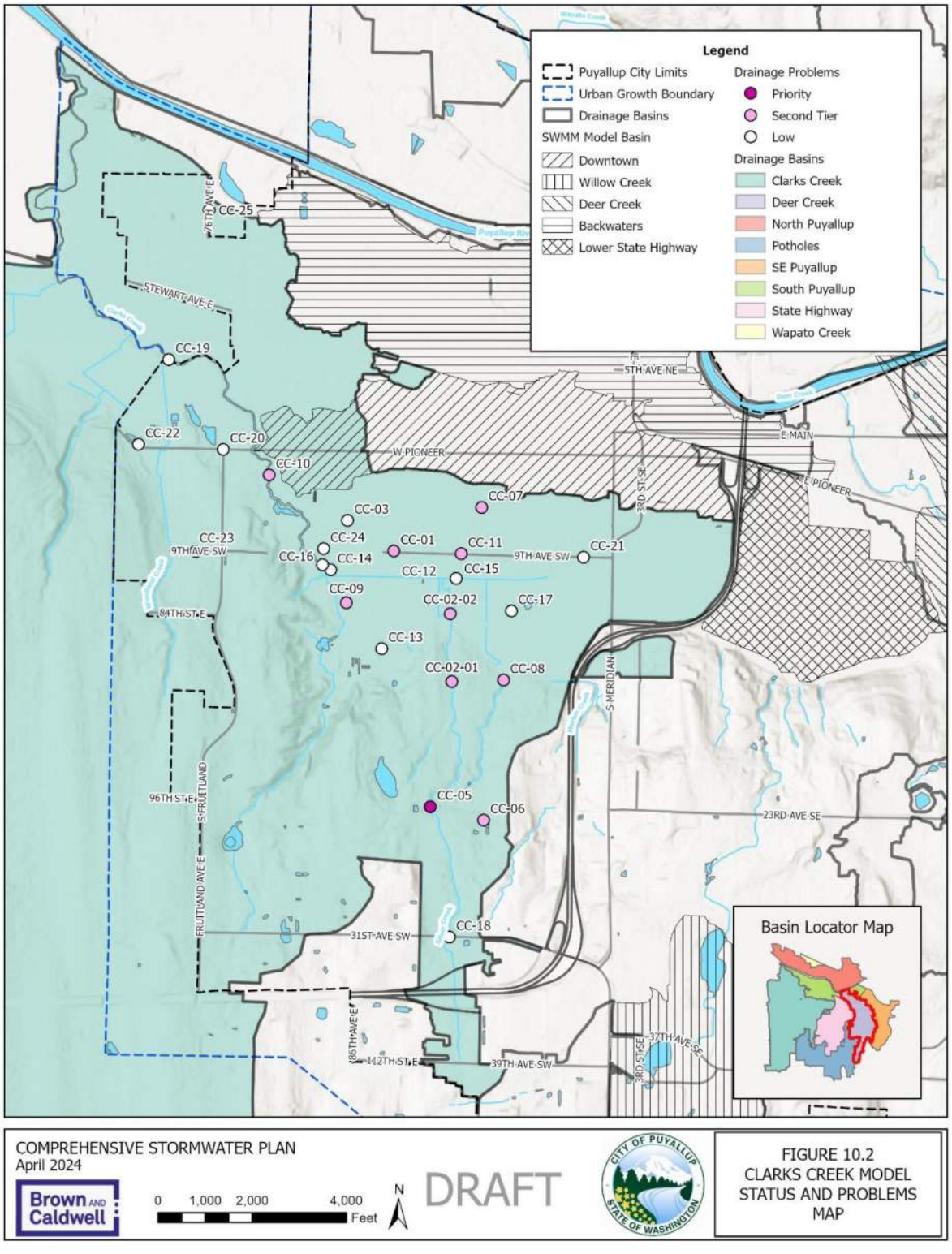

Figure 10-2. Clarks Creek model status and problem map

10.2 Deer Creek Basin (Shaw Road Basin)

10.2.1 Existing Drainage System

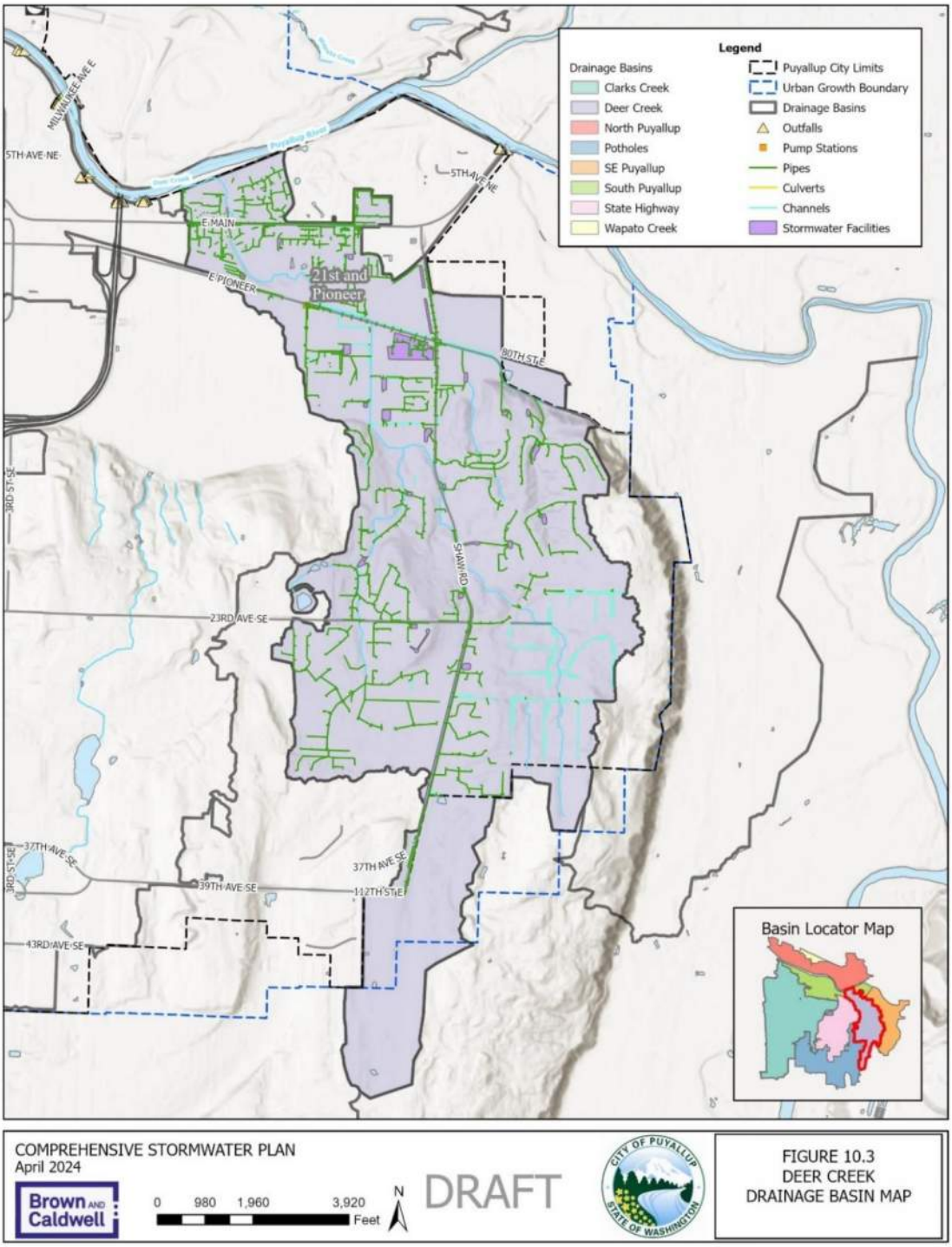

Figure 10-3. Deer Creek drainage basin map

10.2.2 Basin and System Evaluation and Recommendations

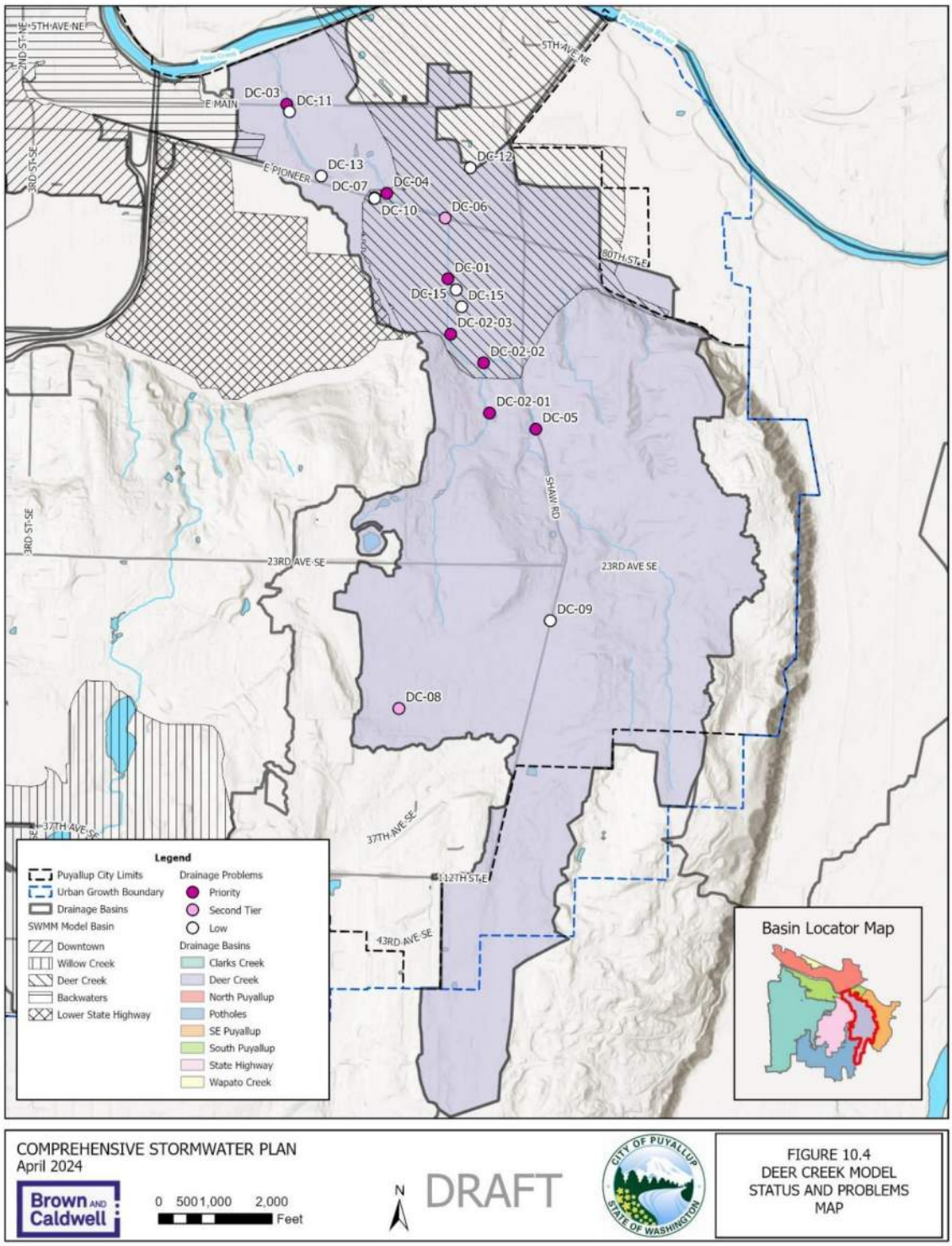

Figure 10-4. Deer Creek model status and project map

Table 10-3. Deer Creek Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
DC-01	Deer Creek Realignment	Deer Creek from 12th Ave to Pioneer Ave SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Priority	
DC-02	Deer Creek/Shaw Creek Emergency Culvert Replacements	Shaw Creek Crossings at 27th St SE and Deer Creek Crossings at 12th Ave SE	Capacity	19-013	Priority	
DC-03	East Main Deer Creek Crossing	East Main at Deer Creek Crossing	Replacing Aging/Deficient Infrastructure	14-060	Priority	
DC-04	21st St. Deer Creek RR Crossing	Deer Creek Railroad Crossing near 21st St SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Priority	
DC-05	Shaw Rd Improvements	Shaw Rd from 25th Ave Ct SE to Pioneer	Replacing Aging/Deficient Infrastructure	16-027	Priority	
DC-06	East Pioneer Drainage Improvements	E Pioneer from 25th St to Pioneer S Curves	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	
DC-07	21st St SE Stormwater Pump Station Removal and Drainage Rerouting	E Pioneer Ave and 31st St SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	
DC-08	Flooding at 31st Ave SE and Cherokee Blvd	31st Ave SE and Cherokee Blvd	Capacity	Not Assigned	Second Tier	
DC-09	Heritage Manor Detention Retrofit	Shaw Road and 26th Ave SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
DC-10	Shope and Deer Creek Levee	1618 E MAIN	Capacity	Not Assigned	Low	
DC-11	BNRR Culvert Replacement near Inter Ave	BNRR and Inter Ave	Floodplain	Not Assigned	Low	
DC-12	BNRR Culvert Replacement near 17th St SE	BNRR and 17th St SE	Capacity	Not Assigned	Low	
DC-13	Purchase of Properties within Deer Creek 100-YR Floodplain	Deer Creek Floodplain	Capacity	Not Assigned	Low	
DC-14	Elevation of Structures in Deer Creek 100-YR Floodplain	Deer Creek Floodplain	Floodplain	Not Assigned	Low	

10.3 North Puyallup Basin

10.3.1 Existing Drainage System

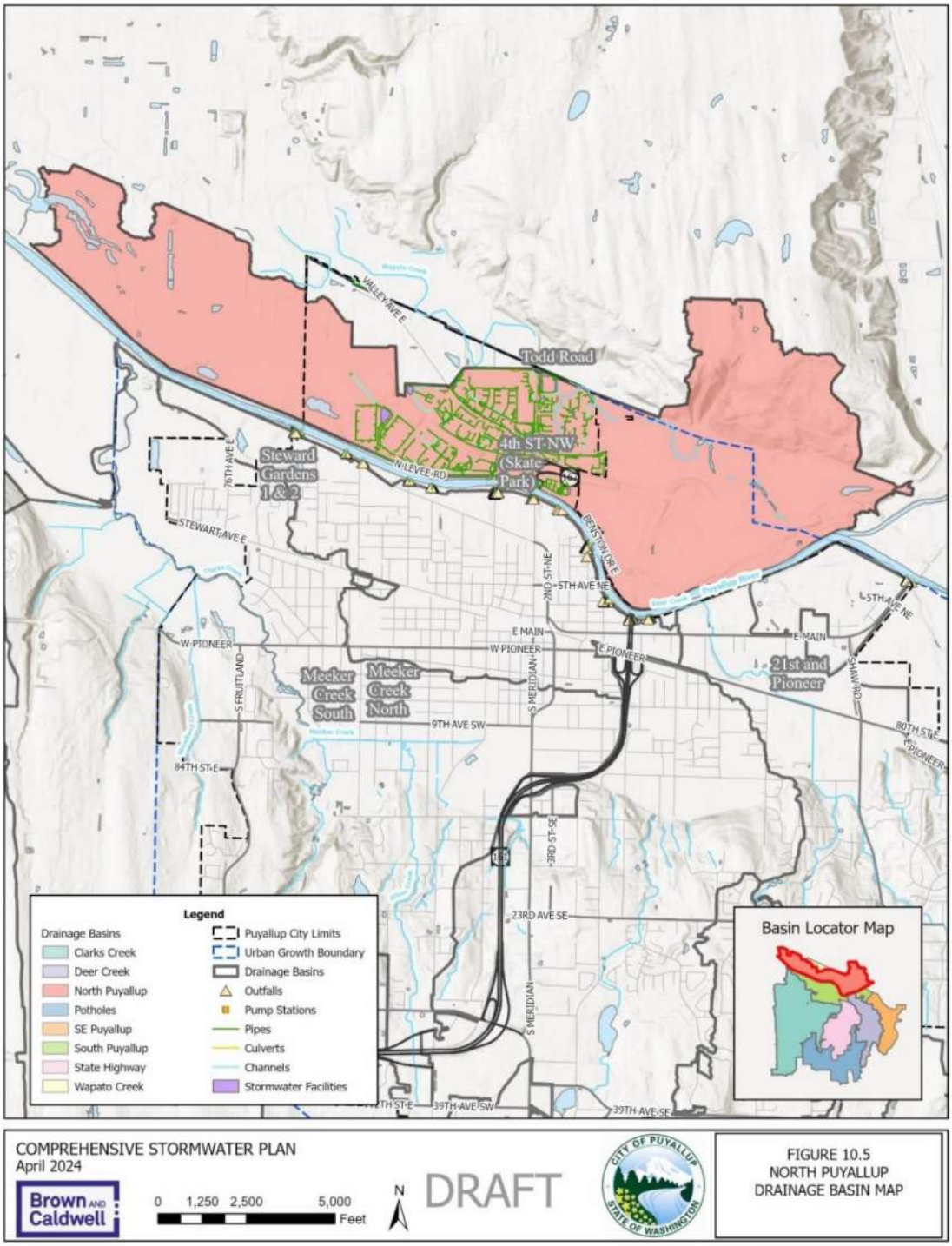

Figure 10-5. North Puyallup drainage basin map

10.3.2 Basin and System Evaluation and Recommendations

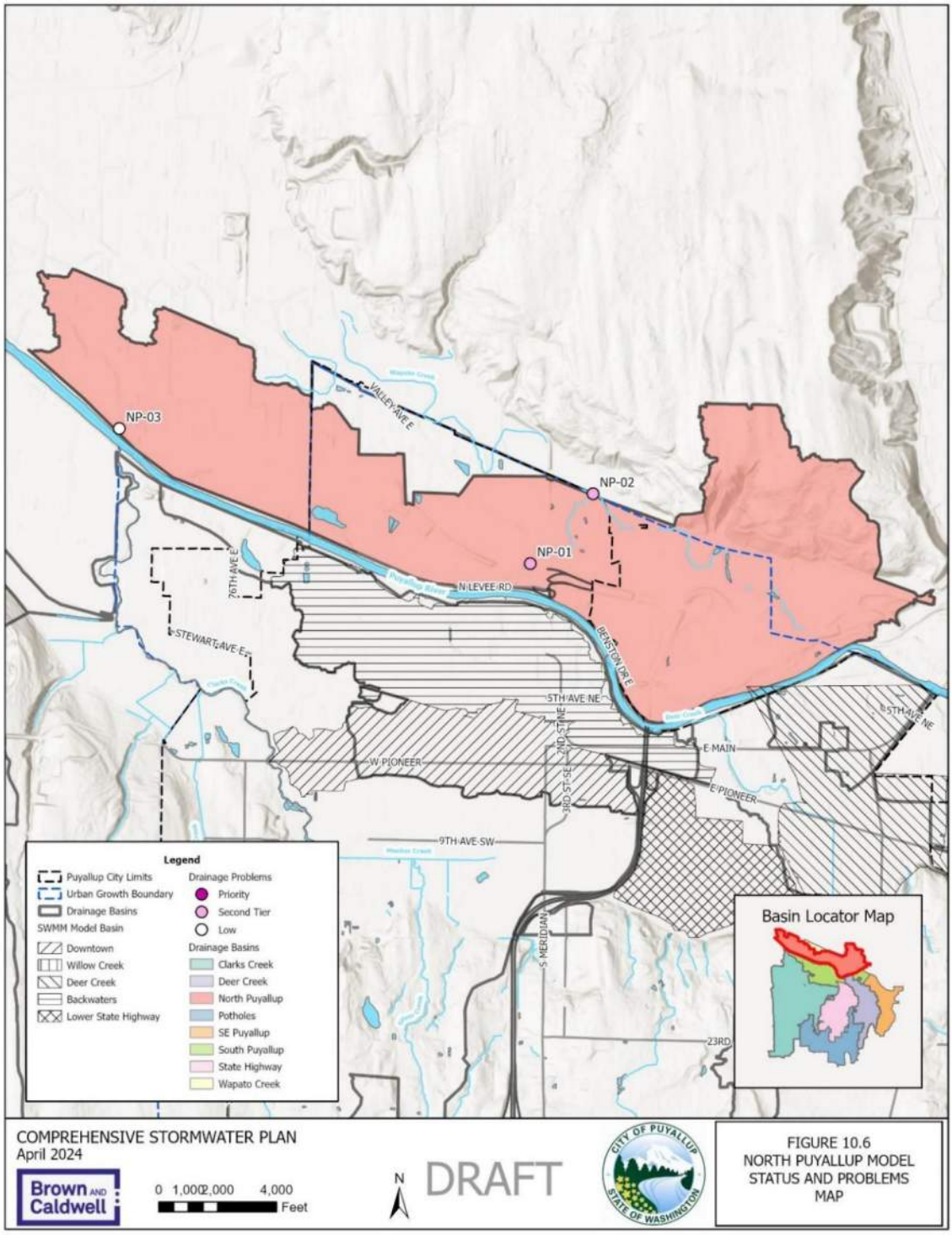

Figure 10-6. North Puyallup Basin model status and project map

Table 10-4. North Puyallup Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
NP-01	Wapato Creek Diversion Repair	Wapato Creek Diversion from Puyallup River to Kia Dealership	Replacing Aging/Deficient Infrastructure	14-067	Second Tier	
NP-02	Wapato Creek Culvert @ Todd Rd	Eastern Culvert @ Todd Road and Wapato Creek	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	
NP-03	North Levee Rd Setback Levee	Right Bank - River Mile 2.8 to 8.15	Floodplain	Not Assigned	Low	

10.4 Potholes Basins

10.4.1 Existing Drainage System

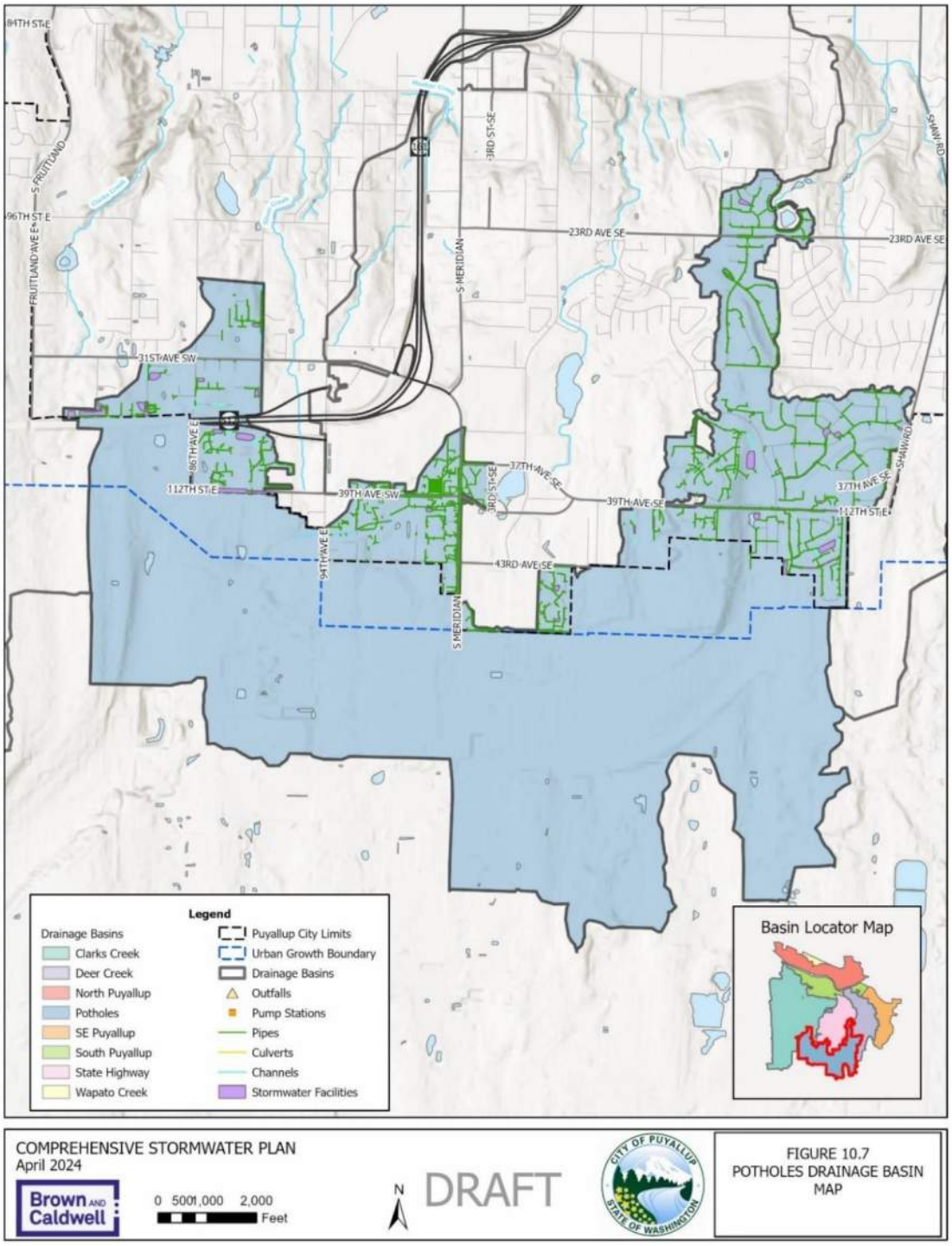

Figure 10-7. Potholes basins drainage basin map

10.4.2 Basin and System Evaluation and Recommendations

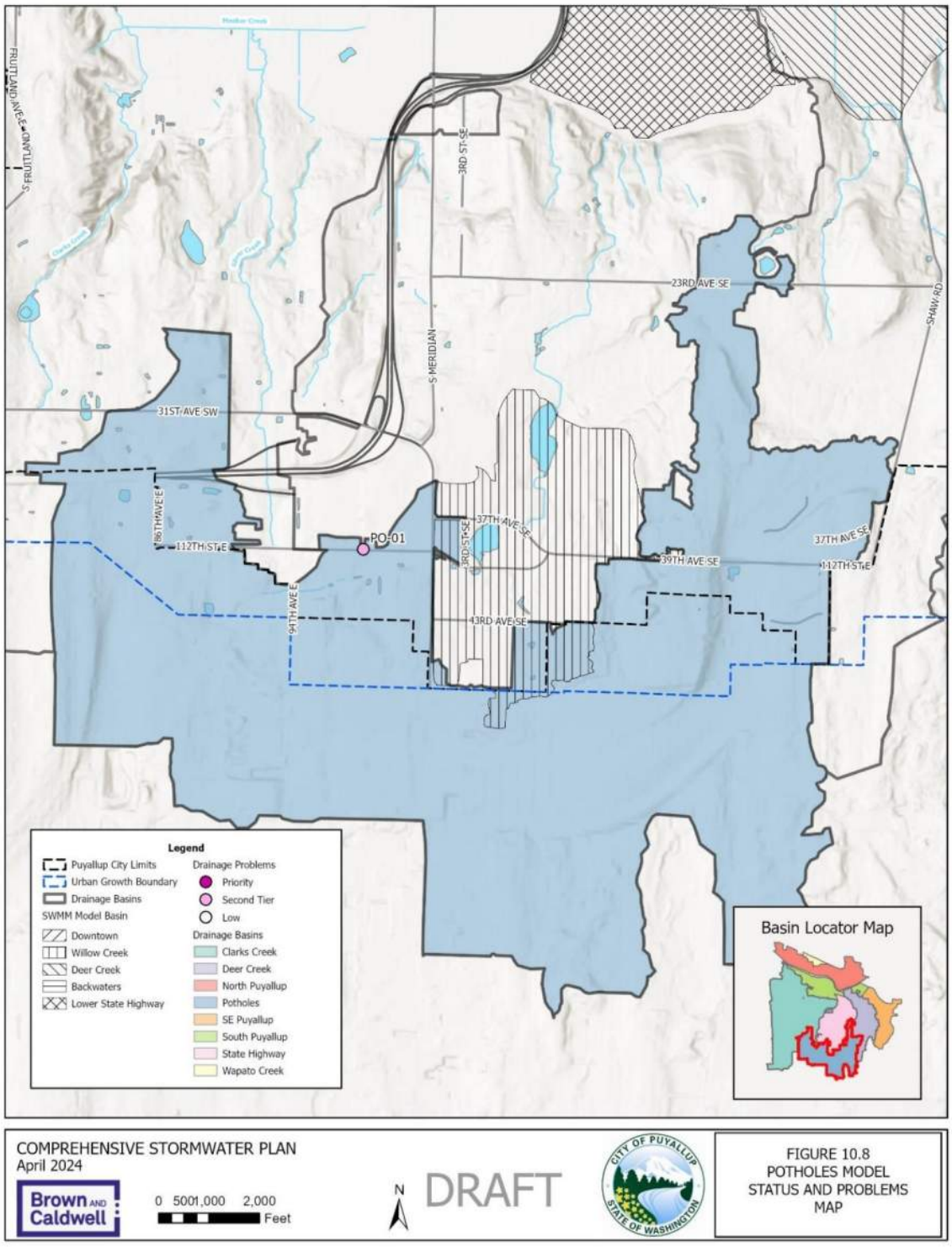

Figure 10-8. Potholes basins model status and project map

Table 10-5. Potholes Basins Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
PO-01	39th Ave SW and 5th St SW Drainage (Drywell)	39th Ave SW and 5th St SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	

10.5 SE Puyallup Basin

10.5.1 Existing Drainage System

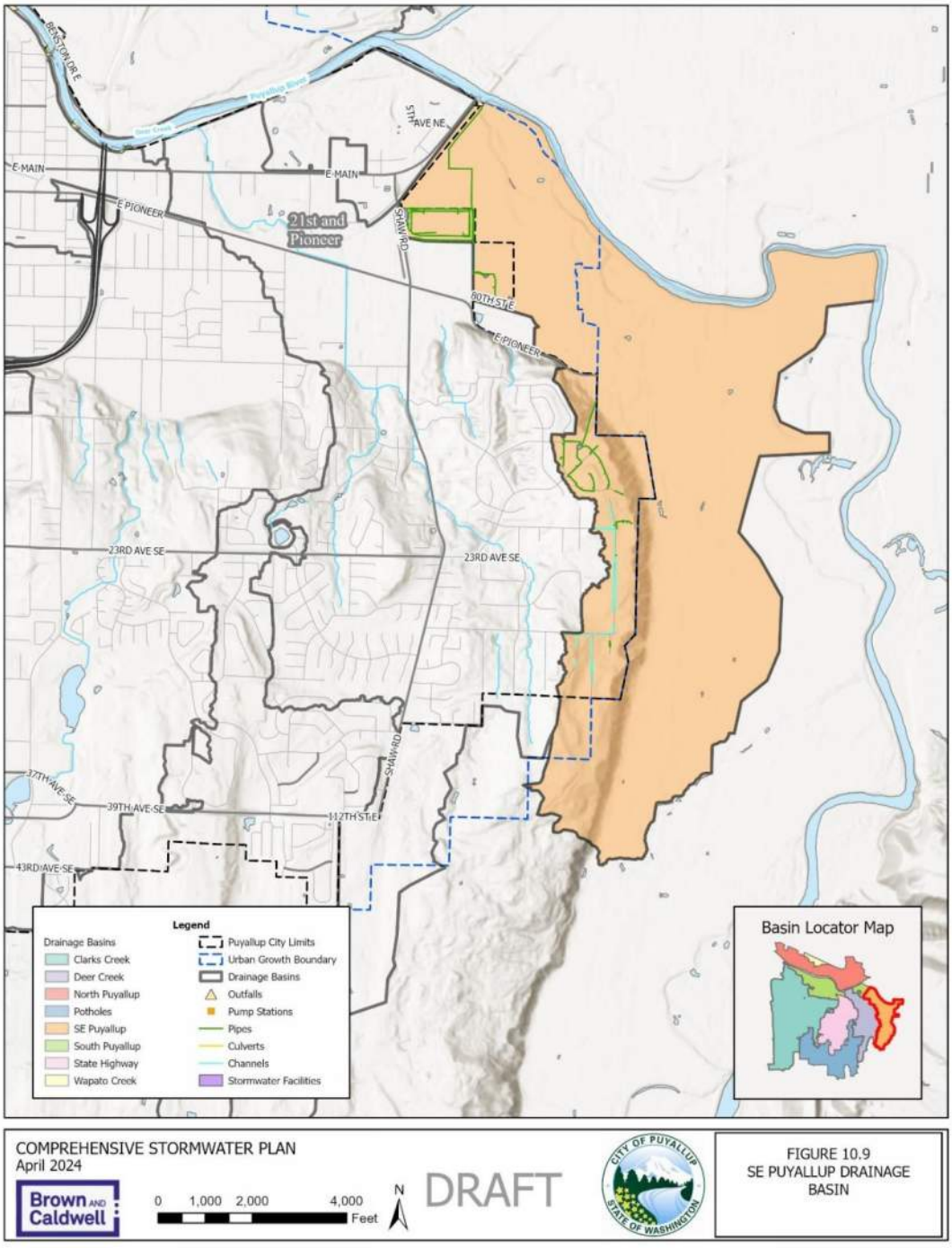

Figure 10-9. SE Puyallup drainage basin map

10.5.2 Basin and System Evaluation and Recommendations

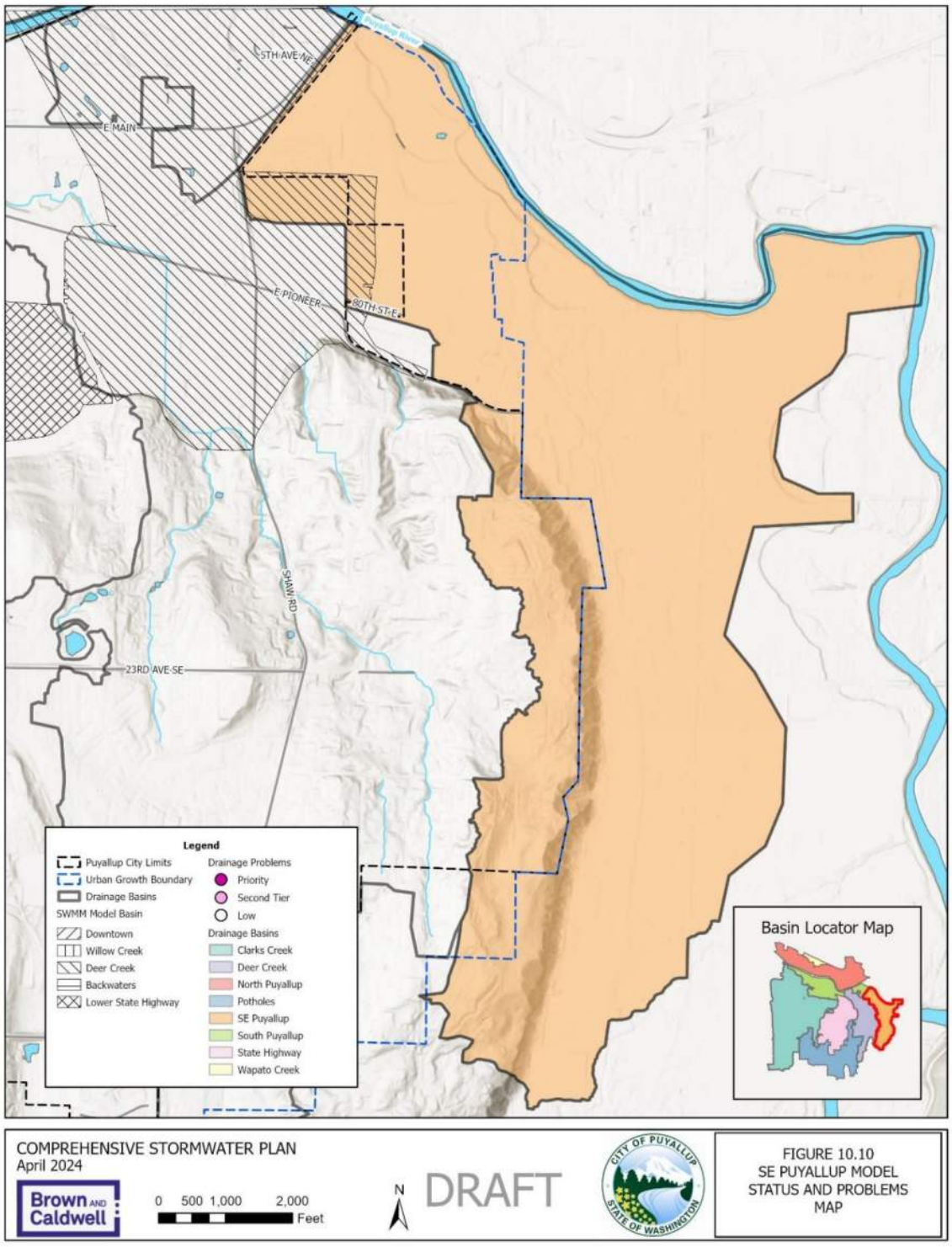

Figure 10-10. SE Puyallup basin model status and project map

10.6 South Puyallup Basin

10.6.1 Existing Drainage System

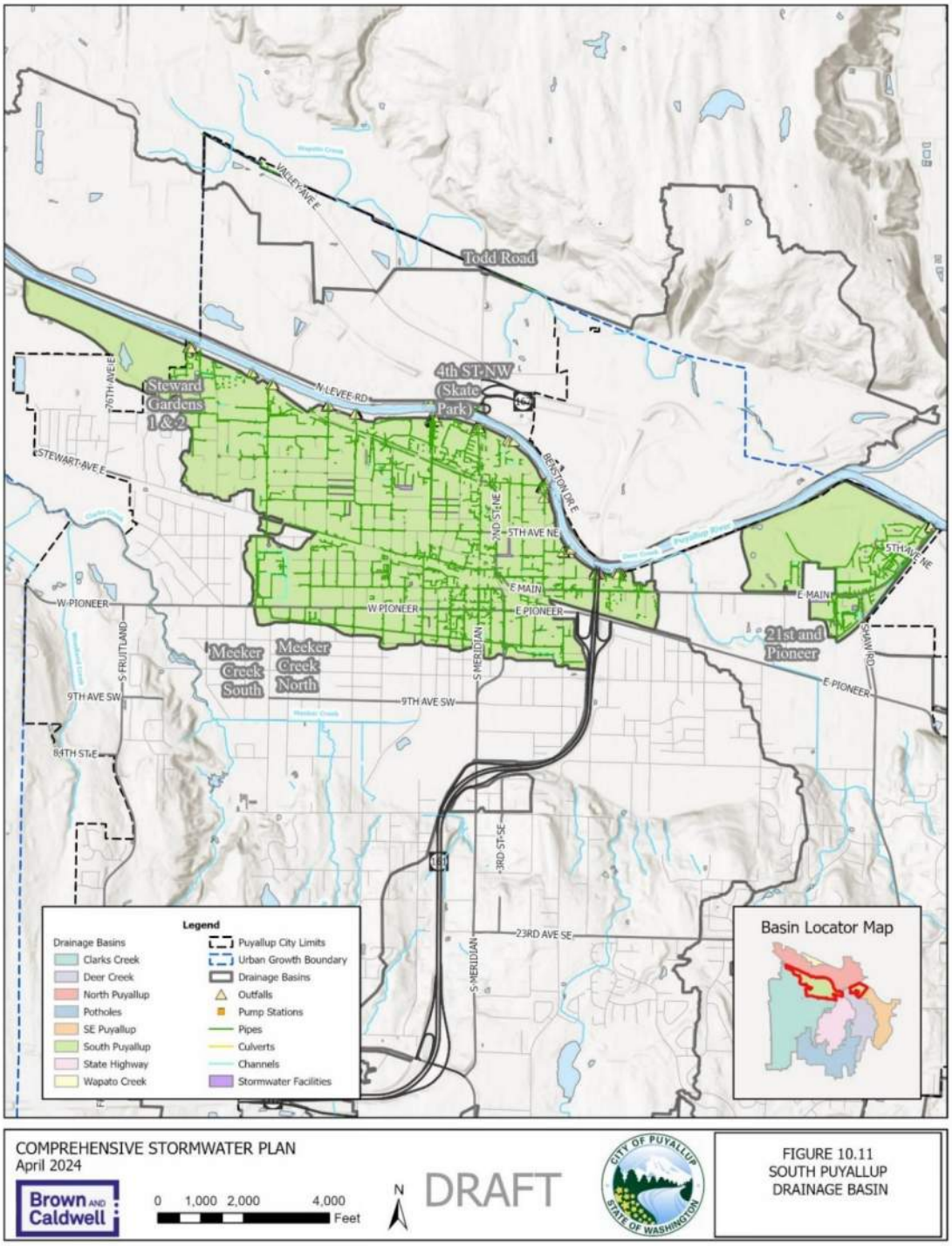

Figure 10-11. South Puyallup drainage basin map

10.6.2 Basin and System Evaluation and Recommendations

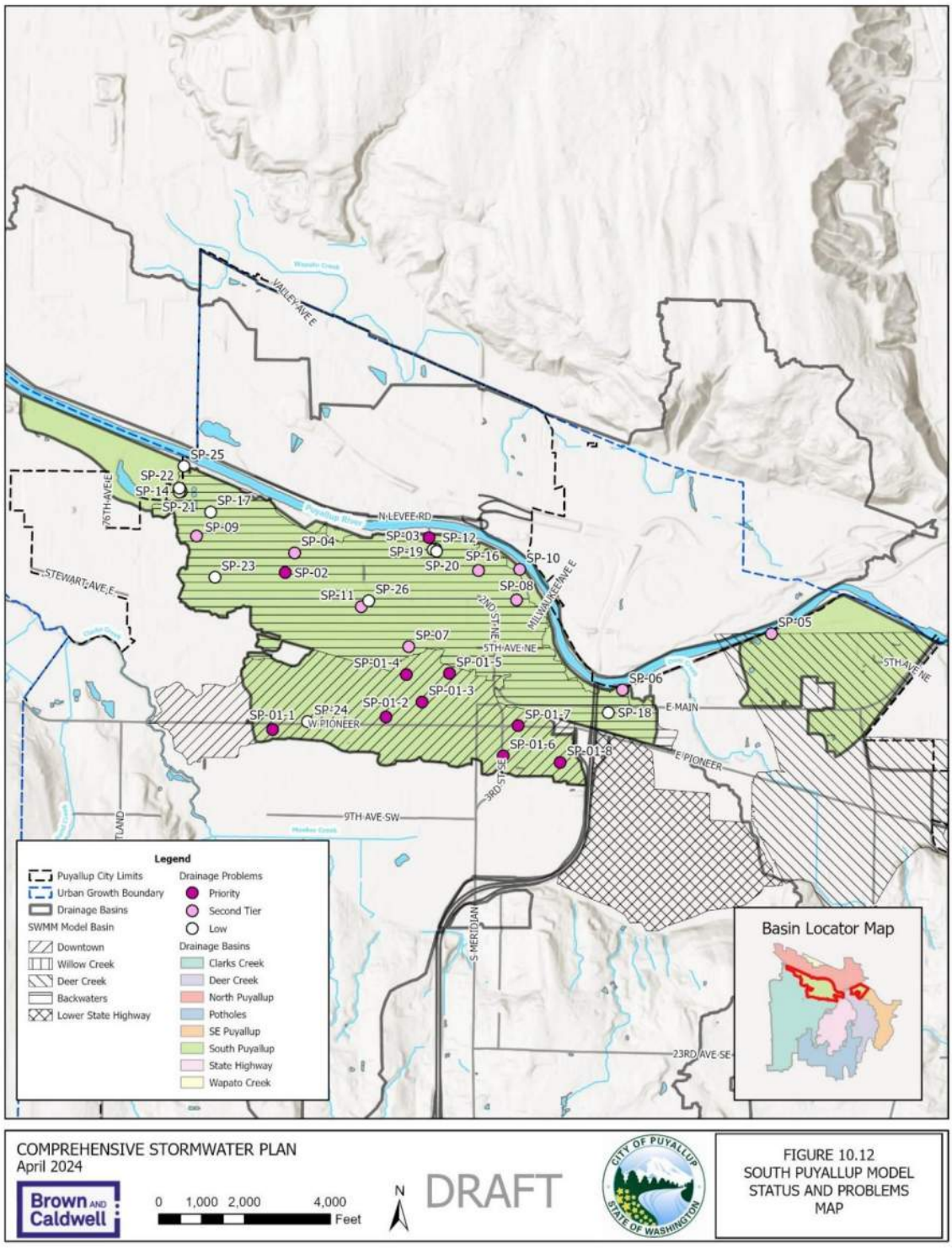

Figure 10-12. South Puyallup basin model status and project map

Table 10-6. South Puyallup Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
SP-01	4th St NW Storm Upgrades for Downtown Revitalization - Phase N-2, N-3, N-4 & N-5; 4th ST (Skate Park) PS	5th St SW from 4th Ave SW to 3rd Ave NW & 4th Ave SW from 5th St SW to 2nd St SE	Expanding Direct Discharge	23-008	Phase N-1 (On-going) Priority	
SP-02	Drainage Improvements on 10th-7th Ave NW	10th Ave NW from 18th St NW to 11th St NW - 9th, 8th, and 7th Ave NW from 15th St NW to 11th St NW	Replacing Aging/Deficient Infrastructure	Not Assigned	Priority	
SP-03	4th St Pump Station Replacement	4th St NW and Puyallup River	Expanding Direct Discharge	Not Assigned	Priority	
SP-04	12th Ave NW Drainage Improvements	12th Ave NW from 15th St NW to 11th St NW	Capacity	Not Assigned	Second Tier	
SP-05	Linden Golf Course Setback Levee	Left Bank - River Mile 9.6 to 10.5	Maintenance/ Operation	Not Assigned	Second Tier	
SP-06	Flashcube Building/Puyallup Executive Park Flood Wall	Left Bank - River Mile 9.1 to 9.25	Floodplain	Not Assigned	Second Tier	
SP-07	5th Ave NW Improvements	5th Ave NW from 4th St NW to 7th St NW	Replacing Aging/Deficient Infrastructure	17-021	Second Tier	
SP-08	9th Ave NE Main Replacement	9th Ave NE from the Puyallup River to 2nd St NE	Capacity	Not Assigned	Second Tier	
SP-09	Flooding @ 13th Ave NW and 20th St NW	20th St NW - 13th Ave NW to 10th Ave NW	Capacity	Not Assigned	Second Tier	
SP-10	Tiffany's Skate Inn/Riverwalk Flood Wall	Left Bank - River Mile 8.1 to 8.6	Maintenance/ Operation	Not Assigned	Second Tier	
SP-11	8th Ave NW Road Reconstruction and Sidewalks	8th Ave NW from 9th St NW to 8th ST NW	Replacing Aging/Deficient Infrastructure	17-019	Second Tier	
SP-12	Parks Maintenance Facility Covered Storage for Outdoor Stockpiles	Parks Maintenance Facility	Maintenance/ Operation	Not Assigned	Second Tier	
SP-13	WWTP Covered and Contained Fueling Station	WWTP	Maintenance/ Operation	Not Assigned	Second Tier	
SP-14	WWTP Containment and WQ for Loading/Unloading Areas	WWTP	Maintenance/ Operation	Not Assigned	Second Tier	

Table 10-6. South Puyallup Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
SP-15	WWTP SPCC Plan Development and Implementation	WWTP	Maintenance/Operation	Not Assigned	Second Tier	
SP-16	N Meridian Drainage Improvements	N Meridian from River Rd to King Family Mini Golf Entrance	Capacity	Not Assigned	Second Tier	
SP-17	Detention Pond - 18th St NW	1404 18th St NW	Capacity	Not Assigned	Low	
SP-18	10th St SE Reconstruction and Utility Replacement	10th St SE from E Main 250 Feet South	Replacing Aging/Deficient Infrastructure	21-008	Low	
SP-19	Parks Maintenance Facility Pallets and Covers for Extra Building Materials and Equipment	Parks Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	
SP-20	Parks Maintenance Facility Fully Enclosed and Covered Dumpster Enclosure	Parks Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	
SP-21	WWTP Fully Enclosed and Covered Dumpster/Hopper Enclosure	WWTP	Maintenance/ Operation	Not Assigned	Low	
SP-22	WWTP Pallets and Covers for Extra Materials and Equipment	WWTP	Maintenance/ Operation	Not Assigned	Low	
SP-23	18th St NW Drainage Improvements	18th St NW from 12th Ave Ct NW to W Stewart Ave	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SP-24	12th St SW Stormwater Improvements	12th St SW from W Main Ave to 4th Ave SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SP-25	Research Infrastructure Near River Road @ 20th St NW Outfall	Puyallup River and 20th St NW Outfall	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SP-26	9th Ave NW and 8th St NW Drainage Reroute	9th Ave NW, 8th St NW and 8th Ave NW	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	

10.7 State Highway Basin

10.7.1 Existing Drainage System

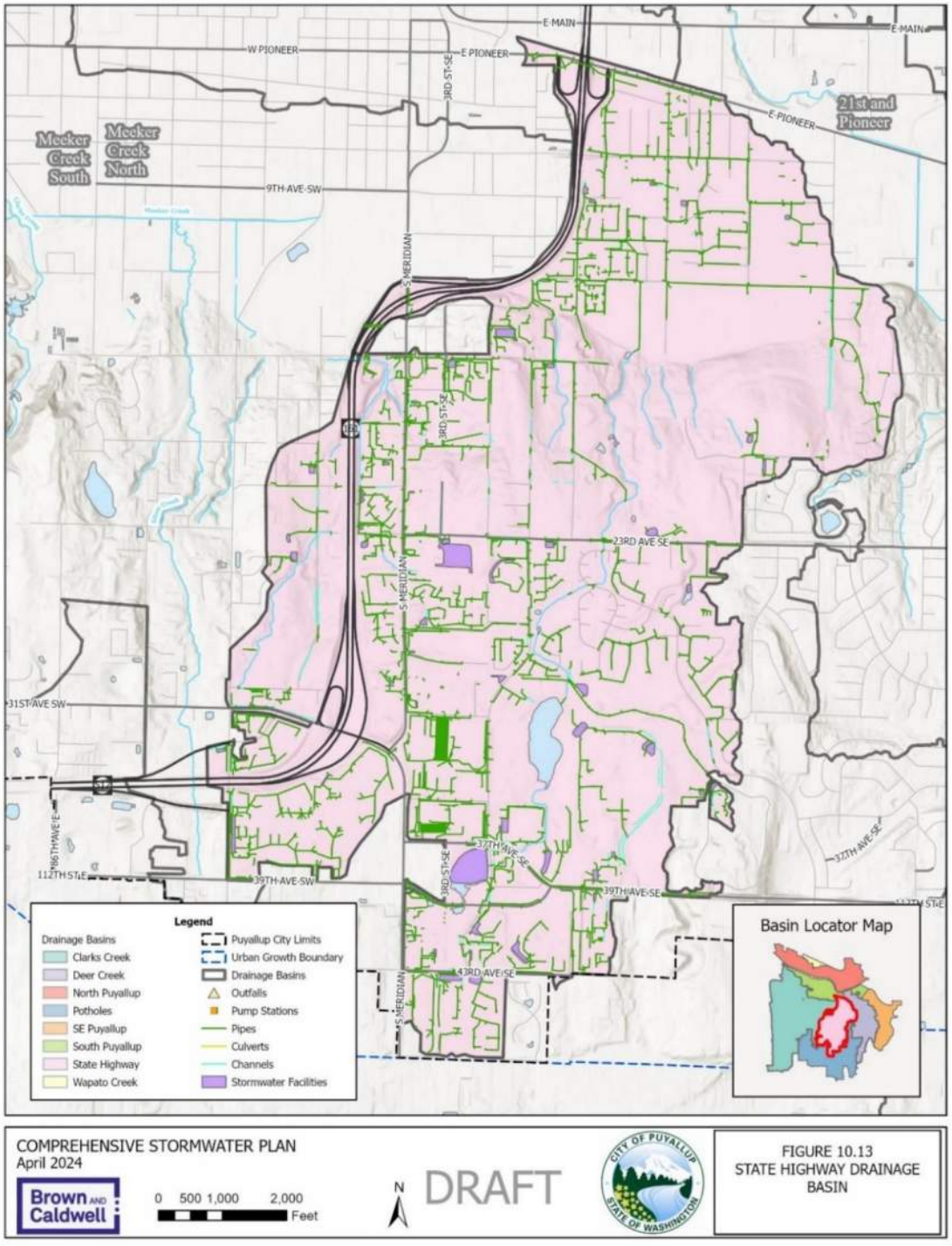

Figure 10-13. State highway drainage basin map

10.7.2 Basin and System Evaluation and Recommendations

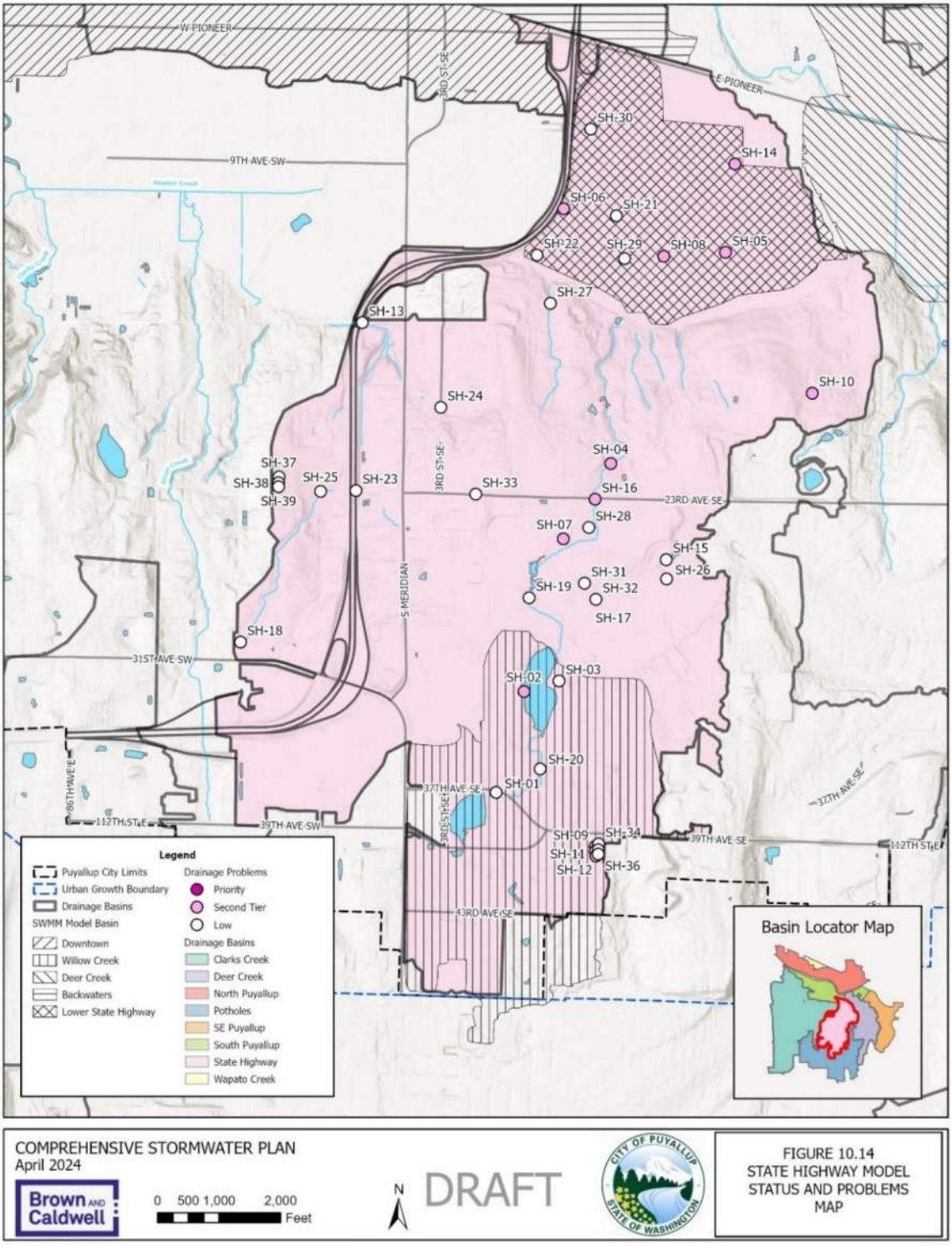

Figure 10-14. State highway basin model status and project map

Table 10-7. State Highway Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
SH-01	Bradley Lake Dam Safety and Outfall Improvements	Bradly Lake Park	Replacing Aging/Deficient Infrastructure	20-017	Second Tier	
SH-02	Wildwood Park Stormwater Diversion	Wildwood Park	Replacing Aging/Deficient Infrastructure	16-030	Second Tier	
SH-03	Storm Sewer Replacement - 12th Ave SE	12th Ave SE from 21st St SE to 13th St SE	Capacity	Not Assigned	Second Tier	
SH-04	Puyallup Downs Wetland Outfall	Puyallup Downs Wetland - Olympic Blvd and Parkwood Blvd	Replacing Aging/Deficient Infrastructure	16-021	Second Tier	
SH-05	12th Ave SE and 13th St SE Flooding	13th St SE and 12th Ave SE	Capacity	Not Assigned	Second Tier	
SH-06	PW Facility Covered Storage for Outdoor Stockpiles/ Sand Shed Pole Barn	PW Maintenance Facility	Maintenance/Operation	14-049	Second Tier	
SH-07	21st St Roadside Ditch	21st St SE south of Vista Dr	Replacing Aging/Deficient Infrastructure	Not Assigned	Second Tier	
SH-08	17th St SE Pipe Rehabilitation	17th St SE just north of 9th Ave SE	Maintenance/ Operation	Not Assigned	Second Tier	
SH-09	23rd Ave SE Culvert	Wildwood Creek 23rd Ave Culvert Crossing	Capacity	Not Assigned	Second Tier	
SH-10	Joint City-State Storm Sewer Agreement and Flow Control Calibration Update	City-State Stormwater Trunkline	Planning	Not Assigned	Low	
SH-11	Willows Pond System Improvements	37th Ave SE and 5th ST SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SH-12	Feasibility/Cost Benefit Study for CIP-SH-E6 A & B (State Highway Basin Plan)	Bradly Lake/Puyallup Downs Wetland	Planning	Not Assigned	Low	
SH-13	Detention Pond - 15th Ave SW	15th Ave SW and SR-512	Capacity	Not Assigned	Low	
SH-14	Heath DC Addition Pond Rehabilitation (Wildwood Elementary Pond)	24th Ave SE west of 15th St SE	Maintenance/ Operation	Not Assigned	Low	
SH-15	Public Works Maintenance Facility Containment and WQ	Public Works Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	

Table 10-7. State Highway Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
	for Loading/Unloading Areas					
SH-16	Public Works Maintenance Facility SPCC Plan Development and Implementation	Public Works Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	
SH-17	State Highway Basin Floodplain Study	State Highway Basin Floodplain	Planning	Not Assigned	Under Construction	
SH-18	Right-of-Way Erosion - 30th Ave SW and 9th St SW	30th Ave SW and 9th St SW	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SH-19	Bradly Lake Inlet Capacity	Bradly Lake Park	Capacity	Not Assigned	Low	
SH-20	Bradly Lake Swale	Swale Behind Lowe's	Replacing Aging/Deficient Infrastructure	Private Project	Low	
SH-21	48-Inch Trunk Line on 10th Ave SE	10th Ave SE East of State Trunk Line to 12th St SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SH-22	Katmandu Sand Trap Retrofit	13th Ave SE and 7th St SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SH-23	23rd Ave SW Maintenance	23rd Ave SW and SR-512	Maintenance/ Operation	Not Assigned	Low	
SH-24	3rd St SE Private Storm Failure	3rd St SE and 19th Ave SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SH-25	5th St SW Culvert	5th St SW and 23rd Ave SW	Capacity	Not Assigned	Low	
SH-26	Monorwood Vault Maintenance Plan/Retrofit	Wildwood Park Drive and 26th Ave SE	Maintenance/ Operation	Not Assigned	Low	
SH-27	Channel Erosion - 15th Ave SE to 13th Ave SE	Channel from 15th Ave SE Crossing to 13th Ave SE	Replacing Aging/Deficient Infrastructure	Not Assigned	Low	
SH-28	Detention west of Wildwood Drive	Parkwood Plat west of Wildwood Dr.	Capacity	Not Assigned	Low	
SH-29	Detention South of 12th Ave SE	South of 12th Ave SE between 11th St SE and 12th St SE (Labelle Property)	Capacity	Not Assigned	Low	
SH-30	7th Ave SE Storm Main Replacement and Detention	7th Ave SE from SR512 to 11th ST SE	Capacity	Not Assigned	Low	

Table 10-7. State Highway Basin Problem and Associated Project Summary

Problem				Project		
ID	Name	Location	Type	CIP Num	Priority	Estimated Cost
SH-31	Purchase of Properties within State Highway Basin 100-YR Floodplain	State Highway Basin Floodplain	Floodplain	Not Assigned	Low	
SH-32	Elevation of Structure in State Highway 100-YR Floodplain	State Highway Basin Floodplain	Floodplain	Not Assigned	Low	
SH-33	23rd Ave SE Widening	23rd Ave SE from Meridian to 9th St SE	Replacing Aging/Deficient Infrastructure	14-014	Low	
SH-34	Public Works Maintenance Facility Brine and De-Icing Secondary Containment	Public Works Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	
SH-35	Public Works Maintenance Facility Pallets and Covers for Salvageable Materials (e.g., pipes, valves, signs, etc.)	Public Works Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	
SH-36	Public Works Maintenance Facility Fully Enclosed and Covered Dumpster Enclosure	Public Works Maintenance Facility	Maintenance/ Operation	Not Assigned	Low	
SH-37	Cemetery Covered Storage for Outdoor Materials	Cemetery	Maintenance/ Operation	Not Assigned	Low	
SH-38	Cemetery Containment and WQ for Stockpiled Materials	Cemetery	Maintenance/ Operation	Not Assigned	Low	
SH-39	Cemetery Fully Enclosed and Covered Dumpster Enclosure	Cemetery	Maintenance/ Operation	Not Assigned	Low	

10.8 Wapato Creek Basin

10.8.1 Existing Drainage System

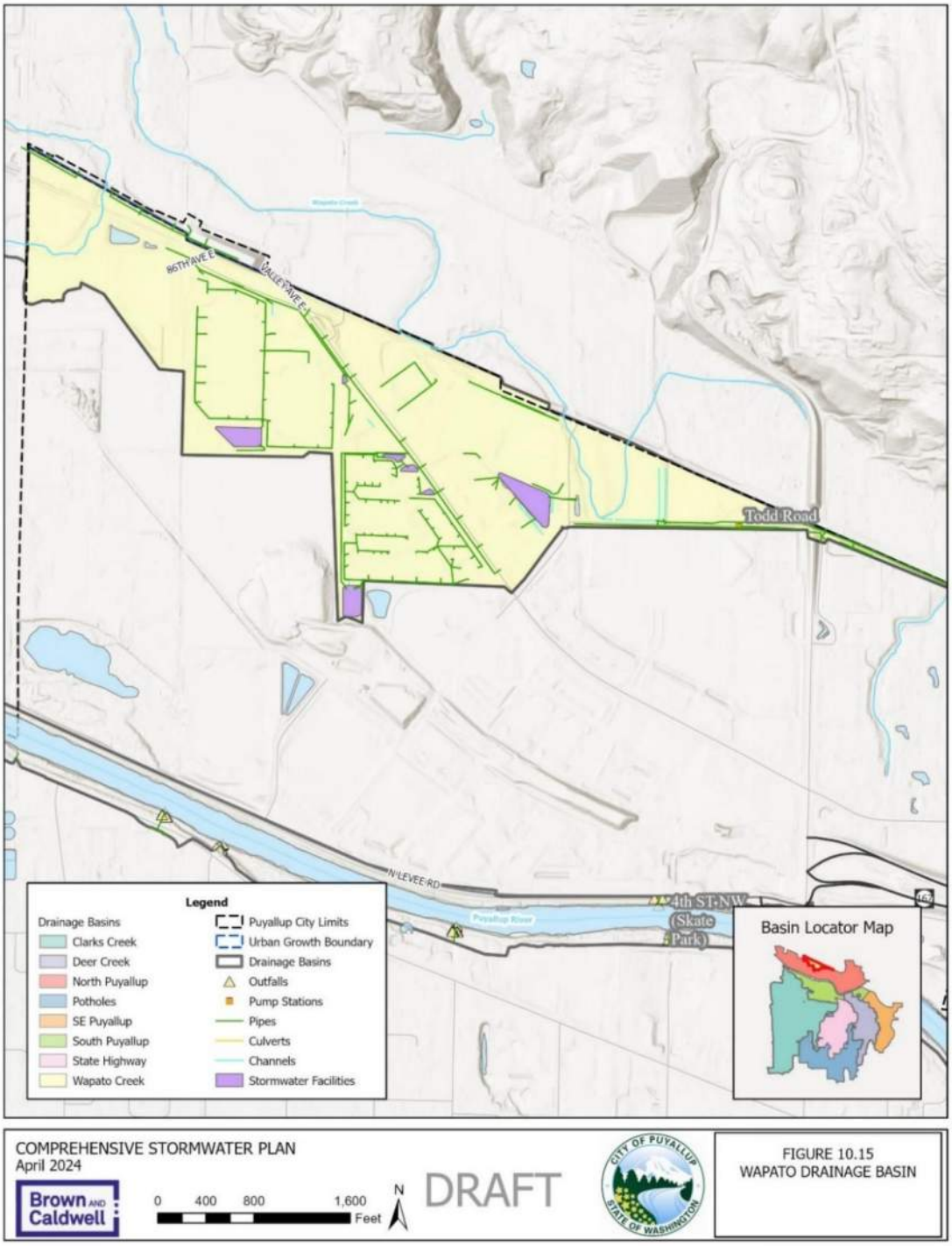

Figure 10-15. Wapato Creek drainage basin map

10.8.2 Basin and System Evaluation and Improvements

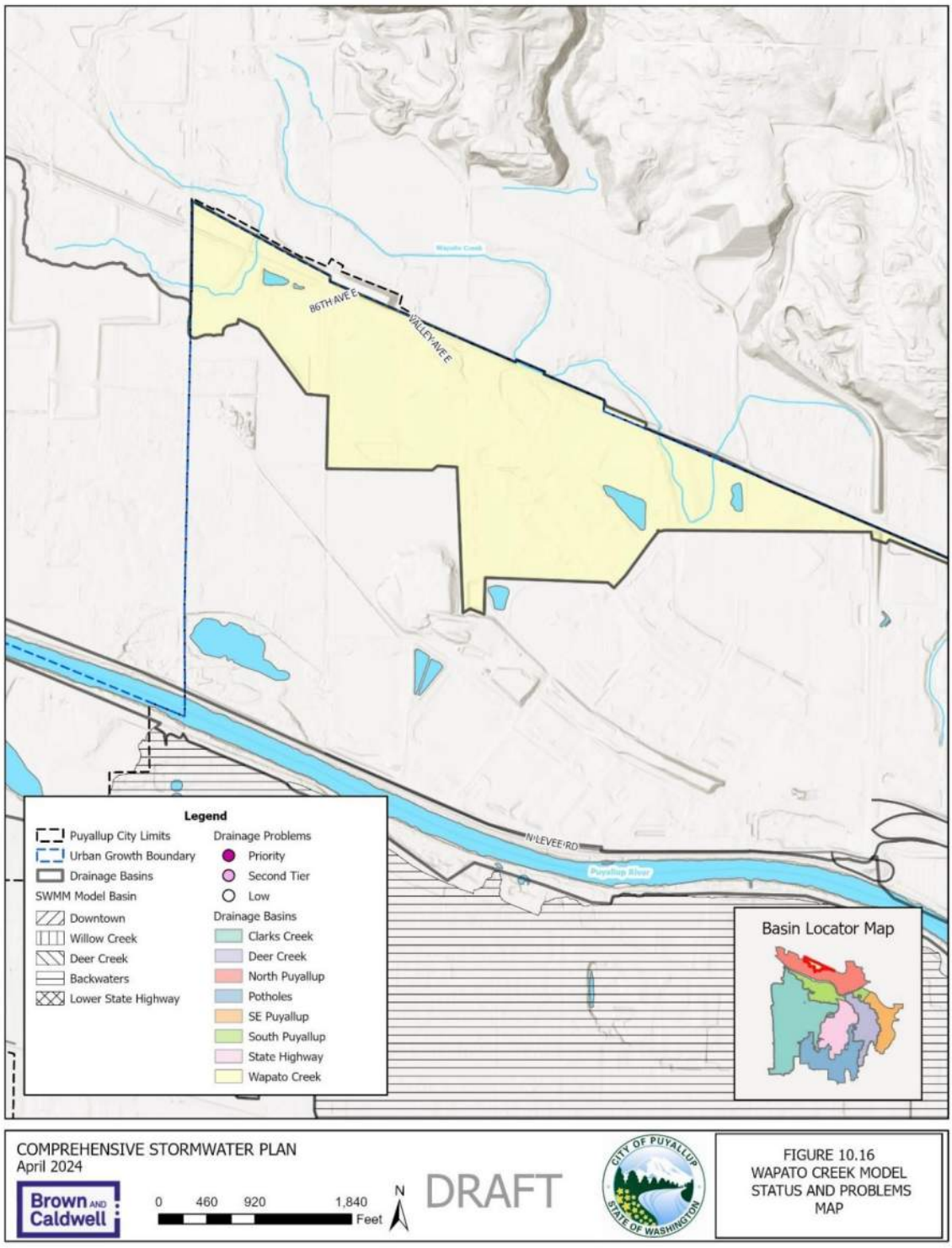

Figure 10-16. Wapato Creek basin model status and project map

Limitations

This document was prepared solely for City of Puyallup in accordance with professional standards at the time the services were performed and in accordance with the contract between City of Puyallup and Brown and Caldwell dated July 5, 2023. This document is governed by the specific scope of work authorized by City of Puyallup; 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 Puyallup and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Appendix A: SEPA Checklist

Appendix B: Problem and Project Identification Tables and Prioritization Matrix

Table B-1. Resolved or Removed Problems

Previous Problem ID	Problem Name	Problem Location	Year Documented	Reason for Removal
CC-15	Fruitland Ditch Erosion	Fruitland Ave E neat 18th Ave SW	2012	Mitigated with Maintenance
CIP-LT-11	12th Ave SE Regional Stormwater Facility	1243 27th St SE (Flaherty Property)	2012	Feasibility/Groundwater Table and Trunk Line Extension
CIP-LT-7	Clarks Creek Basin Plan	Clarks Creek Basin	2012	Retrofit Plan, Comprehensive Plan and, changing SMAP Requirements
CIP-LT-8	Wapato Creek Flow Restoration	Wapato Creek @ Todd Rd - 1,000 Feet East of Meridian	2012	Removed per Hans's Comment
E13B	Willows Pond Expansion	Willows Pond	2007	Property is being developed
KCM-10	N/A	Wapato Creek Culvert Beneath 54th St E	1996	Project Unkown to all Staff
KCM-11	N/A	Pony Lake and 119th Ave E Modifications	1996	Project Unkown to all Staff
KCM-12	Detention - 25th St SW	25th St SW ROW 2,000 Feet North of 104th St E	1996	Feasibility, Complexity, WDFW and Tribal Requiremnts
KCM-13	Woodland Ave Flooding	Woodland Ave between 124th St E and 104th St E	1996	Outside the UGA and COP
KCM-14	Clover Creek Flooding	Clover Creek at 131st St Ct E and 79th Ave Ct E	1996	Outside the UGA and COP
KCM-2	Woodland Creek Pipe Replacement	Woodland Creek Between 102nd St E and 100th St E	1996	Project Unkown to all Staff
KCM-3	Woodland Creek Culvert Replacement - 98th St Ct E	Woodland Creek and 98th St Ct E	1996	Project Unkown to all Staff
KCM-4	Woodland Creek Culvert - 80th St E	Woodland Creek at 80th St E	1996	Outside the UGA and COP
KCM-7	Diru Creek Culvert - Pipeline Rd	Diru Creek at Pipeline Rd and 100th St E	1996	Outside the UGA and COP
KCM-8	Diru Creek Culvert - 84th St E	Diru Creek at 84th St E	1996	Outside the UGA and COP
KCM-9	Diru Creek Culvert - Pioneer Ave	Diru Creek at Pioneer Ave	1996	Outside the UGA and COP
PR-5	Lakes Development Annexation	W Stewart Ave to 16th Ave NW	2012	No Problems Observed over 10 years
PW-1	39th Ave SW Flooding	300 Block 39th Ave SW	2012	Resolved with minor modifications and maintenance
SD-CC-16	Clarks Creek Dredging	Clarks Creek	1996	Feasibility, Complexity, WDFW and Tribal Requiremnts
SD-CC-18	14th Ave SW and S Meridian Detention Pond	14th Ave SW and S Meridian	1996	Property is being developed
SD-CC-19	9th Ave SW Diversion to Meeker Creek	9th Ave SW and 5th St SW	1996	Meeker Pump Station at Capacity and Maintenance Issues
SD-CC-6	Parallel 48-inch Strom Main	W Pioneer Ave from 4th St SW to 17th St SW	1996	Resolved with 15th St Diversion and 4th Ave Drainage Projects
SD-CC-8	Clarks Creek 100-yr Flow Pump Station	Clarks Creek @ Puyallup River	1996	Feasibility, Complexity, WDFW and Tribal Requiremnts
SD-CC-9	Clarks Creek Levee	Clarks Creek	1996	Feasibility and Access to Private Property
SD-SR-2	12th Ave SE Diversion to Puyallup River	12th Ave SE to Puyallup River	1996	Feasibility, WDFW and Tribal Requirements
SD-SR-4	Deer Creek Levee	Deer Creek from BNRR to E Main	1996	Feasiblitiy and Access to Private Property
SD-SR-7	Regional Detention - Shaw Rd and 33rd Ave SE	Shaw Rd and 33rd Ave SE	1996	Residential Development on Property
SI-CC-1	Meridian Street Culvert Replacement	Meridian between 23rd Ave SE and 100th St SE	1996	Unnkown Project by All Current Employees
SI-CC-2	SR 512 Ditch	SR512 and Projection of 17th Ave SE	1996	Project Unkown to all Staff
SI-CC-3	3rd Ave NW Drainage Improvements	3rd Ave NW from 5th St NW to 7th St NW	2012	Vacated ROW with Sound Transit Garage
SI-CC-4	Flooding House	7th St SW and 9th Ave SW	1996	No Problems Observed over 10 years
SI-CC-6	12th Ave SW Culvert Replacement	12th Ave SW and 13th St SW	1996	Resolved with development of Sunridge
SI-CC-7	Fruitland Ave E Culvert Replacement	Fruitland Ave E and Historic Way SW	1996	Resolved with development of Highgrove
SI-NP-1	Wapato Creek North of Todd Rd	Wapato Creek North of Todd Road	1996	Mitigated with Maintenance
SI-NP-2	Wapato Creek at Puyallup Pierce Boundary	Wapato Creek at Puyallup Pierce Boundary	1996	Mitigated with Maintenance
SI-NP-3	Wapato Creek between Todd Rd and Diversion	Wapato Creek between Todd Rd and Diversion	1996	Private Prperty Mainenace Responsibility (Drainage District No Longer Exists)
SI-SH-4	Sand Trap at 14th Ave SE and 22nd St SE	21st St SE and 14th Ave SE	1996	Private Property Issue Per Leagel Department
SI-SR-4	1301 Valley View Culvert	1301 Valley View Drive Culvert	1996	Mitigated with Maintenance
SI-SR-6	Deer Creek Flow Obstruction and Debris Removal	Deer Creek at the Puyallup River	1996	Mitigated with Maintenance
SI-SR-7	Deer Creek Sediment Removal	Deer Creek From 12th Ave SE to Pioneer Ave SE	1996	Deer Creek Realignment Project will Resolve this
SR-10	Sloughing of Highlands Ridge	Pioneer Way E	2012	No Problems Observed over 10 years
SR-11	Flooding @ Crystal Ridge Outfall	Pacels Adjacent to 0420362006	2012	No Problems Observed over 10 years
SR-18	Beaver Dam @Deer Creek	Deer Creek @ Confluence of Puyallup River	2012	No Problems Observed over 10 years
SR-2	Private Pond Complaint	2301 23RD ST SE	2012	No Problems Observed over 10 years
SR-3	Shaw Rd Deer Creek Crossings	Deer Creek between 20th Ave SE and 16th Ave SE	2012	Scope Included in Shaw Rd Project
SR-4	Shaw Rd Heawall	Shaw Rd North of 20th Ave Ct SE	2012	Scope Included in Shaw Rd Project
-	23rd Ave SE 22nd St SE to Shaw Road	24th Ave SE 22nd St SE to Shaw Road	UNK	"Wish List" Previous City Employees
-	2nd Ave NE; Main to 5th St	3rd Ave NE; Main to 5th St	UNK	"Wish List" Previous City Employees
-	43rd Ave SE 10th St to 12th St SE	44th Ave SE 10th St to 12th St SE	UNK	"Wish List" Previous City Employees
-	7th St SE 15th to 12th Ave SE	8th St SE 15th to 12th Ave SE	UNK	"Wish List" Previous City Employees
-	9th St SW W Pioneer to 9th Ave SW	10th St SW W Pioneer to 9th Ave SW	UNK	"Wish List" Previous City Employees

Table B-1. Resolved or Removed Problems				
Previous Problem ID	Problem Name	Problem Location	Year Documented	Reason for Removal
-	E Main Sidewalks - South Side	E Main East of 23rd St SE	UNK	"Wish List" Previous City Employees
-	N. Meridian Main to River Road	N. Meridian Main to River Road	UNK	"Wish List" Previous City Employees
-	S. Meridian 7th Ave S to 9th Ave S.	S. Meridian 7th Ave S to 9th Ave S.	UNK	"Wish List" Previous City Employees
-	Shaw Rd - Manorwood to 39th	Shaw Rd - Manorwood to 39th	UNK	"Wish List" Previous City Employees
-	Tacoma Rd Drainage Improvements	Tacoma Rd between W Pioneer and 4th Ave NW	UNK	"Wish List" Previous City Employees
-	Valley Ave NE 4th St NE to City Limits	Valley Ave NE 4th St NE to City Limits	UNK	"Wish List" Previous City Employees
-	West Stewart 4th St to 12th St NW	West Stewart 4th St to 12th St NW	UNK	"Wish List" Previous City Employees

Table B-2. Completed Projects

Previous Problem ID	Project Name	Project Location	Year Documented	Year Completed
CC-4	19th Ave SW Culvert Modifications	19th Ave SE between 939 and 1001 addresses	2012	2022
CIP-LT-16	Puyallup Stormwater Comprehensive Plan Update	Citywide	2012	2024
CIP-LT-5	LID Retrofit @ Corporate Yards	Corporate Yards (39th Ave SE)	2012	2014
CIP-LT-6, CC-13	Meeker Creek Habitat/Floodplain Restoration	1002 14th ST. SW (Stephans Property)	1996, 2012	2016
CIP-ON-2	8th Ave LID Retrofit	8th Ave - 9th to 11th St NW	2012	2016
CIP-ST-1	15th St. NW Storm Drain Extension Phase 2	15th ST. NW - 4th Ave NW to W Pioneer	1996, 2012	2016
CIP-ST-3, PR-2, G-1	Puyallup River Outfall Backflow Prevention	Outfalls (2,7,10,12-17 19 and 20)	1996, 2012	2016
DF-3	39th Ave SW Flood Mitigation	300 Block of 39th Ave SW Flood Mitigation	2012	2007
E8	Wildwood Dr. Flooding	Wildwood Park Dr. near 31st Ave SE	2007	2018
LP5*	WPCP Flood Wall Mitigation	Left Bank - River Mile 6.8 to 6.9	2012*	2020
SD-CC-10	15th St. NW Storm Drain Extension Phase 1	15th St. NW - 4th Ave NW to W Stewart Ave	1996	2011?
SD-CC-10, SD-PR-4	15th St NW Storm Improvements	W Pioneer Ave to Puyallup River	1996	2000
SD-CC-13	5th St SW Stormwater Main Replacement	5th ST SW from Meeker Creek to 15th Ave SW	1996	?
SD-CC-17	15th Ave SE and 3rd St SE Detention	15th Ave SE and 3rd St SE	1996	2001
SD-CC-2	13th St SW Culvert Replacement	13th St SW and Meeker Creek	1996	1995
SD-CC-3	9th St SW Culvert Replacement	9th St SW and Meeker Creek	1996	1995
SD-PR-1	Pipeline and Outfall Replacement Near WWTP	Alignment of 20th St NW from River Rd to 13th Ave NW	1996	?
SD-SH-2	39th Ave SE Regional Stormwater Detention	Willows Pond	1996	2000
SD-SR-8	21st St SE Storm Main Replacement	21st St SE from 9th Ct SE to Pioneer Way	1996	?
None	WSU LID Frontage Improvements Phase 1	W Pioneer Ave from Fruitland Ave E to Clarks Creek Crossing	UNK	2019
None	Toscano's Storm Repair	5th Ave SE and 29th ST SE	UNK	2023
None	Coorperate Yards Decant Facility	1200 39TH AVE SE	UNK	2023
None	WSU LID Frontage Improvements Phase 4A	Pioneer Way E from Fruitland Ave E to Past WSU Campus Main Entrance	UNK	2020
None	WSU LID Frontage Improvements Phase 4B	Pioneer Way E from Past WSU Campus Main Entrance to Woodland Creek Crossing	UNK	2022
None	Upper Clarks Creek Stabilization	Clarks Creek from 23rd Ave SW and north 1400 LF	UNK	2018

Table B-3. Identified Problems and Projects

Problem ID	Previous Problem ID	Ranking Category	Solution Type	Basin	Overall Ranking (1= highest priority)	Problem Name	Problem Location	Year Documented	CIP ID	Cost	Cost Year (*=escalated from previous year estimate)	Problem Description	Solution/Project
CC-01	CC-3	Priority	Replacing Aging/Deficient Infrastructure	CC	10	23rd Ave SW Culvert	23rd Ave SW near 13th St SW	2012	Not Assigned	$10,650,000	2024	Upstream channel erosion and debris is problem. Debris constricts inlet capacity to culvert at upstream.	Construct detention/water quality facility.
CC-02	CIP-LT-12, CC-16, CC-9	Second Tier	Capacity	CC	9	Meeker Creek N. Stormwater Pump Station	10th Ave SW and 14th St SW PS	2012	15-017	$8,318,000	2024*	There is observed flooding north of Meeker Creek, along 9th Ave. SW. The problem is probably due to insufficient capacity at the pump station.	This project would replace the pump station with a facility having additional capacity. The pump station would continue to pump local stormwater drainage to Meeker Creek. The design flow for the pump station to meet LOS goals should be determined before the project commences.
CC-03	CC-6, CC-7, DF-6, DF-7	Second Tier	Maintenance/ Operation	CC	10	Silver Creek Bank Stabilization	19th Ave SW to 10th Ave SW	2012	Not Assigned	No Estimate	-	This project addresses a systematic issue identified in the Clarks Creek Basin—the transport and deposition of sediment.	The proposed Clarks Creek Basin Plan (CIP-LT-7) will address this basin-wide problem, and should include this project.
CC-04	-	Priority	NPDES	CC	10	Clarks Creek TMDL WQ IP	TBD	2024	Not Assigned	No Estimate	-		
CC-05	-	Second Tier	Planning	CC	16	9th St SW Roadway Improvements	9th ST SW from 15th Ave SW to 31st Ave SW		21-016	No Estimate	-	Project is a primary arterial that needs to be brought up to current standards.	3 lane-section with curb, gutter, and sidewalks (preliminary design).
CC-06		Second Tier	Planning	CC	19	WSU LID Frontage Improvements Phase 2	Fruitland from W Pioneer Ave to 9th Ave SW		22-006	$1,623,000	2024*	-	-
CC-07	CC-5	Second Tier	Replacing Aging/Deficient Infrastructure	CC	26	15th Ave SW Culvert	15th Ave SW near 7th St SW	2012	Not Assigned	No Estimate	-	There is debris and overflow pipes takes high flows to 9th St SW. Flooding concern due to overflow pipes. Standing water.	The location and condition of the private system should be ascertained and legal responsibilities of the City and property owners established so flooding problems can be addressed and solutions proposed
CC-08	CC-14	Second Tier	Replacing Aging/Deficient Infrastructure	CC	34	Clarks Creek Outfall Backflow Prevention	Clarks Creek	2012	Not Assigned	250000	2024*	Flooding on 11th Ave SW near Clarks Creek. City installs slotted grate on nearby sanitary manhole.	-
CC-09	DF-8	Second Tier	Maintenance/ Operation	CC	37	Clarks Creek Stream Bank Erosion	Clarks Creek - River Mile 2 to 4	2012	Not Assigned	No Estimate	-	This project addresses a systematic issue identified in the Clarks Creek Basin—the transport and deposition of sediment.	The proposed Clarks Creek Basin Plan (CIP-LT-7) will address this basin-wide problem, and should include this project.
CC-10	CC-9	Second Tier	Replacing Aging/Deficient Infrastructure	CC	45	9th Ave SW Storm Main	9th St SW from 9th St SW to 13th St SW	2012	Not Assigned	No Estimate	-	Storm pipe may be perforated. Could potentially be missing rivets.	-
CC-11		Low	Replacing Aging/Deficient Infrastructure	CC	Lower piority, not ranked.	7th Ave SW Roadway Settling	7th Ave SW from 18th St SW to 14th St SW		21-033	$,1786,000	2024*	Replace Aging/Deficient Infrastructure.	Replace aging 48-inch pipe, 36-inch sewer main, and 8-inch water main which will resolve sinking roadways over utilities. This project also corresponds with an overlay location and sidewalks will be constructed on the north side of the road.
CC-12	CIP-LT-3	Under Construction	Capacity	CC	Lower piority, not ranked.	11th St SW Culvert Replacement	11th St SW and Meeker Creek	2012	19-022	$852,493	2023 BID, 2011, 1996	-	-
CC-13	DF-2	Low	Capacity	CC	Lower piority, not ranked.	14th St SW Lateral Replacement Phase II	14th St SW - 15th Ave SE to 12th Ave SE	2012	Not Assigned	$414,000	1996	-	-
CC-14	SD-CC-7, SD-CC-15	Low	Floodplain	CC	Lower piority, not ranked.	Purchase of Properties within Clarks and Meeker Creek 100-YR Floodplain	Clarks Creek and Meeker Creek Floodplains	1996	Not Assigned	$4,335,000	1996	-	-
CC-15	SD-CC-11	Low	Capacity	CC	Lower piority, not ranked.	Meeker Creek Regional Detention Facility	Meeker Creek between 9th St SW and 11th St SW	1996	Not Assigned	$800,000	1996	-	-
CC-16	SD-CC-12	Low	Floodplain	CC	Lower piority, not ranked.	Elevation of Structures in Meeker Creek 100-YR Floodplain	Clarks Creek and Meeker Creek Floodplains	1996	PRIVATE	$72,000	1996	-	-
CC-17	SD-CC-13	Low	Capacity	CC	Lower piority, not ranked.	5th St SW Stormwater Main Replacement	5th St SW from Meeker Creek to 15th Ave SW	1996	Not Assigned	$1,040,000	1996	-	-
CC-18	KCM-1	Low	Capacity	CC	Lower piority, not ranked.	Silver Creek Culvert Replacement - 31st Ave SW	Silver Creek Crossing at 31st Ave SW	1996	Not Assigned	$7,000	1996	-	-
CC-19	KCM-5	Low	Capacity	CC	Lower piority, not ranked.	Woodland Creek Outfall and Pipe Replacement	Woodland Creek Outfall to Clarks Creek	1996	Not Assigned	$513,000	1996	-	-
CC-20		Low	Planning	CC	Lower piority, not ranked.	WSU LID Frontage Improvements Phase 3	W Pioneer and S Fruitland Intersection		14-023	$1,140,000	2020	-	-
CC-21		Low	Capacity	CC	Lower piority, not ranked.	9th Ave SW Fair Blvd	9th Ave SW from S Meridian to 5th St SW		14-040	$3,658,916	2022	-	-
CC-22		Low	Replacing Aging/Deficient Infrastructure	CC	Lower piority, not ranked.	WSU LID Frontage Improvements Phase 4C	Pioneer Way E from Woodland Creek Crossing to Western City Limits		Not Assigned	No Estimate	-	-	-

Table B-3. Identified Problems and Projects

Problem ID	Previous Problem ID	Ranking Category	Solution Type	Basin	Overall Ranking (1= highest priority)	Problem Name	Problem Location	Year Documented	CIP ID	Cost	Cost Year (*=escalated from previous year estimate)	Problem Description	Solution/Project
CC-23		Low	Replacing Aging/Deficient Infrastructure	CC	Lower piority, not ranked.	WSU LID Frontage Improvements Phase 5	9th Ave SW from Fruitland Ave E to Woodland Creek		Not Assigned	$2,143,825	2013	-	-
CC-24	SI-CC-5	Low	Replacing Aging/Deficient Infrastructure	CC	Lower piority, not ranked.	18th St SW Drainage Improvements	18th St SW from 7th Ave SW to 10th Ave SW	1996	Not Assigned	No Estimate	-	-	-
CC-25		Low	Replacing Aging/Deficient Infrastructure	CC	Lower piority, not ranked.	26th ST NW Drainage Improvements	26th St NW from 13th Ave NW to 16th Ave NW	New	Not Assigned	No Estimate	-		
DC-01		Priority	Replacing Aging/Deficient Infrastructure	DC	1	Deer Creek Realignment	Deer Creek from 12th Ave to Pioneer Ave SE		Not Assigned	$4,340,000	2024		
DC-02	SR-7, SR-8, SR-9	Priority	Capacity	DC	1	Deer Creek/Shaw Creek Emergency Culvert Replacements	Shaw Creek Crossings @ 27th St SE and Deer Creek Crossings @12th Ave SE	2012	19-013	$11,950,000	2024	1. Culvert immediately downstream of depression - sinkhole at culvert presumed link to utility excavation/tunneling. 2. Every storm event, water jumps culvert and flows north. Property owner is uncooperative and may have altered channel, decreasing capacity. 3. Flooding during moderate rainfall.	-
DC-03	CIP-ON-1	Priority	Replacing Aging/Deficient Infrastructure	DC	3	East Main Deer Creek Crossing	East Main @ Deer Creek Crossing	2012	14-060	$15,025,000	2024	-	48 inch overflow pipe added above and parallel to existing pipe crossing Main Ave East. A flap gate may also be added.
DC-04	CIP-LT-2	Priority	Replacing Aging/Deficient Infrastructure	DC	4	21st St. Deer Creek RR Crossing	Deer Creek Railroad Crossing near 21st St SE	2012	Not Assigned	$15,340,000	2024	The existing culvert underneath the railroad tracks has insufficient capacity for typical storm flows in Deer Creek. This culvert is also a barrier to fish passage due to a large, sudden drop in elevation. In addition, the City desires to replace a pump station conveying storm runoff to this culvert (from the south) with gravity conveyance.	The existing culvert underneath the Burlington Northern railway will be replaced with an appropriately sized fish passable culvert. The 21st St. SE storm drain (force main) will be replaced and extended beneath Pioneer Ave with gravity conveyance.
DC-05		Priority	Replacing Aging/Deficient Infrastructure	DC	5	Shaw Rd Improvements	Shaw Rd from 25th Ave Ct SE to Pioneer		16-027	$30,020,000	2024	Corridor Improvements	Preliminary Engineering Analysis based on alignment land configurations. Also will establish culvert replacement criteria, creek realignment alternatives, and potential phasing.
DC-06		Second Tier	Replacing Aging/Deficient Infrastructure		12	East Pioneer Drainage Improvements	E Pioneer from 25th St to Pioneer S Curves		Not Assigned	No Estimate	-	-	-
DC-07		Second Tier	Replacing Aging/Deficient Infrastructure		32	21st St SE Stormwater Pump Station Removal and Drainage Rerouting	E Pioneer Ave and 21st St SE		Not Assigned	No Estimate	-	-	-
DC-08	SR-1	Second Tier	Capacity	DC	48	Flooding @ 31st Ave SE and Cherokee Blvd	31st Ave SE and Cherokee Blvd	2012	Not Assigned	No Estimate	-	Flooding through house at 31st Ave and Cherokee Blvd SE due to high intensity summer storm. Storm delivered 1-inch of rain in 20 minutes.	-
DC-09	SI-SR-3	Low	Replacing Aging/Deficient Infrastructure	DC	Lower piority, not ranked.	Heritage Manor Detention Retrofit	Shaw Road and 26th Ave SE	1996	Not Assigned	No Estimate	-	Improperly functioning detention facility.	48 inch overflow pipe added above and parallel to existing pipe crossing Main Ave East. A flap gate may also be added.
DC-10	DF-4, SR-16	Low	Floodplain	DC	Lower piority, not ranked.	Shope and Deer Creek Levee	1618 E MAIN	2012	Not Assigned	$593,000	1996	-	-
DC-11	SI-SR-1	Low	Capacity	DC	Lower piority, not ranked.	BNRR Culvert Replacement near Inter Ave	BNRR and Inter Ave	1996	Not Assigned	No Estimate	-	-	-
DC-12	SI-SR-2	Low	Capacity	DC	Lower piority, not ranked.	BNRR Culvert Replacement near 17th St SE	BNRR and 17th St SE	1996	Not Assigned	No Estimate	-	-	-
DC-13	SD-SR-5	Low	Floodplain	DC	Lower piority, not ranked.	Purchase of Properties within Deer Creek 100-YR Floodplain	Deer Creek Floodplain	1996	Not Assigned	$6,548,000	1996	-	-
DC-14	SD-SR-6	Low	Floodplain	DC	Lower piority, not ranked.	Elevation of Structures in Deer Creek 100-YR Floodplain	Deer Creek Floodplain	1996	Not Assigned	$1,188,000	1996	-	-
NP-01		Second Tier	Replacing Aging/Deficient Infrastructure	NP	14	Wapato Creek Diversion Repair	Wapato Creek Diversion from Puyallup River to Kia Dealership		14-067	$97,150,000	2024*	Possible Aging Infrastructure	Wapato Diversion needs to be evaluated and retrofitted to accommodate SR 167 extension. WSDOT will incorporate retrofit into their project but who is responsible for funding retrofit will need to be determined

Table B-3. Identified Problems and Projects

Problem ID	Previous Problem ID	Ranking Category	Solution Type	Basin	Overall Ranking (1= highest priority)	Problem Name	Problem Location	Year Documented	CIP ID	Cost	Cost Year (*=escalated from previous year estimate)	Problem Description	Solution/Project
NP-02	CIP-LT-4, NP-3	Second Tier	Replacing Aging/Deficient Infrastructure	NP	50	Wapato Creek Culvert @ Todd Rd	Eastern Culvert @ Todd Road and Wapato Creek	2012	Not Assigned	$100,000	2011	Peak flows currently cause flooding due to existing restrictive culvert from weeds.	This plan will replace the 24" concrete culvert with a 58" by 36" corrugated metal arch pipe culvert.
NP-03	LP4	Low	Floodplain	NP	Lower piority, not ranked.	North Levee Rd Setback Levee	Right Bank - River Mile 2.8 to 8.15	2012*	Not Assigned	$104,000,000	2011 Regional Cost	-	-
PO-01	PW-2	Second Tier	Replacing Aging/Deficient Infrastructure	PO	30	39th Ave SW and 5th St SW Drainage (Drywell)	39th Ave SW and 5th St SW	2012	Not Assigned	No Estimate	-	Old perf/drywell system. Mall drainage missing mall storm system and city sees more flows as a result.	-
SH-01	CIP-LT-10	Second Tier	Replacing Aging/Deficient Infrastructure	SH	12	Bradley Lake Dam Safety and Outfall Improvements	Bradly Lake Park	2012	20-017	$178,000	2024*	-	-
SH-02	CIP-LT-9, SH-10	Second Tier	Replacing Aging/Deficient Infrastructure	SH	19	Wildwood Park Stormwater Diversion	Wildwood Park	2012	16-030	$171,000	2024*	Diversion pipe end-section is a vertical trash rack that has insufficient capacity and requires frequent maintenance. The low-flow inlet structure consists of a brick manhole that has become plugged with sediment deposited in the channel.	This project will install a 54-inch diameter conical trash rack on a manhole on the existing diversion outlet pipe. Replace the low flow outlet with a 48-inch-diameter riser 12 inches above channel bottom. Construct 12-inch-deep sediment trap (approx. 10 x 12 ft).
SH-03	E11	Second Tier	Capacity	SH	19	Storm Sewer Replacement - 12th Ave SE	12th Ave SE from 21st St SE to 13th St SE	2007	Not Assigned	$961,000	2024*	There is an increased flows from uncontrolled new development upstream, limited conveyance capacity, high groundwater.	The solution is to increase capacity of downstream conveyance to eliminate any flow restrictions.
SH-04	CIP-LT-15, SH-6	Second Tier	Replacing Aging/Deficient Infrastructure	SH	26	Puyallup Downs Wetland Outfall	Puyallup Downs Wetland - Olimpic Blvd and Parkwood Blvd	2012	16-021	$171,000	2024*	City maintenance staff indicates that flow backs up frequently at the outlet of the constructed wetland during storm events.	Remove the tee on the inlet pipe and replace with a 54-inch-diameter riser with a conical trash rack. Set the proposed conical trash rack rim elevation at the existing turned-up tee overflow elevation. Replace existing 18-inch-diameter pipe with 18-inch diameter pipe with beveled end and trash rack.
SH-05	DF-5, SH-16	Second Tier	Capacity	SH	26	12th Ave SE and 13th St SE Flooding	13th St SE and 12th Ave SE	2012	Not Assigned	No Estimate	-	Catch basin inlet capacity may be less than stormwater inflow and may produce excessive overland flow.	Install additional catch basin nearby and raise any road currently flooding.
SH-06		Second Tier	Maintenance/Operation		34	PW Facility Covered Storage for Outdoor Stockpiles	PW Maintenenace Facility	1996	14-049	$656,000	2024*		
SH-07	SH-12	Second Tier	Replacing Aging/Deficient Infrastructure	SH	37	21st St Roadside Ditch	21st St SE south of Vista Dr	2012	Not Assigned	No Estimate	-	Erosive flows in ditch result in debris deposition at base of hill.	1. Install compensatory storage 2. Install pipe with capacity to convey flows from development down the hill 3. Coordinate additional storage with stormwater management for anticipated development nearby
SH-08	SH-21	Second Tier	Maintenance/Operation	SH	49	17th St SE Pipe Rehabilitation	17th St SE just north of 9th Ave SE	2012	Not Assigned	No Estimate	-	Large storm water pipe with root growth.	City will continue ongoing maintenance because cost is less than cost of replacing storm pipe
SH-09	SH-8	Second Tier	Capacity	SH	50	23rd Ave SE Culvert	Wildwood Creek 23rd Ave Culvert Crossing	2012	Not Assigned	$38,000	2024*	Storm flows back up at 23rd Ave SE culvert. Bar screen at upstream end restricts flow.	1. Increase capacity at street crossing 2. improve inlet design (provide emergency overflow) 3. provide detention storage
SH-10		Low	Planning	SH		Joint City-State Storm Sewer Agreement and Flow Control Calibration Update	City-State Stormwater Trunkline		Not Assigned	No Estimate	-	-	-
SH-11	SH-1, SH-22	Low	Replacing Aging/Deficient Infrastructure	SH	51	Willows Pond System Improvements	37th Ave SE and 5th ST SE	2012	Not Assigned	$71,960	2006	1. Limited freeboard in Shell/Willows Pond system (potentially flooding upstream areas) 2. Erosive flows in 21st St SE roadside ditch results in debris deposition at base of hill.	-
SH-12		Low	Planning	SH	Lower piority, not ranked.	Feasibility/Cost Benefit Study for CIP-SH-E6 A & B (State Highway Basin Plan)	Bradly Lake/Puyallup Downs Wetland		Not Assigned	No Estimate	-	-	-
SH-13	SD-CC-5	Low	Capacity	SH	Lower piority, not ranked.	Detention Pond - 15th Ave SW	15th Ave SW and SR-512	1996	Not Assigned	436000	1996	This site received drainage from a rapidly redeveloping area and discharges into an already overwhelmed collection system	Improve existing detention pond
SH-14	SI-SH-2	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Heath DC Addition Pond Rehabilitation (Wildwood Elementary Pond)	24th Ave SE west of 15th St SE	1996	Not Assigned	No Estimate	-	There is no access to the pond which prevents maintenance of the pond or outlet. Culvert might also restrict flow.	1. Improve outlet structure so debris is less likely to restrict flow 2. obtain easement for maintenance of pond and debris removal 3. install culvert at wildwood park dr with a higher capacity
SH-15	-	Low	Maintenance/Operation		Lower piority, not ranked.	Public Works Maintenance Facility Containment and WQ for Loading/Unloading Areas	Public Works Maintenance Facility		Not Assigned	No Estimate	-	-	-

Table B-3. Identified Problems and Projects

Problem ID	Previous Problem ID	Ranking Category	Solution Type	Basin	Overall Ranking (1= highest priority)	Problem Name	Problem Location	Year Documented	CIP ID	Cost	Cost Year (*=escalated from previous year estimate)	Problem Description	Solution/Project
SH-16	-	Low	Maintenance/Operation		Lower piority, not ranked.	Public Works Maintenance Facility SPCC Plan Development and Implementation	Public Works Maintenance Facility		Not Assigned	No Estimate	-	-	-
SH-17		In Progress	Planning	SH	Lower piority, not ranked.	State Highway Basin Floodplain Study	State Highway Basin Floodplain			$44,087	2023	-	-
SH-18	CIP-LT-13, CC-1	Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	ROW Erosion - 30th Ave SW and 9th St SW	30th Ave SW and 9th St SW	2012	Not Assigned	$100,000	2011	-	-
SH-19	SH-4	Low	Capacity	SH	Lower piority, not ranked.	Bradly Lake Inlet Capacity	Bradly Lake Park	2012	Not Assigned	No Estimate	-	-	-
SH-20	E10	Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	Bradly Lake Swale	Swale Behind Lowe's	2007	PRIVATE	No Estimate	-	-	-
SH-21	SH-17	Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	48-Inch Trunk Line on 10th Ave SE	10th Ave SE East of State Trunk Line to 12th St SE	2012	Not Assigned	$971,000	1996	-	-
SH-22	SH-18	Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	Katmandu Sand Trap Retrofit	13th Ave SE and 7th St SE	2012	Not Assigned	No Estimate	-	-	-
SH-23	SH-20	Low	Maintenance/Operation	SH	Lower piority, not ranked.	23rd Ave SW Maintenance	23rd Ave SW and SR-512	2012	Not Assigned	No Estimate	-	-	-
SH-24	SI-CC-10	Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	3rd St SE Private Storm Failure	3rd St SE and 19th Ave SE	1996	Not Assigned	No Estimate	-	-	-
SH-25	SI-CC-12	Low	Capacity	SH	Lower piority, not ranked.	5th St SW Culvert	5th St SW and 23rd Ave SW	1996	Not Assigned	No Estimate	-	-	-
SH-26	SI-SR-5	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Monorwood Vault Maintenance Plan/Retrofit	Wildwood Park Drive and 26th Ave SE	1996	Not Assigned	No Estimate	-	-	-
SH-27	SI-SH-3	Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	Channel Erosion - 15th Ave SE to 13th Ave SE	Channel from 15th Ave SE Crossing to 13th Ave SE	1996	Not Assigned	No Estimate	-	-	-
SH-28	SD-SH-3	Low	Capacity	SH	Lower piority, not ranked.	Detention west of Wildwood Drive	Parkwood Plat west of Wildwood Dr.	1996	Not Assigned	$262,000	1996	-	-
SH-29	SD-SH-6	Low	Capacity	SH	Lower piority, not ranked.	Detention South of 12th Ave SE	South of 12th Ave SE between 11th St SE and 12th St SE (Labelle Property)	1996	Not Assigned	$228,000	1996	-	-
SH-30	SD-SH-7	Low	Capacity	SH	Lower piority, not ranked.	7th Ave SE Storm Main Replacement and Detention	7th Ave SE from SR512 to 11th ST SE	1996	Not Assigned	$339,000	1996	-	-
SH-31	SD-SH-8	Low	Floodplain	SH	Lower piority, not ranked.	Purchase of Properties within State Highway Basin 100-YR Floodplain	State Highway Basin Floodplain	1996	Not Assigned	$7,421,000	1996	-	-
SH-32	SD-SH-9	Low	Floodplain	SH	Lower piority, not ranked.	Elevation of Structure in State Highway 100-YR Floodplain	State Highway Basin Floodplain	1996	Not Assigned	$948,600	1996	-	-
SH-33		Low	Replacing Aging/Deficient Infrastructure	SH	Lower piority, not ranked.	23rd Ave SE Widening	23rd Ave SE from Meridian to 9th St SE		14-014	$67,895	2020	-	-
SH-34	-	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Public Works Maintenance Facility Brine and De-Icing Secondary Containment	Public Works Maintence Facility	2023	Not Assigned	No Estimate	-		
SH-35	-	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Public Works Maintenance Facility Pallets and Covers for Salvageable Materials(i.e. pipes, valve, signs, etc.)	Public Works Maintence Facility	2023	Not Assigned	No Estimate	-		
SH-36	-	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Public Works Maintenance Facility Fully Enclosed and Covered Dumpster Enclosure	Public Works Maintence Facility	2023	Not Assigned	No Estimate	-		

Table B-3. Identified Problems and Projects

Problem ID	Previous Problem ID	Ranking Category	Solution Type	Basin	Overall Ranking (1= highest priority)	Problem Name	Problem Location	Year Documented	CIP ID	Cost	Cost Year (*=escalated from previous year estimate)	Problem Description	Solution/Project
SH-37	-	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Cemetery Covered Storage for Outdoor Materials	Cemetery	2023	Not Assigned	No Estimate	-		
SH-38	-	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Cemetery Containment and WQ for Stockpiled Materials	Cemetery	2023	Not Assigned	No Estimate	-		
SH-39	-	Low	Maintenance/Operation	SH	Lower piority, not ranked.	Cemetery Fully Enclosed and Covered Dumpster Enclosure	Cemetery	2023	Not Assigned	No Estimate	-		
SP-01	CIP-ST-2, CC-17 to CC-24	In construction	Expanding Direct Discharge	SP	5	4th St NW Storm Upgrades for Downtown Revitalization - Phase N-1	4th St NW from River Rd to 3rd Ave NW	2012	14-026	$8,886,000	2023	-	-
SP-01	CIP-ST-2, CC-17 to CC-25	Priority	Expanding Direct Discharge	SP	5	4th St NW Storm Upgrades for Downtown Revitalization - Phase N-2, N-3, N-4 and N-5; 4th St (Skate Park) PS.	5th St SW from 4th Ave SW to 3rd Ave NW & 4th Ave SW from 5th St SW to 2rd St SE; 4th Ave SW from 2nd St SE to 5th St SE, 3rd St SE 412 LF North of 4th Ave SE & W Stewart St from 6th St SW to 2nd St NW	2012	23-008	$16,380,000	2024	Flooding occurs in numerous locations throughout tributaries during moderate and large storm events. Eight locations with roadway flooding in this area were documented in problem descriptions	Replacing existing stormwater conveyance with larger conveyance provides additional flow capacity
SP-02	SD-PR-5	Priority	Replacing Aging/Deficient Infrastructure	SP	7	Drainage Improvements on 10th-7th Ave NW	10th Ave NW from 18th St NW to 11th St NW - 9th, 8th, and 7th Ave NW from 15th St NW to 11th St NW	1996	Not Assigned	$2,495,000	2024	Solve flooding problems	Replace dry wells with 15 to 30 inch diameter storm sewer
SP-03	SD-PR-6	Second Tier	Capacity	SP	16	12th Ave NW Drainage Improvements	12th Ave NW from 15th St NW to 11th St NW	1996	Not Assigned	$948,000	2024*	Solve flooding problems	Replace existing 8 to 12 inch storm sewer with 18 to 24 inch storm sewer
SP-04	LP8	Second Tier	Maintenance/Operation	SP	16	Linden Golf Course Setback Levee	Left Bank - River Mile 9.6 to 10.5	2012*	Not Assigned	$9,058,000	2024*	Flood control facilities have eliminated much of the side channel habitat and flood plain connectivity	Construct a 100-year plus 3 feet of freeboard setback levee approximately 3,700 feet long
SP-05	LP7	Second Tier	Floodplain	SP	19	Flashcube Building/Puyallup Executive Park Flood Wall	Left Bank - River Mile 9.1 to 9.25	2012*	Not Assigned	$273,000	2024*	There is a low point in the revetment which allows floodwaters to overtop causing the flooding of a commercial office building and mobile home park.	Construct flood wall and establish evacuation plan
SP-06		Second Tier	Replacing Aging/Deficient Infrastructure	SP	23	5th Ave NW Improvements	5th Ave NW from 4th St NW to 7th St NW		17-021	$3,273,000	2024*	Road needs to be reconstructed and utility is aging.	Full-width street reconstruction and reconstruction of 6th St NW south of 5th Ave NW. Project will also add traffic calming techniques. Project will also allow opportunity to replace 70 year old 6" vitrified clay sewer pipe and water line on 6th St NW.
SP-07	SD-PR-8	Second Tier	Capacity	SP	23	9th Ave NE Main Replacement	9th Ave NE from the Puyallup River to 2nd St NE	1996	Not Assigned	$1,477,000	2024*	Much of existing storm drain will be replaced with larger pipe to solve problems with frequent flooding.	Replace existing 12 to 24 inch storm sewer with 15 to 30 inch storm sewer
SP-08	CIP-ST-5, PR-3	Second Tier	Capacity	SP	26	Flooding @ 13th Ave NW and 20th St NW	20th St NW - 13th Ave NW to 10th Ave NW	2012	Not Assigned	$85,000	2024*	Local Flooding	Incremental implementation of passive to larger capital projects of pipe replacement
SP-09	LP6	Second Tier	Maintenance/Operation	SP	32	Tiffany's Skate Inn/Riverwalk Flood Wall	Left Bank - River Mile 8.1 to 8.6	2012*	Not Assigned	$7,691,000	2024*	During larger flood events the Tiffany revetment overtops results in flooding and prohibits travel at North Levee Road underpass.	Construct flood wall and close road at underpass during flood events
SP-10		Second Tier	Replacing Aging/Deficient Infrastructure	SP	34	8th Ave NW Road Reconstruction and Sidewalks	8th Ave NW from 9th St NW to 8th ST NW		17-019	$120,000	2024*	Aging/Deficient RW.	Replace and full section rebuild adding curb gutter and sidewalk
SP-11	-	Second Tier	Maintenance/Operation	SP	34	Parks Maintenance Facility Covered Storage for Outdoor Stockpiles	Parks Maintenance Facility	2023	Not Assigned	$132,000	2024*	-	-
SP-12	-	Second Tier	Maintenance/Operation	SP	37	WWTP Covered and Contained Fueling Station	WWTP	2023	Not Assigned	No Estimate	-		
SP-13	-	Second Tier	Maintenance/Operation	SP	37	WWTP Containment and WQ for Loading/Unloading Areas	WWTP	2023	Not Assigned	No Estimate	-		
SP-14	-	Second Tier	Maintenance/Operation	SP	37	WWTP SPCC Plan Development and Implementation	WWTP	2023	Not Assigned	No Estimate	-		
SP-15	SD-PR-7	Second Tier	Capacity	SP	45	N Meridian Drainage Improvements	N Meridian from River Rd to King Family Mini Golf Entrance	1996	Not Assigned	$198,000	1996	Inadequate conveyance capacity of portions of storm drain system.	Replace existing 12 to 15 inch storm sewer with 15 to 18 inch storm sewer

Table B-3. Identified Problems and Projects

Problem ID	Previous Problem ID	Ranking Category	Solution Type	Basin	Overall Ranking (1= highest priority)	Problem Name	Problem Location	Year Documented	CIP ID	Cost	Cost Year (*=escalated from previous year estimate)	Problem Description	Solution/Project
SP-16	SD-PR-2	Low	Capacity	SP	Lower piority, not ranked.	Detention Pond - 18th St NW	1404 18th St NW	1996	Not Assigned	$481,000	1996	-	-
SP-17		Low	Replacing Aging/Deficient Infrastructure	SP	Lower piority, not ranked.	10th St SE Reconstruction and Utility Replacement	10th St SE from E Main 250 Feet South		21-008	$777,040	2023	-	-
SP-18	-	Low	Maintenance/Operation	SP	Lower piority, not ranked.	Parks Maintenance Facility Pallets and Covers for Extra Building Materials and Equipment	Parks Maintence Facility	2023	Not Assigned	No Estimate	-	-	-
SP-19	-	Low	Maintenance/Operation	SP	Lower piority, not ranked.	Parks Maintenance Facility Fully Enclosed and Covered Dumpster Enclosure	Parks Maintence Facility	2023	Not Assigned	No Estimate	-	-	-
SP-20	-	Low	Maintenance/Operation	SP	Lower piority, not ranked.	WWTP Fully Enclosed and Covered Dumpster/Hopper Enclosure	WWTP	2023	Not Assigned	No Estimate	-	-	-
SP-21	-	Low	Maintenance/Operation	SP	Lower piority, not ranked.	WWTP Pallets and Covers for Extra Materials and Equipment	WWTP	2023	Not Assigned	No Estimate	-	-	-
SP-22	-	Low	Replacing Aging/Deficient Infrastructure	SP	Lower piority, not ranked.	18th St NW Drainage Improvements	18th St NW from 12th Ave Ct NW to W Stewart Ave	New	Not Assigned	No Estimate	-	-	-
SP-23	-	Low	Replacing Aging/Deficient Infrastructure	SP	Lower piority, not ranked.	12th St SW Stormwater Improvements	12th St SW from W Main Ave to 4th Ave SW	New	Not Assigned	No Estimate	-	-	-
SP-24	-	Low	Replacing Aging/Deficient Infrastructure	SP	Lower piority, not ranked.	Research Infrastructure Near River Road at 20th St NW Outfall	Puyallup River and 20th St NW Outfall	New	Not Assigned	No Estimate	-	-	-
SP-25	-	Low	Replacing Aging/Deficient Infrastructure	SP	Lower piority, not ranked.	9th Ave NW and 8th St NW Drainage Reroute	9th Ave NW, 8th St NW and 8th Ave NW	New	Not Assigned	No Estimate	-	-	-

Table B-4. Prioritization Matrix

Criteria	Criteria Evaluation Question	Project Ranking for Evaluation Question			Weighting Factor	Maximum Score
		1	2	3		
Project Scale/Scope	How big is the project?	Small project (single location fix or short duration project, study focused on a small area or singular issue).	Medium Project (fixing multiple problems/work in more than one location or medium duration project, medium scoped studies).	Large Project (fixing many projects/work in a large area, long duration work, or holistic study of a basin/city wide work).	5	15
Project Location	How centrally located is the project? How many people or properties does it benefit?	Site located outside major road or populated area, less than 3 properties (homes or businesses) benefit from the project.	Site located within a moderately trafficked or populated area- 3-5 properties benefit from the project.	Site is centrally located within a densely trafficked/populated area (Subdivision or downtown), >5 properties benefit from the project.	5	15
System Impact	Will the project improve or maintain capacity of the system and to what degree?	No system capacity improvements.	Minor, localized improvements to system capacity.	Improvements increase system capacity basin wide or for a large area.	15	45
Regulatory Impact	Does this address a regulatory (state, federal, local) requirement or permit requirement?	No, project is unrelated to a regulatory requirement.	Project is tangentially related to a regulatory requirement.	Project goal is to address a regulatory requirement.	10	30
Hazard Reduction	Is the project addressing a situation that may result in loss of life, injury or property damage?	No known public safety hazard or risk to property damage is associated with the project.	Minor or infrequent hazard or risk of property damage will be mitigated by the project.	Imminent or severe risk of public health hazard or property damage if project is not completed.	15	45
Habitat Impact	Does the project provide improvement to habitat or fish passage?	No improvement to fish passage or habitat.	Project is tangentially related to fish passage improvements or habitat.	Project goal is fish passage improvements or habitat improvements.	10	30
Long Term Impacts (more work)	Will the project create positive opportunities for follow on work (i.e. studies identifying more projects, allow for grant funding)?	No additional work or new projects are anticipated following on this project.	Completion of the project will allow the City to pursue completion of additional projects that are not eligible for grant funding.	Completion of the project will allow the City to pursue additional projects that will include alternative funding opportunities such as grants.	10	30
Maintenance Impact	How will the project impact City resources in the long term (maintenance specifically)?	More maintenance.	No change in maintenance level.	Reduces or removes a known on-going maintenance issue.	10	30
Stakeholder Engagement	Does the project have support from Council/Community? Is it in line with City-wide goals/policies?	Stakeholders are opposed to the proposed project or do not feel it furthers Citywide goals.	Stakeholder opinions are neutral or unknown.	Stakeholders are known to be in support of the project. The project is inline with larger Citywide priorities.	5	15
Project Sequencing	Is there work that has been done previously on this project (i.e. grant funded design), or does it have a partnering opportunity (i.e. road paving/widening project)?	No previous work completed. No partnering opportunities are available.	Previous work has been completed. Partnering opportunity is in planning stages.	Previous work has been completed and opportunity for funding or continuation may become obsolete. Partnering opportunity is scheduled for construction or design completion.	5	15
Funding Opportunity	Is external funding or partnerships available for this project?	Likelihood of securing funding is low.	Likelihood of securing funding is moderate.	Likelihood of securing funding is high.	15	45
					Total Maximum Score:	315

Appendix C: Hydrologic and Hydraulic Modeling Technical Memorandum

Appendix D: Program Technical Memorandums

Osborn Consulting
1800 112th Avenue NE, Suite 220E
Bellevue, Washington 98004
425.451.4009

TECHNICAL MEMORANDUM

Date: May 23, 2024

Project: City of Puyallup 2024 Stormwater Comprehensive Plan
To: Kelton Parker, PE | City of Puyallup
From: Ann Bryant, PE | Osborn Consulting
Subject: Stormwater Infrastructure Repair and Replacement Program TM

TABLE OF CONTENTS

BACKGROUND

The City of Puyallup's (City) Stormwater Management team is responsible for managing and maintaining the City's stormwater infrastructure. To ensure that the stormwater system functions properly, the City is developing a program to assess the condition of stormwater pipes and prioritize repair, replacement, and maintenance projects. This Stormwater Infrastructure Repair and Replacement (R/R) Program (Program) will enable the City's stormwater team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, and replacing assets. The Program will include closed-circuit television (CCTV) inspections of stormwater pipes in the City of Puyallup, as well as the determination of likelihood of failure (LoF) and consequence of failure (CoF) for each asset inspected. The Program will also provide maintenance, rehabilitation, and replacement recommendations to improve the effectiveness of the City's stormwater management program. This initiative will ultimately benefit the City's residents and protect the local waterways from pollution and flooding. This memorandum documents the near-term and ongoing framework for the Program, which was developed during a series of workshops with City staff.

SECTION 1 EXISTING ASSET INVENTORY

To prioritize the pipe sizes and types for inspection under the Program, data from existing inspections were reviewed and an existing asset inventory was created using the City's available Geographic Information System (GIS) data. The City's stormwater pipe geodatabase (*Pipes.gdb*) was obtained from the City on August 25, 2023, and was used to develop an existing asset inventory. Pipe attributes contained within the database, including total number and length, diameter, age, material, ownership, status, type, and function, were analyzed to prioritize assets for inspection.

1.1 Existing Inspection Data

The City provided existing CCTV inspection data for 72 stormwater pipes. The data included both videos and pdf reports for 9 stormwater pipes and videos (without supporting pdf reports) for the remaining 63 stormwater pipes. These pipes were inspected between 2018 and 2022 and were primarily inspected as part of a previous project or in areas of concern. Because there were so few existing inspections and there are no reports with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) ratings for most of these inspections, these assets will be re-inspected as part of the City's Program.

1.2 Assets Prioritized for Inspection

Based on an analysis of the City's GIS data and discussion with the City, the pipes prioritized for inspection include those with the following attributes:

- **Ownership:** Public, Blank (*no attribute listed*), Unknown, and Null
- **Type:** Pipe, Blank, Unknown, and Null

- **Diameter:** Eight (8) inches and larger, Blank, Unknown, Null, and Zero (0)
- **Install Year:** All
- **Material:** All
- **Length:** All

The analysis resulted in 9,125 pipes to be prioritized, with a total length of 150 miles, for the inspection and condition assessment under the City Program, as detailed in **Table 1**.

Table 1. Assets Prioritized for Inspection

Number of Pipes	Length of Pipes (miles)
9,125	150

At this time, pipes with the following attributes will not be prioritized for inspection under the Program:

- **Ownership:** Private and Commercial
- **Type:** Detention and Infiltration
- **Diameter:** Less than eight (8) inches

1.3 Frequency of Inspection

The City plans to begin by inspecting two miles of pipe in 2024 and an additional two miles of pipe in 2025. Starting in 2026, the City plans to inspect five miles per year through 2030, ramping up to a goal of ten miles per year in 2031 and beyond. Consistently inspecting ten miles of pipe per year will equate to approximately a 15-year inspection cycle. That is, if the City inspects ten miles of pipe every year for 15 years, then all 150 miles of pipe currently prioritized for inspections under this program would be inspected within 15 years. This also means that if the City instead decides to inspect five miles of pipe every year, inspecting all 150 miles of pipe that are currently prioritized for inspections under this program would take 30 years. The number of pipes inspected per year or the time to inspect all pipes will increase as the City's stormwater pipe network expands and new pipes are installed.

Table 2 provides an illustration of a potential concept for the City's near-term and ongoing inspection goals. After the initial inspection is complete for each pipe that is prioritized for inspection, the City can then refine the inspection frequency based on its future needs and evidence from previous inspections.

Table 2. City Near-Term and Ongoing Inspection Goals

Year	Inspection Cycle (years)	Number of Pipes per Year	Miles per Year
2024	75	122	2
2025	75	122	2
2026-2030	30	305	5
2031 and Beyond	15	609	10

1.4 Order of Inspection

Inspections will be prioritized by drainage basin to efficiently clean, inspect, and catalog existing assets and to align with current and future basin planning efforts. Basins will be prioritized based on the City's 2023 Stormwater Management Action Plan (SMAP). This plan identifies the Deer Creek Basin (formerly known as Shaw Road Basin) as the City's high priority basin, followed by the Clarks Creek Basin. Due to iron bacteria fouling up a treatment unit and TMDL regulations in the Clarks Creek Basin, the City plans to start with two miles of work in the Clarks Creek Basin in the first year before starting work in the Deer Creek Basin. The Deer Creek Basin contains a total of 1,340 pipes (totaling 23 miles) to be inspected. The Clarks Creek Basin contains 2,564 pipes (totaling 40 miles) to be inspected. Inspections within these basins may be prioritized based on pipe size, age, material, and unknown or blank data. **Table 3.** Pipes Prioritized for Inspection by Basin provides the distribution of pipes prioritized for inspected by basin. An annotated map of the City's drainage basins is shown in **Figure 1**.

Table 3. Pipes Prioritized for Inspection by Basin

Drainage Basin	Number of Pipes	Length of Pipes (miles)
Clarks Creek	2564	40
Deer Creek (Shaw Road)	1340	23
North Puyallup	250	5
Potholes	948	17
SE Puyallup	107	3
South Puyallup	2184	32
State Highway	1645	27
Wapato Creek	87	3
Total	**9125**	**150**

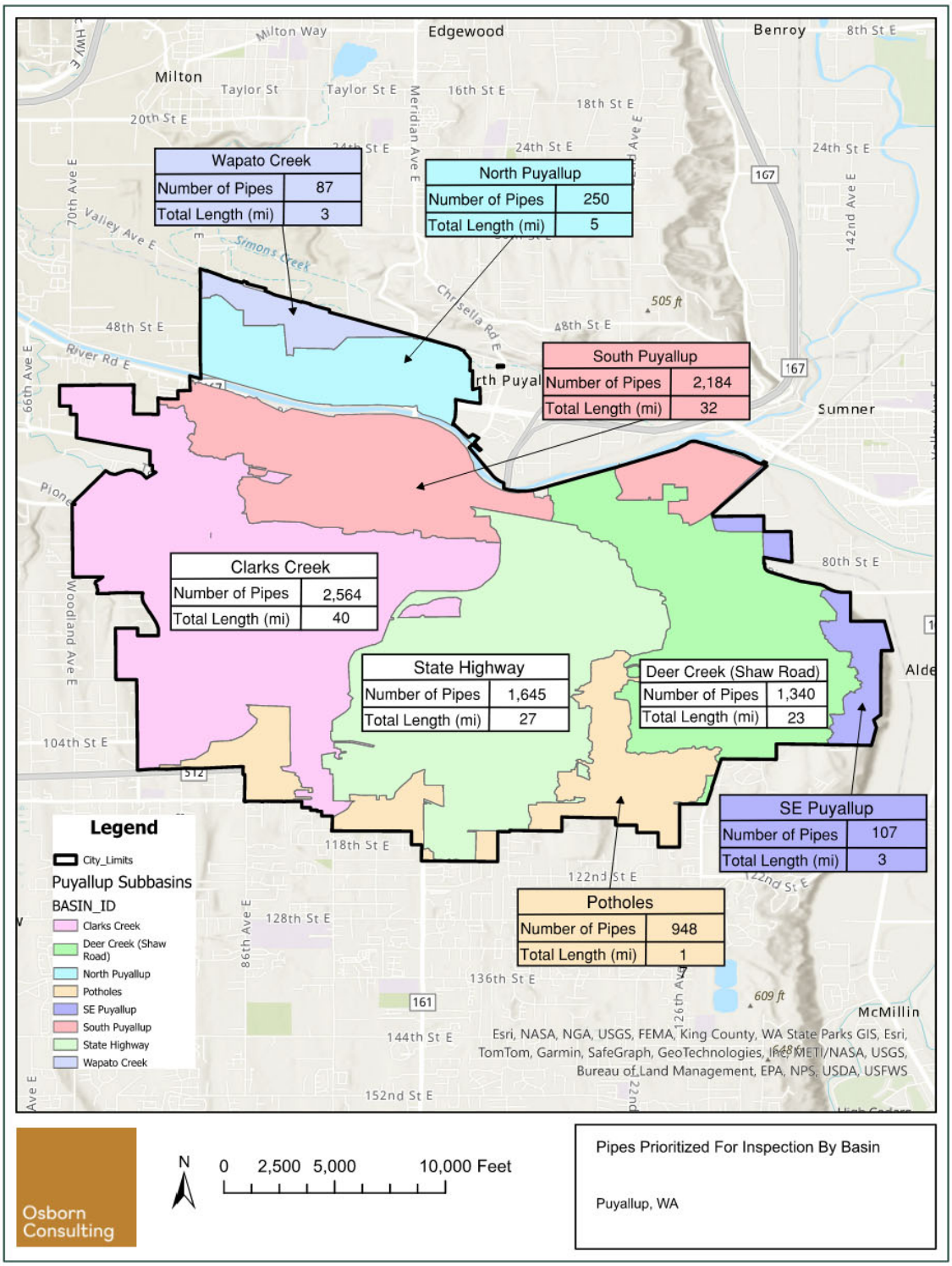


Figure 1. Pipes Prioritized for Inspection by Basin

SECTION 2 CRITICALITY AND RISK FOR STORMWATER PIPES

Risk in the context of this pipe risk management strategy includes two components:

- Likelihood of Failure (LoF)
- Consequence of Failure (CoF)

The LoF represents the condition of the pipe and how likely it is that the pipe might fail due to defects or condition. The CoF represents the impacts to people and property if a pipe fails. Together, these two factors can be used to direct resources based on a relative comparison of overall risk.

2.1 Likelihood of Failure (LoF)

Pipe LoF information will be obtained from condition assessment data collected during CCTV inspections using the standardized NASSCO PACP protocol.

Typical pipe defects observed in stormwater pipes include structural defects such as collapses, deformations, breaks, fractures, cracks, joint offsets at the point where two pipes come together, holes, sags, and crossbores from other pipes or utilities. Maintenance defects include excessive debris that impedes the flow of water, roots, intruding laterals, or blockages that need to be cleared. Both the number of defects and severity of the defects are used in the NASSCO PACP protocol to develop numerical condition grades.

Through inspection, numerical condition grades are assigned for both structural and maintenance defects ranging from 1 (minor) to 5 (most significant). Pipe ratings are based on the number of occurrences for each condition grade within individual pipes and are separately calculated for structural defects and Operational and Maintenance (O&M) defects.

Quick structural ratings (QSR) and quick maintenance ratings (QMR) use the NASSCO PACP numerical condition grades to provide an indication of the severity and number of defects within a pipe. This yields a more comprehensive representation of pipe condition than what a singular value would provide. QSR and QMR values consist of a 4-digit score that is compiled as follows:

- First digit (XXXX) represents the highest severity defect grade occurring along the pipe length.
- Second digit (XXXX) represents the number defects with the highest severity grade.
- Third digit (XXXX) represents the second highest severity defect grade occurring along the pipe length.
- Last digit (XXXX) represents the number of defects with the second highest severity grade.

For example, a pipe with a QSR of 5231 would indicate that there are two instances of defects that have a grade of 5 (most significant), no instances of a defect with a grade of 4 (significant), and one instance of a defect with a grade of 3 (moderate).

The first digit of the pipe's quick rating will be used to assign each pipe a default structural LoF score and a defect maintenance LoF score ranging from 1 to 5 unless the quality assurance and quality control (QA/QC) process indicates a need for revision. During the condition assessment and QA/QC review, the reviewer will have the opportunity to upgrade or downgrade the LoF score as appropriate based on observed defects to ensure that all actionable defects are dealt with in a timely manner (for example, a small hole compared to a large hole). These LoF scores will be used in the Risk Matrix.

The default LoF scores for QSR/QMR ranges are provided for reference in **Table 4**.

Table 4. Default LoF Scores for QSR/QMR Ranges

Default LoF Score	QSR/QMR
5	≥5100
4	≥4100
3	≥3100
2	≥2100
1	≥0000

2.2 Consequence of Failure (CoF)

The CoF will be different depending on where the pipe is located relative to the constructed features in the landscape, such as critical facilities (for example, fire stations and schools), road networks, the diameter of the pipe, and its location relative to sensitive areas such as landslide and erosion hazard areas.

An analysis of pipe CoF was conducted in GIS using the following features described in **Table 5** as indicators of potential consequences to people or property.

Table 5. Consequence of Failure Data

Category	Feature	GIS Data Source	Date Received
Size	Pipe Diameter	*Pipes.gdb -STRM_Pipes*	08/25/2023
Transportation	Arterials	*Roadway_Classifications.gdb*	08/25/2023
	Lahar Evacuation Routes	*Lahar Evac Routes.gdb*	8/25/2023
	Snow Routes	*Snow_Truck_Routes.shp*	8/25/2023
Surface Condition	Public Right-Of-Way	*Right_of_Way_and_Deeds.gdb*	08/25/2023
	Railroads		

Category	Feature	GIS Data Source	Date Received
Miscellaneous	Streams*	*Puyallup_Streams.gdb*	08/25/2023
	Critical Areas - Wetlands	*Wetlands.gdb*	08/25/2023
	Critical Areas - Landslide Hazard Areas	*DNR_Landslide_Hazard_Analysis_2017.gdb*	08/25/2023
	Critical Areas - Floodplains	*Puyallup_Regulated_Floodplain_2017.gdb*	08/25/2023
	Critical Infrastructure – Fire Stations	*Fire_Stations.gdb*	08/25/2023
	Critical Infrastructure - Healthcare	*Public_Health_Care_Facilities.gdb*	08/25/2023
	Critical Infrastructure – Warming and Cooling Shelters	*Puyallup_Tax_Parcels.shp*	08/25/2023
	Critical Infrastructure - Schools	*Puyallup_Schools.gdb*	08/25/2023
	Critical Infrastructure – Transit Hubs	*Puyallup_Tax_Parcels.shp*	08/25/2023

*The stream feature is intended to capture pipes conveying streamflow. As of the writing of the report, available GIS data do not accurately capture all pipes conveying stream flow. The City plans to update GIS data prior to calculating CoF scores to accurately capture all pipes conveying stream flow.

Using the criteria described in **Table 6**, numeric values were assigned to each feature and weighted according to presumed importance. Cumulative scores were then calculated for each pipe, with a minimum CoF score of 1 and a maximum CoF score of 5.

Table 6. Consequence of Failure Criteria and Scoring

Category	Feature	Criteria	Maximum Score
Size	Pipe Diameter	Diameter > 12 inches = 1 point	1
Transportation	Arterials	Pipe intersects with either major or minor arterial 30-foot buffer = 2 points	2
	Snow Routes	Pipe intersects with either principal or secondary snow truck routes 30-foot buffer = 2 points	
	Lahar Evacuation Routes	Pipe intersects with lahar route 30-foot buffer = 2 points	
Surface Conditions	Public Right-Of-Way	Pipe intersects with public right-of-way (no buffer) = 1 point	1
	Railroads	Pipe intersects with railroad with 5-foot buffer = 1 point	
Miscellaneous	Streams*	Pipe intersects with stream (no buffer) = 1 point	**1**
	Wetlands	Pipe intersects with critical area 5-foot buffer = 1 point	
	Landslide Hazard Areas		
	Floodplains		

Category	Feature	Criteria	Maximum Score
Miscellaneous	Critical Infrastructure –Fire Stations	Pipe intersects with critical infrastructure 20-foot buffer = 1 point	
	Critical Infrastructure – Healthcare		
	Critical Infrastructure – Warming/Cooling Shelter		
	Critical Infrastructure – Schools		
	Critical Infrastructure – Transit Hubs		

*The stream feature is intended to capture pipes conveying streamflow. As of the writing of the report, available GIS data do not accurately capture all pipes conveying stream flow. The City plans to update GIS data prior to calculating CoF scores to accurately capture all pipes conveying stream flow.

For example, an 18-inch pipe crossing an arterial that is next to a school would receive one point for the diameter being greater than 12-inches, two points for being within the 30-foot buffer of an arterial, one point for being within five feet of the edge of pavement, and one point for being adjacent to a school for a total CoF Score of 5.

2.3 Risk Matrix

As described above, pipe risk in this context is determined using a pipe's LoF classification combined with the consequence of failure analysis results. By using both the LoF and the CoF information, the pipes can be ranked.

The matrix below identifies a strategy to rank the pipes based on pipe condition relative to all other pipes in the system. A matrix has the benefit of incorporating the rating of both LoF and CoF and is better suited at identifying the "first priority" pipes for more immediate action. **Figure 2** shows the risk matrix for the City pipes.

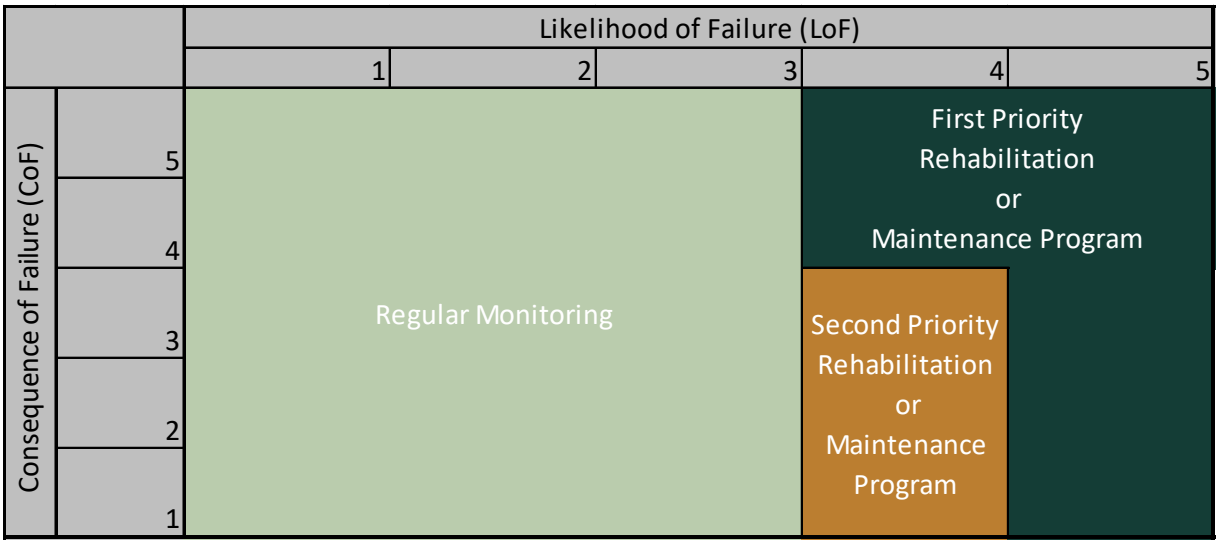


Figure 2. Risk Matrix

SECTION 3 CONDITION ASSESSMENT

The condition assessment process for the City's Program involves collecting and processing CCTV inspection data, performing condition assessments, and determining repair, replacement, and maintenance recommendations.

3.1 Pipe Inspection Protocol

The City's stormwater pipe inspections will be performed using CCTV (closed circuit television) technology and standardized NASSCO PACP pipe condition grading. The overall goal of the pipe inspection process is to obtain quality inspection data to understand the condition of stormwater pipes to support the City's near-term and ongoing planning and allocation of resources for pipe maintenance, repair, and replacement.

3.1.1 Inspection Roles and Responsibilities

The implementation of the pipe inspection protocol will include both City and vendor roles that may change over time. For the near term, the City plans to have a vendor perform the inspection work (pipe inspector, vactor operator, sediment disposal, and traffic control), with City staff in management, data reviewer, and operations support roles. Eventually, the City plans to purchase a second CCTV truck that would be dedicated to the stormwater system and hire additional staff to operate it. The following roles and job responsibilities are recommended to implement the pipe inspection program:

- **Inspection Project Manager (PM):** The Inspection PM will oversee the pipe inspections and ensure progression towards established near-term and ongoing inspection completion targets. The PM will review weekly reports, resolve outstanding issues that arise, assure coordination between departments and vendors, and recommend adaptations to address unexpected situations.
- **Data Reviewer:** The Data Reviewer will be responsible for various inspection data management tasks, including conducting QA/QC reviews on the pipe inspection data and ensuring data is acceptable and complete before being allowed to progress to the condition assessment process.

- **Asset Manager:** The Asset Manager will conduct updates to GIS applications based on data collected during the inspection process, and resolve mapping issues, including managing GIS data for newly discovered assets. GIS will receive weekly updates from Pipe Inspectors when field edits are found.
- **Pipe Inspector:** All pipe inspectors must be NASSCO PACP-certified. They will be responsible for collecting pipe inspection data with CCTV equipment and identifying and coding defects according to the NASSCO PACP protocol. They will be responsible for delivering high-quality pipe image files, and a NASSCO PACP-certified database documenting the pipe inspection data. Additionally, they will be responsible for notifying the PM in the event of an emergency and when new assets are located in the field. Pipe inspectors will submit weekly reports documenting pipe inspection program progress, with data reports and video and photograph files for individual pipes inspected during the previous week.
- **Vactor Operator:** The Vactor Operator will clean pipes as requested by the PM.
- **Sediment Disposal:** Sediment Disposal, specifically the disposal of liquids and soils that were generated during the piper cleaning operations, will be taken care of by the Vactor Operators.
- **Traffic Control:** Traffic Control may be necessary in some areas of the City or for nighttime work. Traffic control will be subject to City review and approval and comply with all local and state laws to ensure a safe workspace for the Pipe Inspectors and Operations Support.
- **Miscellaneous Operations Support:** Miscellaneous Operations Support may be required to assist Pipe Inspectors with field operations issues that arise at any time during the inspection process, such as clearing obstructed maintenance or access holes, and installing “no park” signs.

3.1.2 Inspection Data, Reports, Tracking, and Storage

The pipe inspection condition data collected by the Pipe Inspectors and accessory reports will be delivered to the Inspection PM at different times and in different formats. The organization, visualization, tracking, and storage of inspection data will be supported by software tools such as ArcGIS and GraniteNET.

- **Inspection Data:** Unless there is an urgent situation, all reports and data will be submitted to the PM on a weekly basis. The Pipe Inspector will collect the following data and reports:
  - **NASSCO PACP Compliant Inspection Database:** The GraniteNET database file that includes asset attributes and pipe condition data, including the number and type of defects.
  - **Videos:** CCTV camera video of inspection in .mp4 format. Videos will have the following standard naming convention where D1-XXXX is the GIS asset ID:
    - D1-XXXX_YYYYMMDD.mp4 (inspection video – full inspection)
      - D1-XXXX_YYYYMMDD_US.mp4 (inspection video – partial inspection in upstream direction)
      - D1-XXXX_YYYMMDD_DS.mp4 (inspection video – partial inspection in downstream direction)
    - At a minimum, the video shall include the following information:
      - Date and Time
      - Street Name or Location
      - Upstream and Downstream Structure ID
      - Pipe Size

- Pipe Length
- Pipe Material Type

– **Photographs:** Digital photographs of any defects in .jpg format. The photographs will have the following standard naming convention where D1-XXXX is the GIS asset ID:

♦ D1-XXXX_YYYYMMDD_##.jpg (photo)

– **Inspection Report:** The NASSCO PACP compliant report that is generated by the Pipe Inspector's inspection software for each asset. This report summarizes the observed asset attributes and inspection in .pdf format. The naming convention for these reports is as follows, where D1-XXXX is the GIS asset ID:

♦ D1-XXXX_YYYYMMDD.pdf (inspection report – full inspection)

- D1-XXXX_YYYYMMDD_US.pdf (inspection report – partial inspection in upstream direction)
- D1-XXXX_YYYMMDD_DS.pdf (inspection report – partial inspection in downstream direction)

♦ At a minimum, the inspection report should include the following information:

- Asset ID
- Upstream structure ID
- Downstream structure ID
- Location of inspection (nearest address)
- Pre-cleaning status
- Weather during inspection
- Pipe size
- Pipe shape
- Pipe material
- Pipe type (for example, storm or sanitary pipe)
- Drainage basin
- Inspection date and time
- Inspector's name
- Inspector's NASSCO PACP certificate number
- System owner (the City of Puyallup)
- Direction of inspection (upstream, downstream)
- Length of inspection
- Observed defect codes, descriptions, locations, and grades
- Pipe ratings
- Photos of significant defects

  - **Weekly Summary Report:** The Pipe Inspector's weekly report to the PM that is provided in the Microsoft Excel file format. This report describes the work accomplished over the previous week and notes any circumstances that require the City's action. The following items will be documented in the Weekly Summary Report:
    - Total length of pipe inspected
    - Asset IDs for complete pipe inspections
    - Pipe material, size, and ratings for complete pipe inspections
    - Urgent situations encountered
    - GIS discrepancies, including new assets discovered in the field
    - Any other problems encountered in the field
  - **Urgent Situations:** Immediate phone call to PM.

- **ArcGIS:** The City's stormwater pipe inventory is currently housed in an ArcGIS geodatabase. This ArcGIS data will be the source data for identifying pipes to assess, their locations, and their assumed characteristics, including pipe diameter, material, length, and upstream and downstream structures and types.
- **Inspection Software:** CCTV inspection software will be used by Pipe Inspectors that is compatible with GraniteNET and can be uploaded seamlessly into the City's current version of GraniteNET software.
- **GraniteNET:** The Inspection PM will be tracking the status and actions associated with a pipe inspection such as cleaning and providing access in GraniteNET. The pipe inspection data will be transmitted from the field using a thumb drive or equivalent hardware to the PM for upload into the City's current version of GraniteNET. The GraniteNET NASSCO-certified module will be used for importing NASSCO PACP-certified databases provided by the Pipe Inspector.
- **Excel:** Microsoft Excel will be used for weekly reporting by vendors and may also be used for follow-up work prioritization and scheduling.
- **Cartegraph:** Cartegraph is the City's current asset management software and will be used to track and store the final inspection data.

3.1.3 Inspection Protocol

Pipe inspections will be performed by Pipe Inspectors using CCTV equipment and will utilize NASSCO PACP condition grades and ratings. CCTV pipe inspections and the corresponding data management protocol involves multiple lateral and sequential steps for both the City and the Pipe Inspector to perform. The pipe inspection protocol is illustrated in detailed workflow diagrams included in **Appendix A**. *Step 1 – Annual CCTV Pipe Inspection Flow Chart* and *Step 2 – Pipe Inspection Data Management Flow Chart* outline the process required to complete pipe inspections and properly manage the resulting data, respectively.

Following *Step 1 – Annual CCTV Pipe Inspection Flow Chart* in **Appendix A**, the City will do the following to ensure the physical completion of pipe inspections:

- Select the pipes for inspection.
- Create inspection work orders.
- Make any necessary GIS updates.

- Implement appropriate actions for various scenarios (for example, inaccessible pipes or discovery of critical defects or new assets).

Following *Step 1 – Annual CCTV Pipe Inspection Flow Chart* in **Appendix A**, the Pipe Inspector will do the following to ensure the physical completion of pipe inspections:

- Inspect the pipes.
- Clean the pipes as needed based on condition and accessibility.
- Coordinate with and report to the City any issues, including those pertaining to pipe access and discovery of critical defects or new assets.
- Submit inspection data to the City.

Following *Step 2 – Pipe Inspection Data Management Flow Chart* in **Appendix A**, the City will do the following to properly manage the resulting inspection data:

- Conduct inspection data QA/QC in GraniteNET.
- Determine acceptability and completeness of the data.
- Issue re-inspection work orders if the data is not acceptable or if missing data cannot be obtained without re-inspection.
- Make any necessary GIS updates.
- Upload data determined to be thorough and complete to Cartegraph for the next step in the process: Condition Assessment.

3.2 Condition Assessment Protocol

Condition assessments will be performed for each pipe inspected. During the condition assessment process, the CoF scores will be calculated, LoF scores will be assigned, and repair, replacement, and maintenance recommendations will be determined. The goal of the condition assessment process is to provide prioritized pipe repair, replacement, and maintenance recommendations to enable the City's stormwater team to make informed, risk-based decisions on maintaining, repairing, rehabilitating, or replacing assets.

3.2.1 Condition Assessment Roles and Responsibilities

As with the inspection protocol, the division of City and vendor or consultant roles may change over time. For the near term, it is anticipated that the condition assessment work will be performed by City staff. As the volume of annual inspections increases and depending on City staff availability, the City may explore hiring a consultant to manage or perform the condition assessments. These roles may be covered by the same person and not be a full-time responsibility in the near term, but this may change as the on-going scope of this program increases. The following additional job responsibilities will be needed to implement the condition assessment protocol:

- **Condition Assessment Project Manager (PM):** The Condition Assessment PM will oversee the condition assessment process and review repair, replacement, and maintenance recommendations assigned by the Data Reviewer. The Condition Assessment PM will assign work orders to City crews or prepare contract packages to address recommended repair, replacement, and maintenance actions.
- **Data Reviewer:** For the condition assessment process, the Data Reviewer will ensure inspection and GIS data is complete and up to date, calculate CoF scores for all inspected assets, review inspection data, and use the CoF in association with the NASSCO PACP pipe ratings to

determine the LoF to identify first and second priority status. Based on those determinations, pipes will be evaluated, and repair, replacement, and maintenance recommendations will be assigned by the reviewer. This role requires NASSCO PACP certification or equivalent knowledge.

3.2.2 Condition Assessment Data, Tracking, and Storage

Condition assessment data consists of a CoF score, a structural and maintenance LoF score, a priority (such as first, second, or monitoring), and a repair, replacement, or maintenance recommendation. GraniteNET, Excel, GIS, and Cartegraph, as described previously, will also be used to complete the condition assessment protocol. Cartegraph will be used to track and store the final inspection data, which includes CoF and LoF scores and prioritized repair, replacement, maintenance, and monitoring recommendations.

3.2.3 Condition Assessment Protocol

Condition assessment protocol involves multiple lateral and sequential steps for the City to perform and is illustrated in a detailed workflow diagram included in **Appendix A**. *Step 3 – Pipe Condition Assessment Workflow Chart* outlines the process required to complete the pipe condition assessment.

Following *Step 3 – Pipe Condition Assessment Flow Chart* in **Appendix A**, the City will do the following to property implement the pipe condition assessment process:

- Ensure the inspection and GIS data uploaded to Cartegraph is complete and up to date. The City PM or Asset Manager can redirect the workflow back to Step 2 if the condition assessment cannot be completed with the current data.
- Calculate the CoF for all inspected assets.
- Review CCTV data and assign LoF scores.
- Determine pipe risk based on the combination of CoF and LoF scores in the risk matrix.
- For pipes determined to be First Priority risk where immediate action is needed:
  - Determine and schedule repair, replacement, or maintenance action.
  - Create work orders and contract bundles.
- For pipes determined to be either First Priority risk where immediate action is not needed, or Second Priority risk:
  - Determine repair, replacement, or maintenance recommendation.
  - Conduct QA/QC on the recommendation.
  - Create work orders and contract bundles.
- Pipes that are neither First nor Second Priority risk are categorized as either Regular or Increased Monitoring.

3.3 Repair, Replacement, and Maintenance Recommendations

The condition assessment data will provide information about the severity of structural and maintenance defects as well as the location and number of defects in each pipe segment. Depending on the condition of each asset, there will be a range of options available for restoring pipe functionality.

3.3.1 Spot Repairs

Spot repairs are repairs that can be conducted on a portion of the pipe without replacing the entire pipe segment. These repairs can be made for pipes that have a single, severe defect, or many defects confined to a short segment of pipe. Spot repairs can be open cut or trenchless.

3.3.2 Trenchless Repair

Trenchless repairs, such as cured-in-place (CIPP) lining, slip lining, fold and form lining, spiral wound lining, spray applied polymer lining, or other trenchless repair types, are appropriate for pipes that have multiple defects but are generally intact without large offsets or voids. These pipes can be effectively repaired with trenchless technology. Trenchless repair is typically the default repair method, whereas open cut replacement is reserved as a last resort for pipes that have failed or deteriorated beyond the limits of trenchless repair.

3.3.3 Full Replacement

Full pipe replacement is warranted for pipes that have multiple severe defects or voids that trenchless repair technology cannot appropriately address. Additionally, full replacement may be necessary if pipes are not sized correctly or have other physical attributes such as position, slope, or change in pipe diameter that warrant replacement in addition to the pipe's condition.

3.3.4 Maintenance

Pipes will be cleaned as needed to attempt to complete the CCTV inspection. However, there are instances where sediment, debris, roots, and other maintenance obstructions, such as intruding laterals, will not be cleared with this light cleaning. These maintenance condition observations will be noted in the CCTV report and represented in the maintenance ratings. The maintenance ratings can be used to identify and prioritize necessary maintenance activities.

3.3.5 Special Situations

The condition assessment will identify special situations that require City decisions for repair or replacement. These include but are not limited to illicit connections and utility crossings. Most of these situations require coordination with other entities to resolve the issues.

3.3.5.1 Illicit Connections

Condition assessment will identify illicit connections where pipes have been tapped into the City's drainage pipes. Connections to the storm system should be made at the upstream and downstream structure. Some illicit connections may have been installed using appropriate construction technique and cause no damage to the mainline. However, most illicit connections cause issues, such as protruding laterals or damage to the mainline where the connection was made. These situations will be included and evaluated as part of the pipe's inspection findings.

If a lateral connection is determined to be a sanitary sewer lateral, the City will follow its NPDES Phase II Permit requirements for removing the lateral. If lateral connections are stormwater laterals such as roof drains or groundwater laterals such as footing drains or sump pump drains, they are generally left alone until the mainline pipe needs repair or replacement.

3.3.5.2 Utility Crossings

New utility lines are often constructed using trenchless technology, which can result in drainage pipes occasionally being intersected by other utilities. These crossbores will be picked up during CCTV

inspection and must be remedied to ensure the proper functionality and safety of the drainage system and the utility that crosses the City's drainage network. Some utilities, such as gas line crossings, should be immediately resolved. Other utilities should be notified of the problem and a request should be made to move their line.

3.3.6 Monitoring

Pipes that are neither first nor second priority risk based on their CoF and LoF scores are categorized as either Regular or Increased Monitoring.

3.3.7 Packaging Repair, Replacement, and Maintenance Activities

The Risk Matrix (**Figure 2**) provides a framework for prioritizing future repairs, replacement, and maintenance activities. Similar types of repairs, replacement, and maintenance activities should be bundled together for a contractor to perform. Additionally, work that the City wants to perform in-house should be pulled from these bundles. However, there are other practical considerations that may factor into the prioritization scheme. These considerations include opportunities to partner with other capital projects and geographic project packaging.

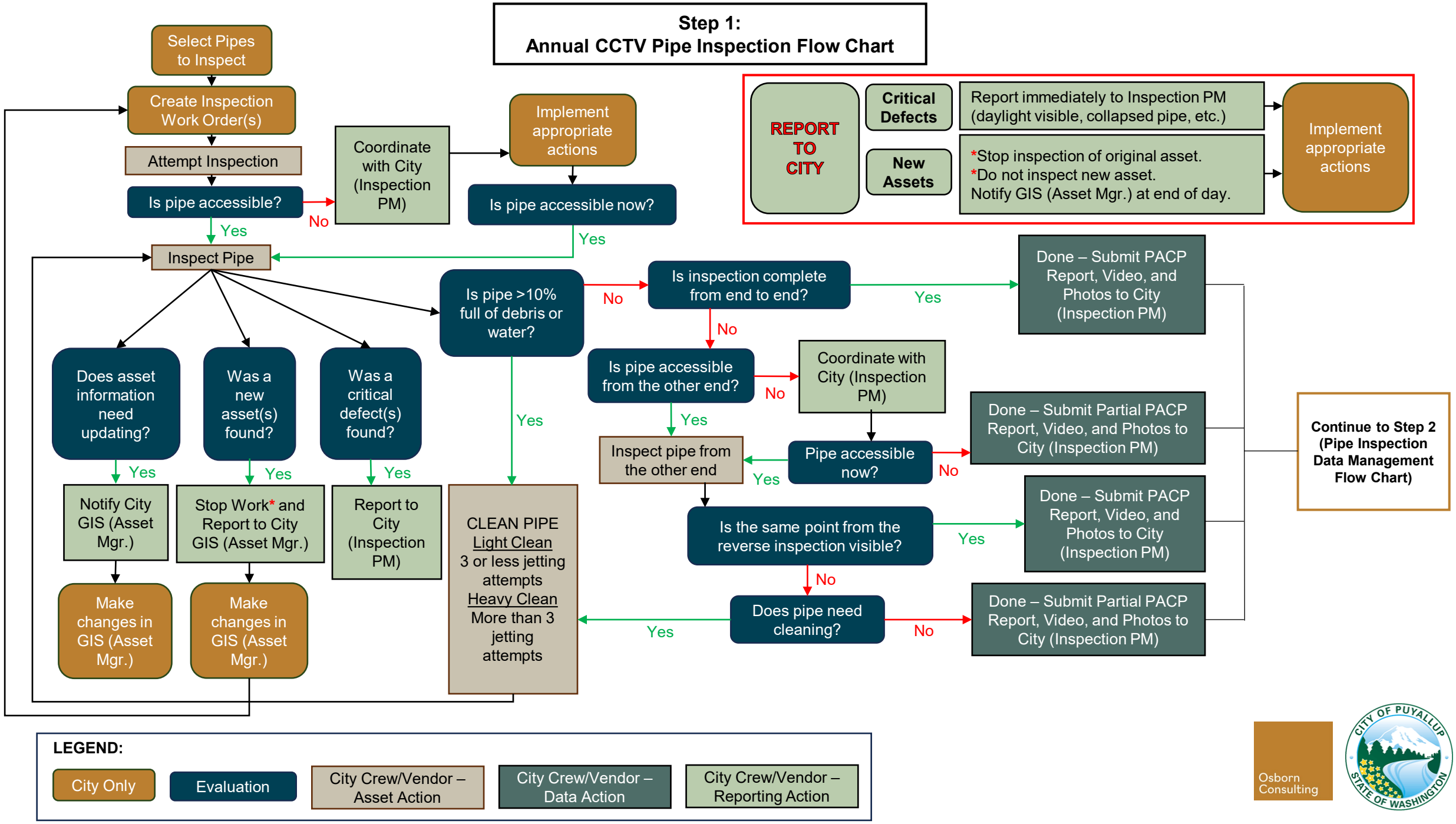
Following both the completion of the condition assessments and the determination of repair, replacement, or maintenance recommendations, the City can identify pipes relative to planned capital projects and identify potential opportunities for repairs or replacements with other projects. When packaging similar types of repairs, replacements, and maintenance activities, second priority pipes located near first priority pipes should also be evaluated to bundle work located within the same neighborhood or relative geographic area within the City.

SECTION 4 CONCLUSION AND NEXT STEPS

This memorandum summarizes the framework for the City's Stormwater Infrastructure Repair and Replacement Program and includes near-term and ongoing program recommendations where applicable. With the framework defined, the City can begin inspecting the stormwater system, perform condition assessments, and undertake recommended repair, replacement, and maintenance projects.

APPENDIX A
WORKFLOW DIAGRAMS

Step 1:
Annual CCTV Pipe Inspection Flow Chart



LEGEND:

City Only | Evaluation | City Crew/Vendor – Asset Action | City Crew/Vendor – Data Action | City Crew/Vendor – Reporting Action

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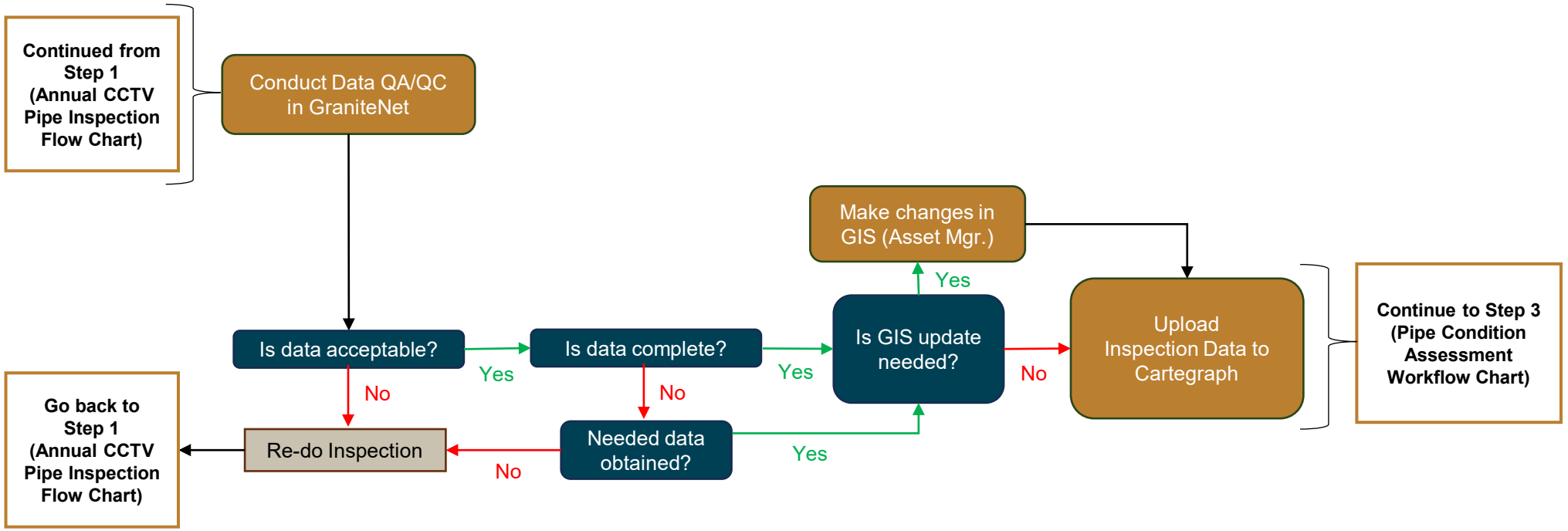
Step 2:
Pipe Inspection Data Management Flow Chart



LEGEND:

City Only | Evaluation | City Crew/Vendor – Asset Action | City Crew/Vendor – Data Action | City Crew/Vendor – Reporting Action

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Step 3:
Pipe Condition Assessment Flow Chart

Continued from Step 2 (Pipe Inspection Data Management Flow Chart)

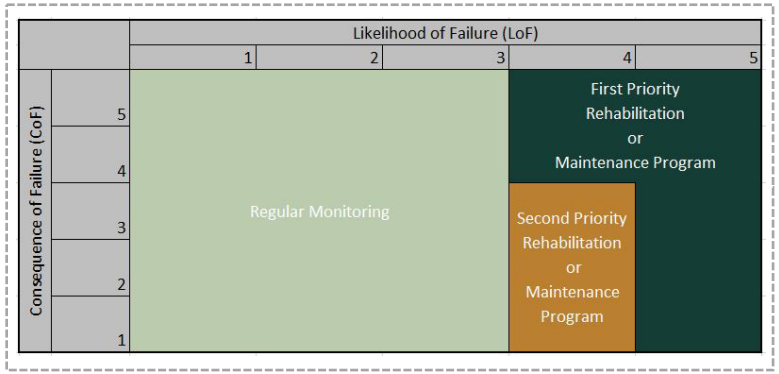
Is inspection data and GIS complete and up to date?

No → Notify GIS Asset Mgr. or Inspection PM → Can pipe condition assessment still be completed?

No → **Go back to Step 2 (Pipe Inspection Data Management Flow Chart)**

Yes

Yes → Calculate Consequence of Failure (CoF) Scores (1 – 5) for all inspected assets → Review CCTV data and assign Likelihood of Failure (LoF) Scores (1 – 5) → Determine pipe risk based on combination of CoF and LoF scores in risk matrix



Is pipe First Priority risk?

Yes → Is immediate action needed?

Yes → Determine and schedule repair, replacement, or maintenance action

No → Determine repair, replacement, or maintenance recommendation

No → Is pipe Second Priority risk?

Yes → Determine repair, replacement, or maintenance recommendation

No → Pipe is categorized as Regular Monitoring

Determine repair, replacement, or maintenance recommendation → QA/QC

QA/QC → Create Repair, Replacement, or Maintenance Work Orders/ Contract Bundles

Determine and schedule repair, replacement, or maintenance action → Create Repair, Replacement, or Maintenance Work Orders/ Contract Bundles

Create Repair, Replacement, or Maintenance Work Orders/ Contract Bundles →

- **Other**
  - City Crew Tasks
- **Monitoring**
  - Increased Frequency
  - Regular Frequency
- **Maintenance**
  - Root Grind
  - Heavy Jetting
- **Special Situations**
  - Illicit Connections
  - Utility Crossings
- **Repair or Replace**
  - Trenchless Repair (Spot or Full)
  - Open Cut Replacement (Spot or Full)

LEGEND:

City Only | Evaluation | City Crew/Vendor – Asset Action | City Crew/Vendor – Data Action | City Crew/Vendor – Reporting Action

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Technical Memorandum

FINAL

Prepared for: City of Puyallup

Project Title: 2024 Stormwater Comprehensive Plan Update

BC Project No.: 180436/ City Project No.: 23-007

Subject: Stormwater Pump Station Repair and Replacement Program

Date: May 3, 2024

To: Kelton Parker, EIT

From: Margaret Ales, P.E.

Copy to: Madison Thompson, EIT

Prepared by: Ben Swain, P.E.*, Certified Reliability Leader

Reviewed by: Ricardo Campos, P.E.*

** P.E. in states other than Washington*

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Executive Summary

The City of Puyallup (City) asked Brown and Caldwell (BC) to develop a framework for a stormwater pump station repair and replacement (R/R) program for the City of Puyallup Public Works Department. This technical memorandum (TM) documents the framework that uses asset management principles to prioritize improvements under a consistent, standards-driven approach.

The framework includes the following elements:

- Risk Management: criteria to establish likelihood of failure (LoF), consequence of failure (CoF), and risk
- Condition Assessment: standardized approach to condition assessment
- Computerized Maintenance Management System (CMMS): recommendations for CMMS use
- R/R Framework: key components for R/R planning

Each section in this TM contains the outcomes of workshops held with program stakeholders (i.e., City staff from the Engineering, Water Pollution Control Plant, and Collections divisions), along with recommended approaches to implementation. During the workshops, BC and the City staff established a risk score for each pump station. Table ES-1 shows the risk scores based on existing information. As the City collects condition assessment information and performs maintenance, the risk scores are expected to change.

Table ES-1. Current Stormwater Pump Station Risk Scores

Station	Total Weighted LoF Score	Total Weighted CoF Score	Total Risk Score [a]
21st and Pioneer	4.6	3.5	15.9
Meeker Creek North	4.1	2.9	11.7
4th ST NW (Skate Park)	3.9	2.9	11.3
19th and Pioneer	3.2	2.9	9.3
Todd Road	3.5	2.3	7.9
Stewart Gardens 2	2.7	2.6	6.9
Meeker Creek South	2.3	3.1	6.9
Stewart Gardens 1	2.6	2.6	6.6

a. *Total risk score values match those presented in Attachment B and are calculated with non-rounded total weighted LoF and CoF scores.*

Recommended Follow-up

In addition to developing a pump station R/R program, BC identified the following recommended actions to implement the approaches established in the framework. Section 6 describes the recommendations in greater detail.

1. Perform a condition assessment of each station.
    a. Use the data collected to create a complete and up-to-date registry of assets (i.e., individual pieces of equipment) within the CMMS.
    b. Record the condition data collected in a data system (CMMS or Excel) that allows new data to be added and trends analyzed.
    c. Identify any assets that require immediate attention and schedule the work.

2. Update Risk Information
    a. A risk evaluation should be performed for each asset. The CoF should be weighted based on each asset's individual impact on the function of the pump station.
    b. Review the risk and condition assessments to identify any required work. Work may include maintenance, repair, rehabilitation, or replacement.
    c. Base prioritization on risk data.
    d. Use the LoF to inform the required action(s).
    e. Make the decision to repair, rehabilitate, or replace individual assets, or embark on a larger station rehabilitation project, through a collaborative process that considers program stakeholders and the most cost-effective resolution.
3. Update the CMMS
    a. Following the asset registry's update, track all work performed using work orders associated with the appropriate asset.
    b. Establish preventative maintenance work orders to direct and track all preventive maintenance work being performed.
    c. Record all reactive work in work orders. Collected information should include the asset repaired, and details of the failure, its causes, and its resolution. Information should be complete enough to perform a failure analysis during the R/R process.
    d. Establish key performance indicators to track work effectiveness.

Continuous Improvement

The implementation of approaches listed in this TM should follow a Plan – Do – Check – Act cycle.

- Plan – This TM represents the foundation of the stormwater R/R process.
- Do – Implement the Plan in stages, with a focus on implementing each step well rather than quickly and involving program stakeholders in the process.
- Check – Monitor Plan implementation and effectiveness. Learn from any opportunities for improvement.
- Act – Continue to work the Plan and improve at each opportunity.

Implementation of the plan represented by this TM will take time and resources to accomplish. Section 6 identifies steps and timelines to implement the pump stations R/R process, beginning with straightforward tasks that can be implemented quickly. Later steps will take more effort and resources but will provide more tools for the effective implementation of the plan. The effectiveness of the plan should be monitored to show the return on investment and identify the areas of the plan to focus efforts for increased effectiveness. Continue to follow the Plan – Do – Check – Act process to build an effective R/R process.

Summary

Asset-management-based approaches for operation and maintenance of stormwater pump stations increase resource efficiency and help achieve desired levels of service. A risk-based approach allows limited resources to be focused on the critical assets and provides an understanding of the impact of decision making. Regular condition assessment utilizing a consistent approach provides a clear understanding of the current state of the assets and identifies R/R needs with enough time to plan and schedule repairs. Preventive work is less costly and safer than reactive work, allowing work to be planned and scheduled instead of reacting to an emergency. The establishment of a consistent, data-driven R/R process provides a justified basis for investments and allows the need for funding to be identified early. Funding decisions can be communicated to all stakeholders. The clear, repeatable process provides an optimized plan for managing the storm pump station assets and managing the risks associated with the storm sewer system.

Section 1: Background Information

The City of Puyallup (City) asked Brown and Caldwell (BC) to develop a framework for a stormwater pump station repair and replacement (R/R) program for the City of Puyallup Public Works Department. BC developed the framework for a stormwater pump station R/R program based on existing station condition assessment information through a desktop study and a series of workshops with City staff from the Public Works Engineering and Sewer and Stormwater Collections divisions.

This section provides a brief summary of the City's stormwater pumps stations and summarizes the workshop results.

1.1 Stormwater Pump Stations

The City operates eight stormwater pump stations to manage stormwater flows within the stormwater collection system. The storm sewer is a Municipal Separate Storm Sewer System (MS4) that discharges into several creek systems and the Puyallup River. The pump stations manage storm flow in the gravity storm sewer system. 4th Street pump station also pumps localized ponded stormwater directly to the Puyallup River when the nearby storm system outfall is closed due to the river's high-water level.

Table 1-1 summarizes the pump stations and related key information, including the consequence of failure (CoF) and likelihood of failure (LoF) associated with the concerns raised during a meeting with the City on September 20, 2023. Figure 1-1 presents the locations of the City's stormwater pump stations.

Attachment A provides a pump station inventory based on currently available information.

Table 1-1. Stormwater Pump Station Summary

	Installed	No. of Pumps	Concerns	CoF/LoF Impact	Failure Impacts
21st and Pioneer	Mid 1990s; updated 2002	1	Safety: location in intersection (difficult to access and driver safety hazard)	Health and safety impacts (CoF) Difficult to maintain or limited/unsafe access (LoF)	Intersection must close if the station goes down Overflows travel down the street to a gravity system
Stewart Gardens 1	1992	2	Residential complaints about pond filling with orange water (iron/bacteria) Catch basins begin to back up	Reputation and public relations impacts (CoF) Community and stakeholder impacts (CoF)	No existing structural impacts
Stewart Gardens 2	1996	1	Residential complaints about pond filling with orange water (iron/bacteria) Catch basins begin to back up	Reputation and public relations impacts (CoF) Community and stakeholder impacts (CoF)	No existing structural impacts
Meeker Creek North	1954	1	Pumping capacity (need to add temporary auxiliary pump)	Community and stakeholder impacts (CoF) External economic impacts (CoF) Level of service (LoF)	Local flooding into road along 9th Avenue near 14th Street SW Impact to residential structures Residential complaints
Meeker Creek South	Retrofit 2018	1	No current concerns	Not applicable	No existing structural impacts
4th Street	1994	1	Flows to increase with 4th Street storm sewer upgrades No redundancy	Reputation and public relations impacts (CoF) Community and stakeholder impacts (CoF) Health and safety impacts (CoF) Indirect economic impacts (CoF) External economic impacts (CoF) Pump-around availability/ pump redundancy (LoF) Asset failure (LoF)	Major flooding affecting City property and structures near the Puyallup River
Todd Road and 23rd Ave NW	1978	1	Needs protection from right-of-way Needs pumping upgrade (still original)	Community and stakeholder impacts (CoF) Indirect economic impacts (CoF) Level of service (LoF)	No existing structural impacts Street flooding
19th and Pioneer	1950-1970	1	Limited information about the station	Proactive maintenance and inspection history (LoF)	The impact of failure is unknown.

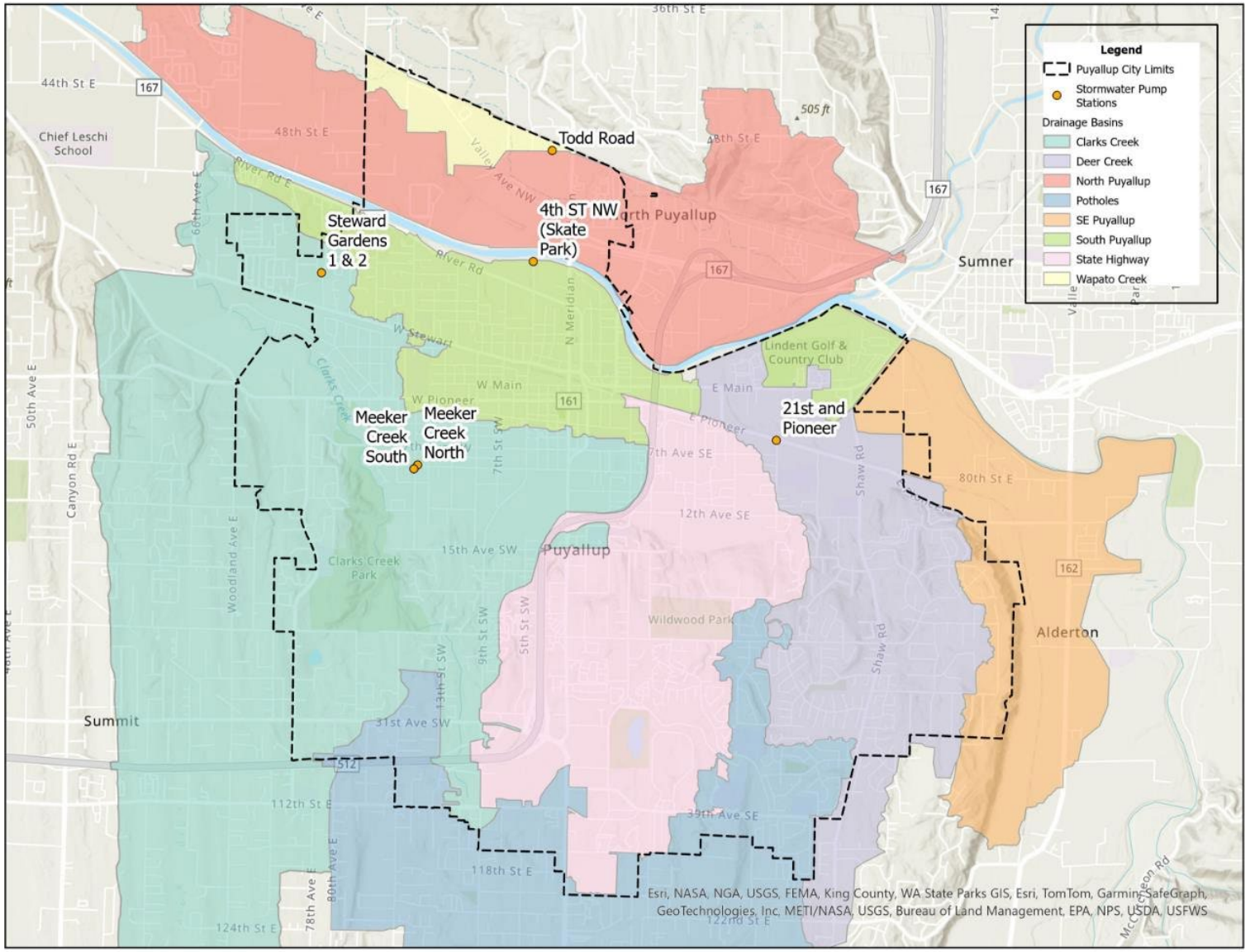


Figure 1-1. City of Puyallup stormwater pump station map

1.2 Project Approach – Stormwater Pump Station Repair and Replacement Program

The City contracted with BC to develop a framework for stormwater pump station R/R. The framework uses a risk-based approach to identify priorities based on LoF and CoF. A collaborative approach was used to establish a standards-based R/R plan focused on the optimization of the Puyallup stormwater pump stations. Data was reviewed to understand the current state of the pump station assets, and input was gathered from Engineering, Collections, and the Water Pollution Control Plant staff to understand asset history, maintenance routines, and current concerns. The information has been compiled in this TM to provide guidance in implementing the framework.

A workshop was held on Oct. 11, 2023, to review LoF, CoF, and risk criteria. The criteria are documented in Section 2.1. City staff provided documentation and input during the workshop to help establish a current-state risk evaluation of the stormwater pump stations. The results of the workshop are documented in Section 2.

A workshop was held on Nov. 14, 2023, to review condition assessment approaches and discuss how condition assessment informs the R/R process. A condition assessment inspection form was developed for use at stormwater pump stations. The condition assessment process is described in Section 3, and the condition assessment inspection form is shown in Appendix C.

A second condition assessment workshop that included discussion of the Computerized Maintenance Management System (CMMS) was held on Nov. 30, 2023. The discussion centered on ways to track asset information and work orders to provide information for use in R/R planning. CMMS usage is described in Section 4.

A workshop was held on Dec. 19, 2023, to review the R/R process and discuss how LoF, CoF, risk, condition assessment, and CMMS data will be used to establish an R/R plan for the stormwater pump stations. The process is described in Section 5.

City staff performed a condition assessment of 4th Street Pump Station on April 3, 2024, utilizing the approaches documented in this TM. The results of the condition assessment are shown in Appendix D.

Section 2: Risk Management

Understanding LoF, CoF, and risk, defined below, provides a foundational basis for understanding the state of assets and their priority in decision making:

- LoF is defined as the chance of something occurring.
- CoF is defined as the impact the failure has on level of service (LOS), the utility, customers, or the general public. CoF is sometimes referred to as criticality.
- Risk = LoF x CoF

Establishing a documented LoF, CoF, and risk for each pump station and each asset sets a clear understanding of the state of the asset. This information informs decisions about where limited resources can best be directed, and the potential impact to the asset of not receiving appropriate investment.

LoF and CoF factors are given a weighting, which allows some factors to carry a higher level of importance than others. This is important when factors such as field-verified data or health and safety need to play a greater role in decision making.

The resulting formula to calculate risk is:

$$\text{Risk} = \sum (\text{LoF} * \text{Weight}/100) * \sum (\text{CoF} * \text{Weight}/100)$$

2.1 LoF and CoF Criteria

The City established LoF and CoF and associated scoring and weightings for its stormwater pump stations in a series of workshops. Tables 2-1 and 2-2 list the criteria description and weighting and scoring categories for LoF and CoF, respectively.

Table 2-1. Likelihood of Failure Criteria

Criteria	Description	Negligible = 1	Low = 2	Moderate = 3	High = 4	Very High = 5	Weighting
Preventive maintenance and inspection history	Proactive maintenance, testing, or inspections completed in accordance with plans	Consistent preventive maintenance and inspection scheduled and performed	--	Preventive maintenance and inspection scheduled but infrequently performed	--	No planned preventive maintenance or inspection	15
Asset failure	Frequency of asset failure within 2 years under normal operating conditions based on historical asset operation and maintenance records	No known failures in the analysis period	--	1 or more failures in the analysis period	--	1 or more emergency failures in the analysis period	15
Remaining life	Remaining useful life based on the asset's age	New or like new. Greater than 80% useful life remaining	80% to 60% useful life remaining	60% to 40% useful life remaining	40% to 20% useful life remaining	At or nearing end of useful life; less than 20% useful life remaining	10
Level of Service	Is the station or asset able to meet the required LOS?	Maintains LOS	--	Does not meet LOS but does not result in flooding	--	Does not meet LOS	15
Difficult to maintain or limited/unsafe access	Assets that require specialized skills or equipment to operate and maintain; difficult to access	Able to access and maintain	Limited access and/or no specialized skills or equipment required	Limited access and/or requires specialized skills or equipment available in-house	Unable to access and/or requires specialized skills or equipment available in-house	Unable to access and/or requires specialty contractor(s) and equipment	15
Spare parts availability	Assets with parts that are difficult to find, no longer made, and/or with no vendor support	Parts readily available	Parts available within 24 hours	Parts available within a week	Parts available within a month	Parts available within multiple months or no parts available and/or no vendor support	15
Backup power availability	Availability of backup power	Onsite generator installed	--	Offsite portable generator available and/or dual feed available	--	No backup power	5
Pump-around availability/pump redundancy	Availability of redundant pump or pump-around capabilities	Redundant pump in place	Staff can bypass pump around the station; required pump owned by City	Rented/contracted portable backup pump locally available	Limited ability to pump around	Station not capable of being pumped around	10

Following the condition assessment of assets, the score for Asset Failure and Remaining life will be replaced with the Condition Score, and the weighting of the scores applied to the Condition Score. See Section 3.6 for additional information on updating Risk following condition assessment.

Table 2-2. Consequence of Failure Criteria							
Criteria	Description	Negligible = 1	Low = 2	Moderate = 3	High = 4	Very High = 5	Weighting
Reputation and public relations impacts	Effect of reputation and public perception impacts based on media attention/story (i.e., attention the failure draws)	No impact	Public may inquire, but no media coverage	Correspondence with elected city officials or city manager	Multi-agency interest and exposure on social media	Broad media coverage and exposure on multiple media platforms	15
Community and stakeholder impacts	Number of customers, assets, and/or facilities impacted due to a failure	No impact to roadways or community members	Local roadway impacted or fewer than 100 community members impacted	Minor collector impacted or 100 to 300 community members impacted	Major collector impacted or 300 to 500 community members impacted	Arterial impacted or 1,000 or more community members impacted	20
Health and safety impacts	Public health and safety impacts, and employee safety	No electrical hazards, confined space, specialized tools, or other employee or public safety impacts	Pump station above ground or minor hazards exist	Pump station above ground and moderate hazards exist	Pump station below ground or moderate/minor traffic risk	Flood control pump station, pump station is underground, or high traffic risk	20
Indirect economic impacts	Total repair or rehabilitation and/or replacement costs; increased operational costs	Less than $30k	$30k to $250k	$250k to $500k or unknown	$500k to $2M	$2M or more	15
External economic impacts	Liability costs, fines, property damage	Less than $5k	$5k to $20k	$50k to $100k	$100k to $500k	$500k or more	30

The Consequence of Failure score for individual assets can be adjusted utilizing the Consequence Score (CS) shown in Table 2-3. This adjusts the station CoF score for the impact each individual asset has on the ability of the station to provide the required level of service. The CS utilizes a 1–4 scale, with "1" being a Station Upset and a "4" being a Catastrophic failure. An adjustment factor is established for each asset based on the CS divided by the total possible score (4). The station CoF score is multiplied by this adjustment factor, providing an Adjusted CoF Score.

The final Adjusted Risk Calculation for the asset is:

Risk = ∑ (LoF * Weight/100) * ∑ (CoF * Weight /100) * (CS/4)

Example:

Asset: Pump (1 of 2)

Likelihood of Failure (LoF): 3.4

Consequence of Failure (CoF): 2.7

Consequence Score (CS): 1 (Station Upset)

3.4 * 2.7 * (1/4) = 6.8

Calculations of Risk can made in the "Risk Assessment – Puyallup SW Pump Stations by Asset" Excel document. The condition assessment and risk calculations for 4th Street Pump Station in Attachment D show how this approach is applied.

Table 1-3. Consequence Score

Rating	Description	Details
4	Catastrophic	• Catastrophic station failure • Flooding requiring bypass pumping • Death • Extreme financial loss
3	Station Failure	• Station failure • Flooding not requiring bypass pumping • Severe injury or health/safety • Major financial loss
2	Station Interruption	• Station interruption • Moderate financial impact • Health/safety hazard
1	Station Upset	• Station upset • Minor financial impact • Potential health/safety hazard

2.2 Risk Assessment

As described above, the LoF and CoF are combined to provide a risk value for each pump station. Attachment B shows the scoring of the pump stations based on the criteria established in the risk workshop.

Table 2-4 shows the risk scores for the stormwater pump stations based on existing information. As the City collects condition assessment information and performs maintenance, the risk scores are expected to change.

Table 2-4. Current Stormwater Pump Station Risk Scores			
Station	Total Weighted LoF Score	Total Weighted CoF Score	Total Risk Score [a]
21st and Pioneer	4.6	3.5	15.9
Meeker Creek North	4.1	2.9	11.7
4th ST NW (Skate Park)	3.9	2.9	11.3
19th and Pioneer	3.2	2.9	9.3
Todd Road	3.5	2.3	7.9
Stewart Gardens 2	2.7	2.6	6.9
Meeker Creek South	2.3	3.1	6.9
Stewart Gardens 1	2.6	2.6	6.6

a. Total risk score values match those presented in Attachment B and are calculated with non-rounded total weighted LoF and CoF scores.

Risk can also be represented in a matrix format by graphing the CoF and LoF on an x- and y-axis. Figure 2-1 displays the scored stations on a risk matrix. The risk matrix is then applied to decision making as discussed in Section 2.3.

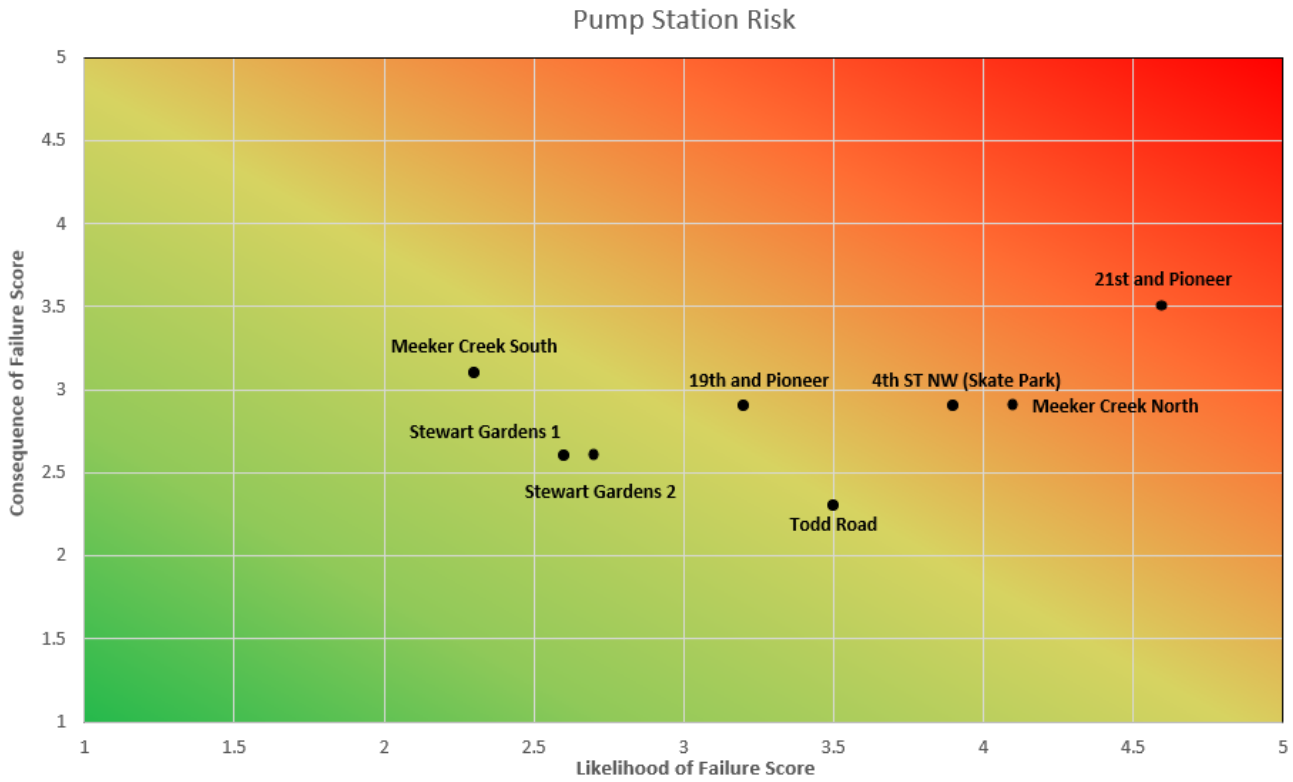


Figure 2-1. Station scores as applied on a risk matrix

2.3 Risk Application

Risk, and the components of risk, provide input into asset R/R plan development. The decisions made are based on what action will provide the most effective reduction in risk. Some risk elements are most effectively addressed through increased maintenance, while other elements require asset replacement. Some assets will require redesign to properly reduce risk.

Figure 2-2 displays some of the strategies that can be used to address risk.

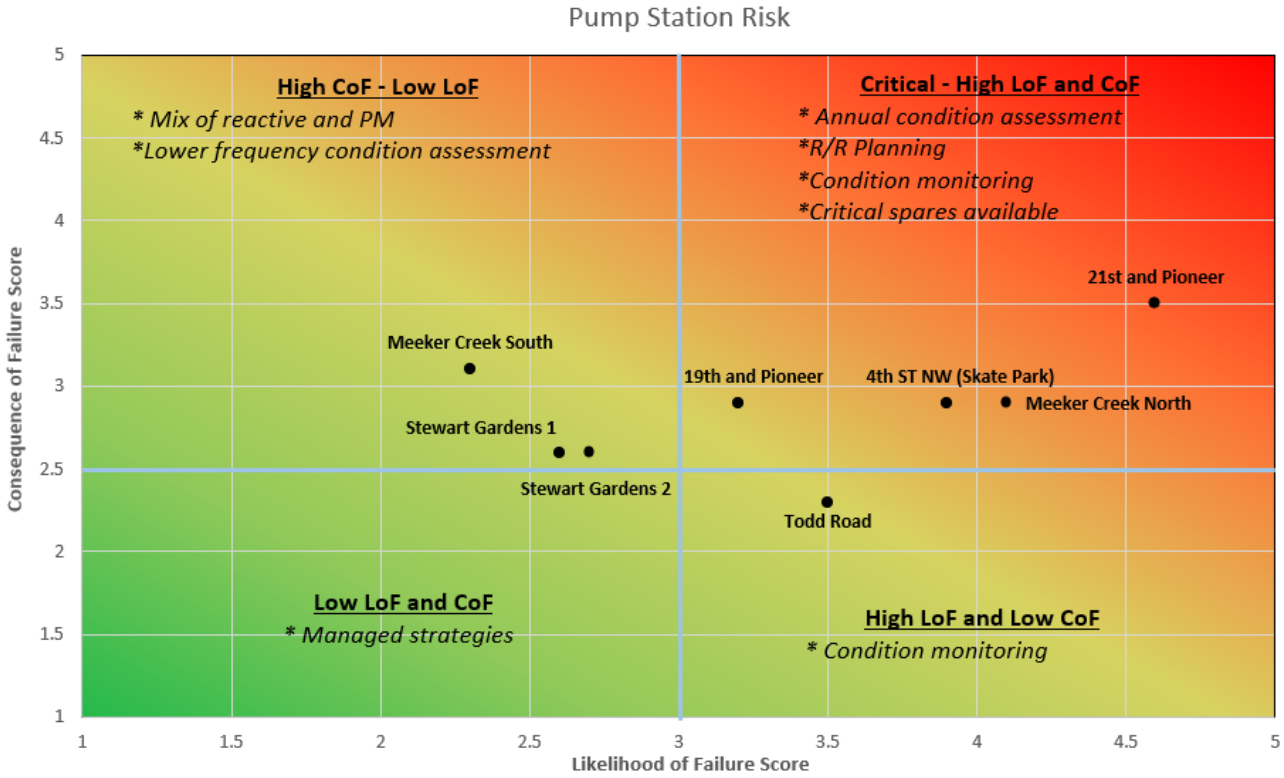


Figure 2-2. Potential strategies to address risk

2.3.1 Consequence of Failure

Consequence typically does not change without a change in the design of an asset, or even a facility. A CoF that is too high may drive a larger change in design to reduce risk.

The stakeholder and public impact factors of CoF may be mitigated through proactive engagement.

2.3.2 Likelihood of Failure

LoF provides the greatest opportunity to reduce risk. Regular maintenance and proactive replacement are the lowest cost options to reduce risk. Design changes may be valuable in cases where the existing design is unsafe or less effective.

Table 2-5 shows how LoF aligns with different R/R approaches.

Table 2-5. LoF Reduction Approaches	
LoF Factor	Approach
Proactive Maintenance and Inspection History	Maintenance
Asset failure/condition	Maintenance
Life remaining/condition	Replace
LOS	Replace or redesign/retrofit
Difficult to maintain or limited/unsafe access	Redesign/retrofit
Spare parts availability	Replace or redesign/retrofit
Backup power availability	Redesign/retrofit
Pump-around availability/pump redundancy	Redesign/retrofit

2.3.3 Risk Management Strategies

2.3.3.1 Condition Assessment

Understanding the current state of the asset is the most important factor in risk management. An initial baseline condition assessment of every asset will inform the risk rating of each asset and the appropriate maintenance strategies. Following the initial baseline condition assessment, subsequent condition assessment is based on the asset's LoF and CoF. High LoF/CoF assets should receive more frequent (annual) assessments to identify any further deterioration before they reach a failure point. Assets that are high LoF/low COF or low LoF/high CoF may receive a medium frequency (2 to 3 years) of inspection. Assets that are low LoF/CoF may fall within the "run to fail" category and only need a check during preventive maintenance (PM) rounds to assess functionality.

Condition assessment is addressed in greater detail in Section 3.

2.3.3.2 Maintenance

Regular maintenance is a key strategy in addressing risk. PM should be documented for each station and each asset. Standard Operating Procedures (SOP) should be established to ensure that work is performed consistently and correctly. Initial SOPs should be based on manufacturers' information and staff experience. SOPs can then be refined as the effectiveness of the PMs is established. Some assets may need more-frequent maintenance based on environmental factors, wear/age, and previous work history.

Reliability-centered maintenance should be used for the most critical assets. Failure Modes Effects and Criticality Analysis (FMECA) should be used to establish precision maintenance approaches for these assets to ensure that maintenance addresses all potential failure modes in advance of any potential failure.

2.3.3.3 Condition Monitoring

Condition monitoring uses tools that allow failure modes to be evaluated and to warn in advance of any impending failure. It uses the output of the FMECA to identify the particular failure modes to monitor and the appropriate tools to be used. Tools may include thermography, vibration monitoring, flow testing, motor testing, and ultrasound. The criticality can identify whether approaches may simply be used during routine condition assessment or if permanent monitoring connected to SCADA should be applied.

2.3.3.4 Critical Assets and Spare Parts

Development of a critical asset and spare parts management strategy helps ensure reliability and availability of assets with a high CoF. This strategy may include maintaining an inventory of critical spare parts and/or establishing robust service level agreements with key vendors and contractors to ensure timely response and availability. These approaches are anticipated to reduce the consequence of a risk event occurring.

2.3.3.5 Repair and Replacement

R/R is a key risk management strategy. When equipment is obsolete or failing, R/R may be the most effective way to reduce risk. Risk factors should be evaluated to identify whether a redesign would help prevent future failures or if a replacement in kind would be effective. When failures occur, the evaluation should include investigating the cause to ensure that the causal factors of the current asset do not also lead to premature failure of the replacement asset. The R/R process is described in Section 5.

2.3.3.6 Managed Strategies

Low LoF/low CoF assets are typically assets that require minimal attention. In some cases, asset maintenance may cost more than asset replacement. Following the baseline condition assessment and establishment of risk, these assets should be reviewed to identify the appropriate level of maintenance. They may simply require a routine check to verify they are operating correctly and to address any housekeeping issues that may affect the asset. Replacements should be easily available so that when they fail they can be replaced quickly. If replacement is difficult or costly, then PM measures should be established, and replacement should occur alongside other work being performed at the station.

Section 3: Condition Assessment

Condition assessment is a valuable tool to inform R/R planning. It helps answer these questions:

- What condition is the asset in?
- Is it performing its intended function?
- How likely is it to fail?

The resulting information thus enables:

- Assessment of LoF
- Estimation of the remaining useful life
- Establishment of appropriate maintenance requirements
- Assessment of when an asset should be repaired or replaced
- Establishment of a prioritized capital improvement plan (CIP) list

Condition assessment evaluates both the physical condition and performance of an asset. It is possible that an asset's physical condition may be acceptable, but if its performance is not meeting the required LOS, the asset is considered failing. Conversely, an asset may be providing the required LOS but may be on the verge of a catastrophic failure. Both physical condition and performance are important to understand.

3.1 Condition Assessment Approaches

Condition assessment uses three primary approaches that provide increasing levels of information:

- Level 1 Desktop – Input is provided based on already-collected data, such as install dates, work orders, and staff input. This information is typically useful to identify which assets need a deeper level of condition assessment.
- Level 2 Visual – Input is based on a visual and sensory evaluation of the asset. A standardized evaluation identifies the current state of an asset. The results are analyzed to determine any required follow-up. This inspection can be performed quickly and periodically to maintain a current understanding.
- Level 3 Physical – Input is based on the use of various tools to provide measurements that are compared against an established standard. These may include flow measurements, thermography,

motor testing, ultrasound, and disassembly to measure and evaluate components. This is a more labor-intensive approach that is typically reserved for critical assets or assets that have failure modes that are not evaluated by visual means.

3.2 Failure Modes

A key component of condition assessment is understanding failure modes. Failure modes are the different ways that an asset can fail. A vertical turbine pump may fail due to impeller wear, seal failures, water in oil, misalignment, or ragging. Understanding the failure mode informs the condition assessment and inspector on which components need evaluation. Failure modes also inform a proactive maintenance approach, allowing the preventive or predictive maintenance plan to focus on the activities that carry the most value.

3.3 Condition Assessment Form

Attachment C is a standard condition assessment form BC provided for the City's use in assessing the stormwater pump stations. Each asset is provided space for an evaluation of common components. The bottom of each sheet shows the scoring values for condition and performance. The score is applied to each asset based on the visual condition and the performance. The overall score for the asset is the highest score. The overall score for the pump station is based on the highest score of the assets that are required for the operation of the station.

Refinements may be made to the form as use continues. The form is suitable for use at stormwater pump stations.

3.4 Condition Assessment Analysis

Condition assessment results should be analyzed to identify any follow-up action required.

It is recommended that the results of the condition assessment be recorded in an accessible format, such as the CMMS or an Excel spreadsheet. Individual values are important, but some values are more beneficial when viewed as trends. If subsequent condition assessments show a continued deterioration, it can be expected that it will persist. Proactively addressing the deterioration, as well as the cause, will prevent an unexpected failure and loss of service.

3.5 Asset Record

The information about what assets exist at each station should be used to update the CMMS. Each asset and their related attributes should be captured on the condition assessment form and entered as a separate asset in the CMMS. The assessment can then be used to have maintenance scheduled and work orders tracked to establish a consistent history for use in future planning.

3.6 Risk Update

Information gathered during condition assessment should be used to update the risk evaluation. The additional assets identified during the condition assessment should be used to create a risk evaluation for all assets.

The risk evaluation for individual assets will typically inherit the CoF from the pump station. The overall risk factors remain the same; however, not all assets in a station will have the same impact on the station's ability to provide the required LOS. For example, the failure of a pump that has no redundancy will result in a loss of service, whereas loss of just the pump station's HVAC may not have an immediate effect. An adjustment factor should be applied to each asset so that the asset's true CoF is understood.

The LoF should also be updated based on the inspection. The following established factors are revised based on the inspection:

- Proactive Maintenance and Inspection History – Performing an inspection updates the score from "5 – Very High" to "3 – Moderate" simply by having an up-to-date inspection.
- Asset Failure – The desktop-based failure history is useful as a starting point, but actual real-world information about the asset provides a current datapoint about its condition. It is possible the previous failure and repair brought the asset back to an acceptable condition and removed future concerns; however, repeated failures of the same type should continue to be considered in the asset evaluation. Depending on the failure mode that occurred, the failure may have been caused by a factor external to the asset and should be evaluated.
- Remaining Life – Assets typically have an expected service life, but age is not a failure mode. Assets that are old typically fail because of wear and tear, the environment in which they operate, or improper maintenance. Old assets may operate far past their expected service life if they are maintained well, and newer assets may fail well before their expected service life if they are not maintained well. The actual asset condition should replace the desktop-based life remaining.

The inputs for asset failure and remaining life are replaced with the condition score, with the combined weighting being applied to the updated value.

Section 4: Computerized Maintenance Management System

The CMMS plays a vital role in effective management of asset-related data. The CMMS is the brains of an asset management program, acting as the repository of asset information and the connection between the different elements. The development of a CMMS is a significant investment that delivers a high rate of return.

The key roles of the CMMS are:

- Asset registry, which provides a record of all assets with key attributes
- Work order management, which generates and tracks work
- Failure history, which provides data about failures for use in failure prevention and R/R planning
- Condition assessment, which provides a record and condition of assets
- Key performance indicators (KPI), which provide a measure of organizational goals

4.1 Implementation

CMMS implementation can be a significant undertaking. The City uses Cartegraph as its CMMS; however, the stormwater pump stations are not currently logged in Cartegraph. The stormwater pump stations should be created in Cartegraph, along with the associated assets. Then, the City's standard CMMS procedures should be implemented for stormwater pump stations. Implementation is equal parts technical and work culture. It is more effective to take longer to implement a CMMS than to rush the process and implement an ineffectual tool.

4.2 Asset Registry

All assets should be logged into the CMMS to maintain an accurate and up-to-date list. Asset lists should be completed based on an agreed-upon asset definition. Assets removed from service should have their records expired or retired, and new records created for their replacements.

Key asset attributes should be recorded as a part of the asset record. At a minimum, the record should include:

- Make
- Model
- Serial number
- Install date
- Location
- Size (inches, kilowatts, etc.)

4.3 Work Orders

Work orders should be created and tracked through the CMMS. Doing so provides a centralized location for the management and history of all activities associated with an asset.

Planned maintenance should be assigned to each asset, with planned work orders generated automatically based on calendar time, run time, or other appropriate triggers. Planned work orders should contain information necessary for maintenance staff to perform the required tasks properly, including SOPs, safety information, and spare part information.

Reactive work should be tracked within the CMMS to provide a failure history. Reactive work orders should contain details that help identify the initiating problem and its cause, and how the asset was repaired. Using standardized failure codes helps simplify data analysis. Staff should also record any details that may be useful in the failure analysis.

4.4 Condition Assessment

Condition assessment data should be tracked through the CMMS. Doing so provides a centralized location of information that can be used to inform KPIs. Data should show the total number for risk, CoF, and LoF, as well as the individual scores in the calculations.

Condition collection should be performed using mobile data collection tools to increase collection and analysis efficiency.

Configuring condition assessment data analysis within Cartegraph may take significant effort. Until configuration can occur, it is beneficial to track this information in an Excel spreadsheet that will allow easy data review and trend tracking.

4.5 Key Performance Indicators

KPIs are important to establish to track the effectiveness of work being performed and determine if LOSs are being met. KPIs raise the alarm to issues that need to be addressed. The key items to track are:

- Is important work getting done?
- Is everything performing as needed?
- Are there problems that need to be addressed?

Every KPI should have a purpose in supporting the desired goals of the organization. The measurements should drive positive behavior. KPIs should be easy to understand and track. Complex measures that require additional work are typically counterproductive.

KPIs typically center around the following priorities:

- Work performance
- Regulatory compliance
- Staff resources
- Financial aspects (time and money)
- Risk

KPI development should be a collaborative effort among all key stakeholders, with agreement on what items are being measured, what the values of success and opportunity for improvement are, and what actions should result.

Example KPIs include:

- Work order compliance
- Average age of work order backlog
- Planned maintenance ratio
- Emergency work
- Overtime (hours) due to emergencies

Section 5: Repair and Replacement

R/R planning supports the continued effective operation of assets to meet the established LOS. Identification of work follows a standardized approach using updated data to make informed decisions. A consistent capital planning process supports consistent decision making based on objective data. A risk-based process optimizes the allocation of limited resources.

5.1 Identification of R/R Work

The goal of R/R is to renew an asset, or group of assets, to return it to a cost-effective state. The information that provides input to the R/R process should be analyzed on a periodic basis, annually at a minimum, to determine what actions should be taken to optimize maintenance, plan investments, and provide LOS at an optimal cost.

5.1.1 Maintenance History

Work orders should be generated as repair work is identified. Periodic review of work orders will help determine whether repair work should be elevated to rehabilitation or replacement. The review should consider whether the repair returns the asset to original condition, or if the repair will need to be repeated and under what time frame (mean time between repair). The cause of a failure should be evaluated to ensure it has been addressed. If repeated repairs are expected, the asset should be considered for rehabilitation or replacement.

5.1.2 Condition Assessment

Assets should have a condition assessment performed on a recurring basis, with the interval depending on LoF and CoF. Condition assessments should identify any assets to be considered for R/R. Assets should also receive condition assessment following any failures, or when identified through the maintenance history. The data collected in the condition assessment should inform decisions being made on R/R. The condition assessment may require a Level 3 Physical condition assessment to accurately understand the current condition.

5.1.3 Repair/Replacement

R/R should evaluate whether an asset of concern would best be addressed through replacement in kind, replacement with a newer model, or a redesign. Inputs should consider LoF and CoF factors, as well as staff feedback.

Evaluation should be performed on an asset level as well as a facility level. If replacement of a single asset achieves the appropriate risk reduction, additional work may not be needed. If multiple assets need repair, redesign provides the optimal opportunity. If larger factors within the facility are identified, a larger station rehabilitation should be packaged as a project.

5.2 Capital Planning Process

A standard capital planning process provides consistency and thoroughness to ensure that funds are properly allocated in the most cost-effective manner. R/R planning should be a collaborative process that involves operations, maintenance, engineering, finance, and any other stakeholder. A collaborative process is key to ensuring that all viewpoints are accounted for and each stakeholder understands the basis for decisions made.

Figure 5-1 shows a typical annual capital planning process. A brief introduction to each step follows the figure.

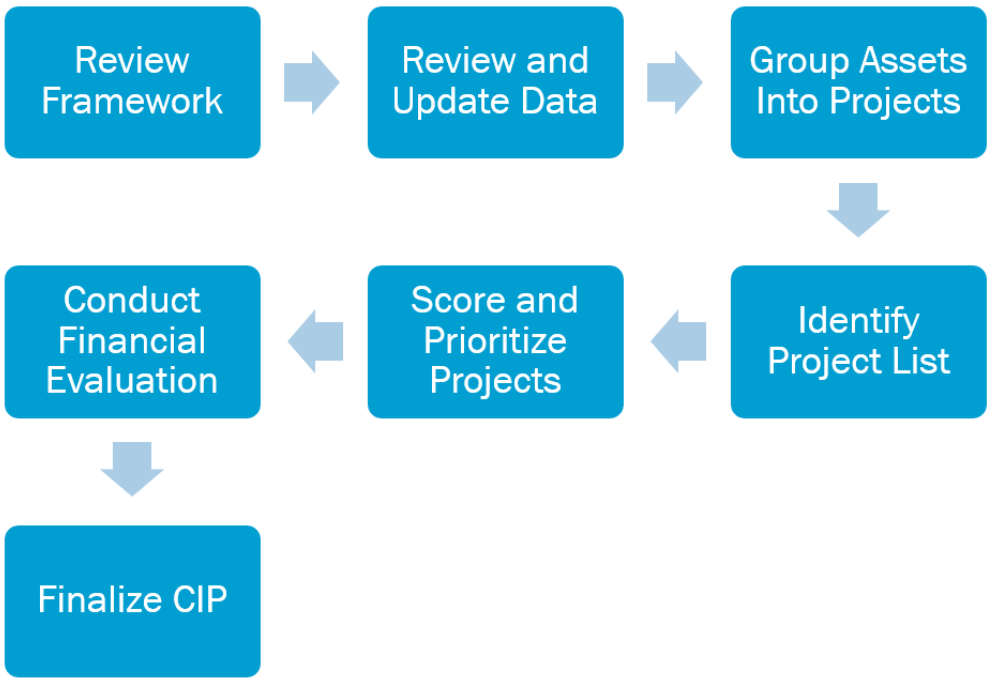


Figure 5-1. Annual capital planning process

5.2.1 Review Framework

The capital planning decision-making framework should be periodically reviewed to determine whether new inputs should be considered and to confirm the current inputs remain valid. Changes in regulatory requirements or the application of experience may shift the criteria used for decision making. All changes made to the framework must be documented, along with the driver for any changes.

5.2.2 Review and Update Data

The R/R process requires updating all relevant data based on the updated risk framework so decisions are made using recent and complete data. The data should include:

- Condition assessment
- Maintenance history
- Updated LoF, CoF, and risk
- Estimated costs

5.2.3 Group Assets into Projects

Using the reviewed and updated data, projects should be packaged that provide the most cost-effective approach to work. Projects are most frequently packaged based on location, such as a singular pump station. However, specialty work may be more cost effective across multiple locations, such as SCADA improvements. Package size should be established to encourage competition from among a suitable pool of contractors capable of performing the work. If a packaged project size is too small, a larger percentage of the costs will go to overhead costs, and too large of a project may eliminate available contractor options and reduce the competition that keeps costs lower.

5.2.4 Identify Project List and Score/Prioritize

All potential projects should be compiled into a list and given a score. The framework should identify how the score is assigned to the project. Some options for scoring include:

- Highest risk score of the assets included
- Highest CoF score of the assets included
- Weighted average of risk scores (note that a straight average may wash out high scores and allow a project with medium scores to score higher than a project with a few assets with higher risks)

5.2.5 Financial Evaluation and Review

Costs should be developed for projects based on a standardized approach. The costs may be developed based on previous bid prices, vendor or consultant input, or industry resources. Costs should include engineering, bidding, right-of-way acquisition, construction, and contingency markups to account for a full project cost.

The financial evaluation must factor in current and projected funding for R/R. The number, size, and timing of R/R projects will be determined by the amount of funding available. Funding projections should also include any available outside funding.

The format used for the 2024-2029 Draft Capital Facilities Plan – Storm, provided by the City, is an effective approach to allocating projects to available budgets and developing a longer-range plan. The project justification should include elements from this framework, including Risk, CoF, LoF factors, and asset history. A risk summary for each project can also be beneficial.

5.2.6 Finalize CIP

The annual CIP should receive final approval by the highest-level authority. The upcoming year should be final such that the appropriate project management has the authority to move forward with implementation. The second year should be firm such that contracts with consultants can be pursued and any funding opportunities can be applied for. Some flexibility should be considered for new factors in the decision-making process over the upcoming year, but changes should be limited to only those necessary. Plans beyond 2 years should be considered aspirational for the purposes of planning but understood that the annual review of the framework may shift these projects as new information becomes available.

Section 6: Recommendations

This section documents recommendations for implementing the contents of this technical memo. The steps are provided in the order deemed most appropriate and effective in establishing a stormwater pump station R/R framework.

An estimated timeframe for step implementation and level of effort for work to be performed by City staff are provided. These are dependent on availability of resources to perform each step.

6.1 Implementation Plan

1. Perform a condition assessment of each stormwater pump station. Each station should be visited by engineering and maintenance staff. Asset attribute information should be documented and a condition score assigned.
    a. Visit each station to perform a baseline visual condition assessment of all assets. Use the Condition Assessment Form (Attachment C) to document the condition of each asset and appropriate asset attributes.
        i. Recommended timeframe: within next 3 months
        ii. Level of effort: 4 hours per station
    b. Use the data collected to create a complete and up-to-date registry of assets within the CMMS. All assets should be created and the asset attributes added to the record.
        i. Recommended timeframe: within next 3 months
        ii. Level of effort: 8 hours per station
    c. Record the condition data collected in a system that allows for new data to be added and trends to be analyzed. Use the CMMS or an Excel spreadsheet to record the information in an easily accessible format that allows additional data to be added as it becomes available.
        i. Recommended timeframe: within next 3 months
        ii. Level of effort: 4 hours per station
    d. Identify any assets that require immediate attention and schedule the work. Any assets scoring a “4” or “5” should have an action identified to return the condition to a “1” or a “2”. Any assets scoring a “3” should be noted for more frequent follow-up to identify any further degradation.
        i. Recommended timeframe: within next 3 months
        ii. Level of effort: 4 hours per station
2. Update Risk information
    a. A risk evaluation should be performed for each asset. The CoF should be weighted based on that asset’s individual impact on the pump station’s function.
        i. Recommended timeframe: within next 3 months
        ii. Level of effort: 1 hour per station
3. Repair and Replacement Planning
    a. Review risk and condition assessments to identify any required work. Work may include maintenance, R/R, or replacement. Use the R/R process to develop the plan.
    b. Base prioritization on risk data.
    c. LoF should inform action.

d. Make any decisions about repair, rehabilitation, and replacement of individual assets, or a larger station rehabilitation project, through a collaborative process that considers program stakeholders and the most cost-effective resolution.

i. Recommended timeframe: within next 6 months

ii. Level of effort: 4 hours per station

4. CMMS

a. Following the update of the asset registry, track all work performed using work orders associated with the appropriate asset.

b. Establish PM work orders to direct and track all PM work being performed. All PM work should be documented as job plans, including tasks, resources, and safety information.

c. Record all reactive work in work orders. Collected information should include the asset repaired, and details of the asset's failure, causes, and resolution. Information should be complete enough to perform failure analysis during the R/R process.

d. Establish KPIs to track work effectiveness.

i. Recommended timeframe: within next 2 years

ii. Level of effort: dependent on current use of CMMS

6.2 Future Opportunities

This technical memo presents foundational elements for moving stormwater pump station management from a reactive state to a proactive state. There are additional strategies that should be considered once the foundational elements are in place. They include:

- Strategic Asset Management Plan (SAMP) – A SAMP is an organization-wide asset management plan that provides a consistent framework used at every level to provide clear direction on priorities and approaches. A SAMP will promote collaboration and consistency to ensure each appropriate City staff member understands the basis for making decisions.
- Long-term R/R Planning – A 30-year or longer outlook should be established that uses effective useful life of assets to establish a long-range funding plan. The goal is to identify any spikes in funding requirements so that investments can be spread out and a longer-range funding plan can be developed.
- Reliability – As foundation elements are in place, the opportunity arises to use more advanced tools to firm up reliability of assets and facilities. These approaches are used to implement more effective maintenance and avoid failures. Asset life can be extended using these approaches, and thus reduce the life-cycle costs of assets.
  - FMECA – As previously discussed, FMECA is an advanced approach used with critical assets to identify possible ways an asset or system can fail and what actions can be taken to prevent that failure. This allows designs to be adjusted to design out potential failure modes or add features to prevent the failure. It also informs maintenance approaches and allows targeted maintenance to be performed.
  - PM Optimization – This is a detailed review of PM plans to ensure the value of each task. Often, PM plans are developed based on manufacturer recommendations or a "this is what we have always done" approach. Review of PM plans may identify tasks that can be removed if they provide no value, added if they will increase effectiveness, or have the timing adjusted to optimize the work.

- Root Cause Failure Analysis – This is a detailed review of asset failures to identify the true cause and to develop plans to prevent future failures. This is especially useful for complex failures where the cause is not immediately apparent. Some asset failures occur due to outside factors and are not internal to the asset itself; therefore, asset replacement may restore function but not address the original cause.

Attachment A: Pump Station Inventory

Table A-1. Pump Station Inventory

Name	Asset ID	Street Location	Facility Location	Purpose	Install Date	Size	No. of Pumps	Type	Tide Gates and Check Valves	Record dwgs or sketch	Army Corps of FEMA requirement	Standard Operating Procedures	Pump Manual	Maintenance Records	Service Requests	Run time data or draw down tests?	Preventative Maintenance Tasks	Photos	Pump Manufacturer	Pump Model No.	Pipe Sizes		Pipe Inverts	
																					IN	OUT	IN	OUT
21st and Pioneer PS	D7-00262	Intersection of E Pioneer Ave and 21st St SE	72" MH	Lift Station	Unknown	WW: 72" MH and 174" D AD : 44" Round Lid	1	Pump: FLYGT BS 2250	Unknown	Yes	No	None	Pump Curve: Y RPS: 1770 HP: 87	None	None	None	None	No	Unknown	2250.011	Unknown	Unknown	Unknown	Unknown
Meeker Creek North PS	D7-00241	10th Ave SW between 14th St SW and 13th St SW	10' ID Pump House	Lift Station	1954	WW: 10' W x 11.5' D AD: 4'x5' Hatch	2	Unknown	4" Check Valve	Yes	No	None	None	None	None	Run Timer: Y Cycle Counter: N High Water Warning: Y	None	No	Unknown	Unknown	18" OD Steel Pipe	8" Steel Pipe to 10" Steel Pipe w/ 8"x10" reducer	Unknown	Unknown
4th St NE PS (Skate Park)	D7-00193	Culdesac of 4th St NW	96" MH	Lift Station	1978	WW: 96" ID x 115" D AD: 30"x30" Hatch and 24" MH	1	Pump: S6L Series Submersible Sewage Pump Sluice Gate: Waterman Model C-20 Canal Gate Bar Screen: 1-1/2"x3' (1-1/4"x3/16" Flat Aluminum Bars - 1/2" O.C.)	8" G-931 IBBM Check Valve 8" G-745-0 Flanged Gate Valve	Yes	No	None	Pump Curve: Y Pump Parts List: Y Total Head: 20' RPM: 1150 GPM: 900 HP: 10	Yes	None	Temp. Rise Test: Y	Yes	Yes	Hydr-o-matic Pumps	S6750M4-6	12" Conc 12" PVC	8" DI Force Main 12" Conc	23.85 Conc 27.5 PVC	23.35 Conc
Todd Road PS (23rd Ave NW - Fred Meyer)	D7-00264	Todd Rd NW	96" ID MH	Lift Station	1994	WW: 96" ID x 20' D AD: 36.5" x 64.75" Hatch	2	Unknown	Check Valve: Y, unknown type Plug Valve/Gate Valve: Y, unknown type	Yes	No	None	HP: 40	None	None	Run Timer: N Cycle Counter: N High Water Warning: Y	None	No	Hydr-o-matic Pumps	Unknown	24" PVC 12" PVC	2-6" Steel Y into 12" Steel	Unknown	Unknown
Stewart Gardens PS 2 (Flansburg PS 2)	D7-00228	23rd St NW	96" ID MH	Lift Station	Unknown	WW: 96" ID and 9'6: D AD: ?	2	Pump: Hy-dro-matic	Unknown	No	No	None	None	None	None	Run Timer: N Cycle Counter: N High Water Warning: Y	None	No	Hydr-o-matic Pumps	Unknown	Unknown	Unknown	Unknown	Unknown

Table A-1. Pump Station Inventory

Name	Asset ID	Street Location	Facility Location	Purpose	Install Date	Size	No. of Pumps	Type	Tide Gates and Check Valves	Record dwgs or sketch	Army Corps of FEMA requirement	Standard Operating Procedures	Pump Manual	Maintenance Records	Service Requests	Run time data or draw down tests?	Preventative Maintenance Tasks	Photos	Pump Manufacturer	Pump Model No.	Pipe Sizes		Pipe Inverts	
																					IN	OUT	IN	OUT
Meeker Creek South PS	D7-00260	Intersection of 10th Ave SW and 14th St SW	72" MH	Lift Station	Retrofit 2018	WW: 72" Diam x 12' D AD: 48" x 60"	1	FLYGT N-3153 Hand Iron N Submersible Pump	10" Flap Gate	Yes	No	None	Pump Curve: Y Pump Parts/ Fittings: Y Total Head: 29 RPM: 1755 GPM: 1545 HP: 20	None	None	Run Timer: Unknown Cycle Counter: Unknown High Water Warning: No, Float Controlled	None	No	FLYGT	NP 3153 LT 3-414	18" x 48" Conc Box Culvert	8" to 6" PVC	25.33	Unknown
Stewart Gardens PS 1 (Flansburg PS 1)	D7-00227	23rd St NW	72" MH	Lift Station/ Flood Control	1992	WW: 72" ID x 16' D AD: 48"x 36" Hatch	2	Pump: FLYGT CP 3085	2 - 6" FLYGT HDL Ball Check Valve 2 - 6" Plug Valves	Yes	No	None	Pump Curve: N HP: 5	None	None	Run Timer: Y Cycle Counter: Unknown High Water Warning: No, Float Controlled	None	No	FLYGT	Unknown	12" Conc	6" DI to 6" PVC	18.75	Unknown
19th St Storm PS		19th and W Pioneer											Pump Curve: N Pump Parts/ Fittings: N Total Head: Unknown RPM: 1185 GPM: Unknown HP: 75			Head Controlled								

Attachment B: Risk Worksheet

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

							LIKELIHOOD OF FAILURE					
							Condition/Maintenance Based					
							Preventive maintenance and inspection history			Asset failure		
						Criteria Weight	15			15		
							Preventive maintenance, testing, or inspections completed in accordance with plans.			Frequency of asset failure within 2 years under normal operating conditions based on historical asset operation and maintenance records.		
Facility ID	Facility Name	Facility Type	Capacity (gpm)	Install Date	Station Type	# of Assets						
D7-00262	21st and Pioneer	Storm		Rehab 2002	Underground		5	Preventive Maintenance and inspection scheduled but infrequently performed		5	1 or more emergency failures in the period of analysis	All electrial was just hit by a car and needs to be replaced. Entire station is out of serrvice. Pump and panel.
D7-00227	Stewart Gardens 1	Storm		1992	Above Ground		5	No planned preventive maintenance or inspection		1	No known failures in the analysis period	
D7-00228	Stewart Gardens 2	Storm		1996	Underground		5	No planned preventive maintenance or inspection		1	No known failures in the analysis period	
D7-00241	Meeker Creek North	Storm		1954	Above Ground		5	No planned preventive maintenance or inspection		5	1 or more emergency failures in the period of analysis	
D7-00260	Meeker Creek South	Storm		Rehab 2018	Underground		5	No planned preventive maintenance or inspection		1	No known failures in the analysis period	
D7-00193	4th ST NW (Skate Park)	Storm/Flood		1978	Underground		3	Preventive Maintenance and inspection scheduled but infrequently performed		3	1 or more failures in the analysis period	
D7-00264	Todd Road	Storm		1994	Underground		5	No planned preventive maintenance or inspection		3	1 or more failures in the analysis period	
-	19th and Pioneer	Storm		1950-1970	Above Ground		5	No planned preventive maintenance or inspection		1	No known failures in the analysis period	Unknown. Assume working correctly, but no failures that bring significant attention.

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

LIKELIHOOD OF FAILURE

Design/Construction Based

			Remaining life			Level of Service			Difficult to maintain or limited/unsafe access		
			10			15			15		
			Remaining useful life based on the asset's age			Does it meet LOS?			Assets that require specialized skills or equipment to operate and maintain; difficult to access		
Facility ID	Facility Name	Facility Type									
D7-00262	21st and Pioneer	Storm	2	80% to 60% useful life remaining	Station will basically be brand new after repairs.	5	Does not meet level of service.		4	Unable to access and/or requires specialized skills or equipment available in-house	
D7-00227	Stewart Gardens 1	Storm	3	60% to 40% useful life remaining		3	Does not meet LOS, but does not result in flooding.		2	Limited access and/or no specialized skills or equipment required	
D7-00228	Stewart Gardens 2	Storm	3	60% to 40% useful life remaining		3	Does not meet LOS, but does not result in flooding.		2	Limited access and/or no specialized skills or equipment required	
D7-00241	Meeker Creek North	Storm	5	At or nearing end of useful life; less than 20% useful life remaining		5	Does not meet level of service.		1	Able to access and maintain	
D7-00260	Meeker Creek South	Storm	2	80% to 60% useful life remaining		1	Maintains LOS		3	Limited access and/or requires specialized skills or equipment available in-house	
D7-00193	4th ST NW (Skate Park)	Storm/Flood	4	40% to 20% useful life remaining		5	Does not meet LOS		3	Limited access and/or requires specialized skills or equipment available in-house	
D7-00264	Todd Road	Storm	3	60% to 40% useful life remaining		5	Does not meet level of service.		3	Limited access and/or requires specialized skills or equipment available in-house	
-	19th and Pioneer	Storm	5	At or nearing end of useful life; less than 20% useful life remaining	Assume no replacements or parts or pump has been complted since original install.	3	Does not meet LOS, but does not result in flooding.	No, issue in the past. Assume LOS is not being met but no flooding.	1	Able to access and maintain	

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

LIKELIHOOD OF FAILURE

Design/Construction Based

			Spare parts availability			Backup Power Availability			Pump Around Availability/Pump Redundancy		
			15			5			10		
			Assets with parts that are difficult to find, no longer made, and/or with no vendor support.			Availability of backup power.			Availability of redundant pump or pump around capabilities.		
Facility ID	Facility Name	Facility Type									
D7-00262	21st and Pioneer	Storm	5	Parts available within multiple months or no parts available and/or no vendor support		5	5 - No backup power		5	Station not capable of being pumped around.	
D7-00227	Stewart Gardens 1	Storm	3	Parts available within a week		1	1 - Onsite generator installed		1	Redundant pump in place.	Not capable to pump around, but other station gives some backup
D7-00228	Stewart Gardens 2	Storm	3	Parts available within a week		1	1 - Onsite generator installed		2	Ability to pump around at the station. Utility owned pump.	Not capable to pump around, but other station gives some backup
D7-00241	Meeker Creek North	Storm	5	Parts available within multiple months or no parts available and/or no vendor support		5	5 - No backup power		2	Staff can bypass pump around the station. Required pump owned by City	
D7-00260	Meeker Creek South	Storm	2	Parts available within 24-hours		1	1 - Onsite generator installed		2	Staff can bypass pump around the station. Required pump owned by City	
D7-00193	4th ST NW (Skate Park)	Storm/Flood	3	Parts available within a week		5	No backup power		4	Limited ability to pump around.	
D7-00264	Todd Road	Storm	3	Parts available within a week		3	3 - Offsite portable generator available and/or dual-feed available		2	Staff can bypass pump around the station. Required pump owned by City	
-	19th and Pioneer	Storm	5	Parts available within multiple months or no parts available and/or no vendor support	Unkown, assume parts are not available.	5	5 - No backup power		2	Staff can bypass pump around the station. Required pump owned by City	

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

CONSEQUENCE OF FAILURE

			Reputation and public relations impacts			Community and stakeholder impacts			Health and safety impacts		
			15			20			20		
			Effect of reputation and public perception impacts based on media attention/story (i.e., attention the failure draws)			Number of customers, assets, and/or facilities impacted due to due to a failure.			Public health and safety impacts, and employee safety		
Facility ID	Facility Name	Facility Type									
D7-00262	21st and Pioneer	Storm	3	Corresponce with elected city officials or city manager		5	Arterial impacted or 1000 or more community members impacted.	21st St SE - Minor Collector E Pioneer - Major Arterial	5	Flood control pump station, pump station is underground, or high traffic risk	
D7-00227	Stewart Gardens 1	Storm	1	No Impact		2	Local roadway impacted or fewer than 100 community members impacted	23rd St NW - Local Access	2	Pump station above ground or minor hazards exist	
D7-00228	Stewart Gardens 2	Storm	1	No Impact		2	Local roadway impacted or fewer than 100 community members impacted	23rd St NW - Local Access	2	Pump station above ground or minor hazards exist	
D7-00241	Meeker Creek North	Storm	2	Public may inquire, but no media coverage		3	Minor collector impcated or 100 to 300 community members impacted	10th Ave SW - Alley 14th St SW - Minor Collector	3	Pump station above ground or minor hazards exist	Old Electrical Equipment
D7-00260	Meeker Creek South	Storm	2	Public may inquire, but no media coverage		3	Minor collector impcated or 100 to 300 community members impacted	14th St SW - Minor Collector	4	Pump station below ground or moderate/minor traffic risk	Shoulder of the North Bound Lane
D7-00193	4th ST NW (Skate Park)	Storm/Flood	3	Corresponce with elected city officials or city manager		2	Local roadway impacted or fewer than 100 community members impacted		5	Flood control pump station, pump station is underground, or high traffic risk	
D7-00264	Todd Road	Storm	2	Public may inquire, but no media coverage		2	Local roadway impacted or fewer than 100 community members impacted	23rd Ave NW - Local Access	4	Pump station below ground or moderate/minor traffic risk	Should/Sidewalk of the Road
-	19th and Pioneer	Storm	1	No Impact		5	Arterial impacted or 1000 or more community members impacted.	W Pioneer - Major Arterial	2	Pump station above ground or minor hazards exist	

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

			CONSEQUENCE OF FAILURE								
			Indirect economic impacts			External economic impacts					
			15			30					
			Total repair or rehabilitation and/or replacement costs; increased operational costs			Liability costs, fines, property damage			Total Weighted Likelihood of Failure Score	Total Weighted Consequence of Failure Score	Total Risk Score
Facility ID	Facility Name	Facility Type									
D7-00262	21st and Pioneer	Storm	3	$250k to $500k or unknown		2	$5k to $20k	18 Structures	**4.6**	**3.5**	**15.9**
D7-00227	Stewart Gardens 1	Storm	3	$250k to $500k or unknown		4	$100k to $500k	55 Structures	**2.6**	**2.6**	**6.6**
D7-00228	Stewart Gardens 2	Storm	3	$250k to $500k or unknown		4	$100k to $500k	55 Structures	**2.7**	**2.6**	**6.9**
D7-00241	Meeker Creek North	Storm	3	$250k to $500k or unknown		3	$50k to $100k	41 Structures	**4.1**	**2.9**	**11.7**
D7-00260	Meeker Creek South	Storm	3	$250k to $500k or unknown		3	$50k to $100k	41 Structures	**2.3**	**3.1**	**6.9**
D7-00193	4th ST NW (Skate Park)	Storm/Flood	3	$250k to $500k or unknown		2	$5k to $20k		**3.6**	**2.9**	**10.4**
D7-00264	Todd Road	Storm	3	$250k to $500k or unknown		1	Less than $5k	3 Structures	**3.5**	**2.3**	**7.9**
-	19th and Pioneer	Storm	3	$250k to $500k or unknown		3	$50k to $100k	41 Structures	**3.2**	**2.9**	**9.3**

Attachment C: Condition Assessment Form

City of Puyallup Department of Public Works – Work Order
STORM WATER PUMP STATION CONDITION ASSESSMENT FORM

Inspector Names: _____ **Assessment Date:** _____ **Time:** _____

PS #: _____ **PS. Name:** _____ **PS. Address:** _____

House Keeping: ☐ Good ☐ N/A ☐ Poor Lighting ☐ Tripping Hazards Present ☐ No Fall Protection ☐ Potential for Shock or Electrocution ☐ Sump Pump Inoperable ☐ Electric Space Heater Inoperable ☐ Other:

Health and Safety Issues: _____

Asset Class	CMMS Code	Asset Present	Year Installed	Condition Score	Performance Score	Utilization (%)	Field Observation / Comments
Site Improvements (SIM)		**Y / N**				**N/A**	
▪ ***Sidewalks***	*N/A*	*Y / N*				*N/A*	
▪ ***Landscaping***	*N/A*	*Y / N*				*N/A*	
▪ ***Fencing***	*N/A*	*Y / N*				*N/A*	
▪ ***Access Road/Vehicle Access***	*N/A*	*Y / N*				*N/A*	
Site Improvements Field Obs: ☐ *Good* ☐ *N/A* ☐ *Fencing Not Secure* ☐ *Sidewalks and Curbs Cracked* ☐ *Tripping Hazard* ☐ *Sidewalks Not Well Maintained* ☐ *Site too Close to Traffic* ☐ *Shrubbery or Bushes Not Well Kept* ☐ *Grade Sloped* ☐ *Other:*							
Structure and Wet Well (PST)		**Y / N**				**N/A**	
▪ ***Building***	*N/A*	*Y / N*				*N/A*	
Building Field Obs: ☐ *Good* ☐ *N/A* ☐ *Roof Degraded* ☐ *Windows Cracked* ☐ *Doors and Security Failing* ☐ *Needs Paint* ☐ *Cracks on the Wall* ☐ *Other:*							
▪ ***Dry Well / Basement***	*N/A*	*Y / N*				*N/A*	
Dry Well Field Obs: ☐ *Good* ☐ *N/A* ☐ *Dry Well Structure Spalling or Cracked* ☐ *Evidence of Concrete Corrosion* ☐ *Other:*							
Dry Well Ladder Field Obs: ☐ *Good* ☐ *Fair: Surface Corrosion; Steps Intact and Solid; Minor Anchor Bolt Corrosion* ☐ *Poor: Corroded or Broken Steps; Corroded or Broken Wall Anchors* ☐ *Other:*							
Dry Well Wall Field Obs: ☐ *Good* ☐ *Fair: Concrete Sealant Peeled or Cracked; Concrete Soft at Surface* ☐ *Poor: Exposed/Missing Aggregate; Exposed/Missing Re-bar* ☐ *Other:*							
Doors Field Ops: ☐ *Good* ☐ *Fair: Slight Corrosion But Operates Properly* ☐ *Poor: Heavy Corrosion and is Difficult to Close or Open* ☐ *Other:*							
▪ ***Wet Well***	*N/A*	*Y / N*				*N/A*	
Wet Well Field Obs: ☐ *Good* ☐ *N/A* ☐ *Hatch Damaged or Difficult to Open* ☐ *Wet Structure Spalling or Cracked* ☐ *Evidence of Concrete Corrosion* ☐ *Wet Well Needs Cleaning - Solids/Grease* ☐ *Other:*							
Hatch Field Obs: ☐ *Good* ☐ *Fair: Minor Corrosion to Hatches, Hinges, or Latches* ☐ *Poor: Corroded or Broken Hatches, Hinges, or Latches* ☐ *Other:*							
Wet Well Ladder Field Obs: ☐ *Good* ☐ *Fair: Surface Corrosion; Steps Intact and Solid; Minor Anchor Bolt Corrosion* ☐ *Poor: Corroded or Broken Steps; Corroded or Broken Wall Anchors* ☐ *Other:*							
Wet Well Wall Field Obs: ☐ *Good* ☐ *Fair: Concrete Sealant Peeled or Cracked; Concrete Soft at Surface* ☐ *Poor: Exposed/Missing Aggregate; Exposed/Missing Re-bar* ☐ *Other:*							
Influent Pipe Field Obs: ☐ *Good* ☐ *Fair: Slight Corrosion; Pipe Intact* ☐ *Poor: Severe Pipe Corrosion* ☐ *Other:*							
Float Controls Field Obs: ☐ *Good* ☐ *Fair: Some Debris But Operating Properly* ☐ *Poor: Covered in Debris or Broken* ☐ *Other:*							
Sump Pump and Piping Field Obs: ☐ *Good* ☐ *Fair: Slight Pipe Corrosion* ☐ *Poor: Heavy Pipe Corrosion* ☐ *Other:*							
▪ ***Influent Valve #1***	*PS#-IN*	*Y / N*				*N/A*	
Influent Valve Field Obs: ☐ *Good* ☐ *Fair: Operates But Does Not Close Fully* ☐ *Poor: Does Not Operate* ☐ *Other:*							
▪ ***Influent Valve #2***	*PS#-IN*	*Y / N*				*N/A*	
Influent Valve Field Obs: ☐ *Good* ☐ *Fair: Operates But Does Not Close Fully* ☐ *Poor: Does Not Operate* ☐ *Other:*							
HVAC (HVA)		**Y / N**					
▪ ***Dry Well HVAC***	*N/A*	*Y / N*					
Asset Size: ☐ *KVA* ☐ *HP*							
Dry Well HVAC Field Obs: ☐ *Good* ☐ *N/A* ☐ *Old* ☐ *Ventilation Fans Inoperable* ☐ *Makes Noise* ☐ *Fans Vibrate* ☐ *Belts Loose or Torn* ☐ *Ventilation Duct Work Corroded* ☐ *Other:*							
▪ ***Wet Well HVAC***	*N/A*	*Y / N*					
Asset Size: ☐ *KVA* ☐ *HP*							
Wet Well HVAC Field Obs: ☐ *Good* ☐ *N/A* ☐ *Old* ☐ *Ventilation Fans Inoperable* ☐ *Makes Noise* ☐ *Fans Vibrate* ☐ *Belts Loose or Torn* ☐ *Ventilation Duct Work Corroded* ☐ *Other:*							

Condition Ranking: 1) Excellent 2) Slight Visible Degradation 3) Visible Degradation 4) Integrity of Component Moderately Compromised 5) Integrity of Component Severely Compromised
Performance Ranking: 1) Component Functioning As Intended 2) In-Service, But Higher Than Expected O&M 3) In-Service, But Function Is Impaired 4) In-Service, But Function Is Highly Impaired 5) Component Is Not Functioning As Intended

City of Puyallup Department of Public Works – Work Order
STORM WATER PUMP STATION CONDITION ASSESSMENT FORM

Asset Class	CMMS Code	Asset Present	Year Installed	Condition Score	Performance Score	Utilization (%)	Field Observation / Comments
Electrical Systems (ELE)		**Y / N**				**N/A**	
▪ ***Control Panels***	*N/A*	*Y / N*				*N/A*	
▪ ***Lighting Panels***	*N/A*	*Y / N*				*N/A*	
▪ ***Main Switch***	*N/A*	*Y / N*				*N/A*	
▪ ***Transfer Switch***	*N/A*	*Y / N*				*N/A*	
▪ ***Surge Suppressor Panel***	*N/A*	*Y / N*				*N/A*	
Asset Size:	☐ *220 V* ☐ *240 V* ☐ *460 V* ☐ *480 V*						
Electrical Systems Field Obs: ☐ *Good* ☐ *N/A* ☐ *Control Panel Corroded* ☐ *Old/Outdated/Obsolete* ☐ *Contacts Loose* ☐ *Cables Fatigued and Checked* ☐ *Dust Inside Panel* ☐ *Exposed Wires* ☐ *Switch Gear Worn* ☐ *Other:*							
Generator (GEN)		**Y / N**				**N/A**	
▪ ***Emergency Generator***	*N/A*	*Y / N*				*N/A*	
▪ ***Emer. Gen. Connector***	*N/A*	*Y / N*				*N/A*	
▪ ***Fuel Tank***	*N/A*	*Y / N*				*N/A*	
Asset Size:	☐ *KVA* ☐ *HP*						
Generator Field Obs: ☐ *Good* ☐ *N/A* ☐ *Contacts Loose* ☐ *Cables Fatigued and Checked* ☐ *Engine Fluids Low* ☐ *Poor Housekeeping* ☐ *Poor Accessibility* ☐ *Other:*							
Instrumentation (INS)		**Y / N**				**N/A**	
▪ ***SCADA/PLC/Controls***	*N/A*	*Y / N*				*N/A*	
▪ ***Level Transducers/Level Floats***	*N/A*	*Y / N*				*N/A*	
Instrumentation Field Obs: ☐ *Good* ☐ *N/A* ☐ *Transducer Failing* ☐ *Modem Failed* ☐ *Sensors Failed* ☐ *HMI Failed* ☐ *Controls Obsolete* ☐ *PLC Failed* ☐ *Poor Housekeeping* ☐ *Other:*							
Motors (MTR)							
▪ ***Motor 1***	*N/A*	*Y / N*					
Asset Size (HP):							
Motor 1 Field Obs: ☐ *Good* ☐ *N/A* ☐ *Makes Noise* ☐ *Vibrates* ☐ *Shaft Bearing Noise* ☐ *Opposite End Bearing Noise* ☐ *Overheating* ☐ *Needs Lubrication* ☐ *Over Lubricated* ☐ *Mount Failing* ☐ *Leaking* ☐ *Emergency Stop Button in Dry Well Inoperable* ☐ *Other:*							
▪ ***Motor 2***	*N/A*	*Y / N*					
Asset Size (HP):							
Motor 2 Field Obs: ☐ *Good* ☐ *N/A* ☐ *Makes Noise* ☐ *Vibrates* ☐ *Shaft Bearing Noise* ☐ *Opposite End Bearing Noise* ☐ *Overheating* ☐ *Needs Lubrication* ☐ *Over Lubricated* ☐ *Mount Failing* ☐ *Leaking* ☐ *Emergency Stop Button in Dry Well Inoperable* ☐ *Other:*							
Hor. And Vert. Pumps (PMS)							
▪ ***Pump 1***	*N/A*	*Y / N*					
Discharge Size:	*Suction Diameter:*			*Pump Size (GPM):*		*TD H:*	
Pump 1 Field Obs: ☐ *Good* ☐ *N/A* ☐ *Seals Leaking* ☐ *Vibrating* ☐ *Shaft Deflection* ☐ *Cavitating* ☐ *Belts Loose* ☐ *Bearing Noise* ☐ *Mount Failing* ☐ *Evidence of Pipe Strain* ☐ *Other:*							
Pump Vent Line Field Obs: ☐ *Good* ☐ *Fair: Slight Corrosion But Operates Properly; Needs Sealant Around Opening* ☐ *Poor: Any One Vent Does Not Operate; Corroded or Broken Off at Wall* ☐ *Other:*							
▪ ***Pump 2***	*N/A*	*Y / N*					
Discharge Size:	*Suction Diameter:*			*Pump Size (GPM):*		*TD H:*	
Pump 2 Field Obs: ☐ *Good* ☐ *N/A* ☐ *Seals Leaking* ☐ *Vibrating* ☐ *Shaft Deflection* ☐ *Cavitating* ☐ *Belts Loose* ☐ *Bearing Noise* ☐ *Mount Failing* ☐ *Evidence of Pipe Strain* ☐ *Other:*							
Submersible Pumps (SUB)							
▪ ***Pump 1***	*N/A*	*Y / N*					
Discharge Size:	*Suction Diameter:*		*Pump Size (HP):*		*Pump Size (GPM):*		*TD H:*
Pump and Motor 1 Field Obs: ☐ *Good* ☐ *N/A* ☐ *Rail System Corroded* ☐ *Does Not Seat Well* ☐ *Cables Corroded or Failing* ☐ *Other:*							
▪ ***Pump 2***	*N/A*	*Y / N*					
Discharge Size:	*Suction Diameter:*		*Pump Size (HP):*		*Pump Size (GPM):*		*TD H:*

Condition Ranking: 1) Excellent 2) Slight Visible Degradation 3) Visible Degradation 4) Integrity of Component Moderately Compromised 5) Integrity of Component Severely Compromised
Performance Ranking: 1) Component Functioning As Intended 2) In-Service, But Higher Than Expected O&M 3) In-Service, But Function Is Impaired 4) In-Service, But Function Is Highly Impaired 5) Component Is Not Functioning As Intended

City of Puyallup Department of Public Works – Work Order
STORM WATER PUMP STATION CONDITION ASSESSMENT FORM

Asset Class	CMMS Code	Asset Present	Year Installed	Condition Score	Performance Score	Utilization (%)	Field Observation / Comments
Pump and Motor 2 Field Obs: ☐ *Good* ☐ *N/A* ☐ *Rail System Corroded* ☐ *Does Not Seat Well* ☐ *Cables Corroded or Failing* ☐ *Other:*							
Piping and Valves (MEC)		**Y / N**				**N/A**	
Suction Isolation Valves							
▪ ***Pump 1***	*N/A*	*Y / N*				*N/A*	
Suction Iso Valve Size:	☐ *3 in.* ☐ *4 in.* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
Piping and Valves Field Obs: ☐ *Good* ☐ *N/A* ☐ *Valve Operator Stuck* ☐ *Valve Seat Leaking* ☐ *Flanges Leaking* ☐ *Valve Not Seating* ☐ *Valve Not Operating* ☐ *Evidence of Pipe Strain* ☐ *Other:*							
▪ ***Pump 2***	*N/A*	*Y / N*				*N/A*	
Suction Iso Valve Size:	☐ *3 in.* ☐ *4 in.* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
	☐ *Good* ☐ *N/A* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
Discharge Isolation Valves							
▪ ***Pump 1***	*N/A*	*Y / N*				*N/A*	
Discharge Iso Valve Size:	☐ *3 in.* ☐ *4 in.* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
Piping and Valves Field Obs: ☐ *Good* ☐ *N/A* ☐ *Valve Operator Stuck* ☐ *Valve Seat Leaking* ☐ *Flanges Leaking* ☐ *Valve Not Seating* ☐ *Valve Not Operating* ☐ *Evidence of Pipe Strain* ☐ *Other:*							
▪ ***Pump 2***	*N/A*	*Y / N*				*N/A*	
Discharge Iso Valve Size:	☐ *3 in.* ☐ *4 in.* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
	☐ *Good* ☐ *N/A* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
Check Valves							
▪ ***Pump 1***	*N/A*	*Y / N*				*N/A*	
Check Valve Size:	☐ *3 in.* ☐ *4 in.* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
Piping and Valves Field Obs: ☐ *Good* ☐ *N/A* ☐ *Valve Operator Stuck* ☐ *Valve Seat Leaking* ☐ *Flanges Leaking* ☐ *Valve Not Seating* ☐ *Check Valve Not Operating* ☐ *Evidence of Pipe Strain* ☐ *Other:*							
▪ ***Pump 2***	*N/A*	*Y / N*				*N/A*	
Check Valve Size:	☐ *3 in.* ☐ *4 in.* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
	☐ *Good* ☐ *N/A* ☐ *6 in.* ☐ *8 in.* ☐ *10 in.* ☐ *12 in.* ☐ *14 in.* ☐ *16 in.* ☐ *24 in.* ☐ *36 in.* ☐ *48 in.*						
Additional Comments							

Condition Ranking: 1) Excellent 2) Slight Visible Degradation 3) Visible Degradation 4) Integrity of Component Moderately Compromised 5) Integrity of Component Severely Compromised
Performance Ranking: 1) Component Functioning As Intended 2) In-Service, But Higher Than Expected O&M 3) In-Service, But Function Is Impaired 4) In-Service, But Function Is Highly Impaired 5) Component Is Not Functioning As Intended

Attachment D: 4th Street Pump Station Condition Assessment and Scoring

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

Facility ID	Facility Name	Facility Type	Capacity (gpm)	Install Date	Station Type
D7-00193	4th ST NW (Skate Park)	Storm/Flood		1978	Underground

LIKELIHOOD OF FAILURE

Condition/Maintenance Based

Design/Construction Based

	Preventive maintenance and inspection history			Asset failure			Remaining life			Level of Service		
Criteria Weight	15			15			10			15		
	Preventive maintenance, testing, or inspections completed in accordance with plans.			Frequency of asset failure within 2 years under normal operating conditions based on historical asset operation and maintenance records.			Remaining useful life based on the asset's age			Does it meet LOS?		

Asset ID	Asset Name	Asset Type	Capacity (gpm)	Install Date	Station Type	# of Assets													
1	**Station Summary**			**1978**	**Underground**		**3**	**(3) Preventive Maintenance and inspection scheduled but infrequently performed**		**3**	**(3) 1 or more failures in the analysis period**		**4**	**(4) 40% to 20% useful life remaining**		**5**	**(5) Does not meet LOS**	
2	Wet Well			1978			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
3	Wet Well Hatch						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
4	Wet Well Ladder						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
5	Wet Well Wall						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
6	Influent Pipe						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
7	Float Controls						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
8	Sump Pump and Piping						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
9	Control Panels			1978			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
10	Main Switch			1978			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
11	Electrical Systems						3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
12	SCADA			2019			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	1	(1) New or like new. Greater than 80% useful life remaining		5	(5) Does not meet LOS	Based on station score
13	Pump 1			1978			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
14	Valve, Pump 1, Discharge Isolation			1978			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score
15	Valve, Pump 1, Check			1978			3	(3) Preventive Maintenance and inspection scheduled but infrequently performed	Updated due to condition assessment	3	(3) 1 or more failures in the analysis period	Based on station score	4	(4) 40% to 20% useful life remaining	Based on station score	5	(5) Does not meet LOS	Based on station score

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

Facility ID	Facility Name	Facility Type	Capacity (gpm)	Install Date	Station Type
D7-00193	4th ST NW (Skate Park)	Storm/Flood		1978	Underground

LIKELIHOOD OF FAILURE

Design/Construction Based

	Difficult to maintain or limited/unsafe access			Spare parts availability			Backup Power Availability			Pump Around Availability/Pump Redundancy		
Criteria Weight	15			15			5			10		
	Assets that require specialized skills or equipment to operate and maintain; difficult to access			Assets with parts that are difficult to find, no longer made, and/or with no vendor support.			Availability of backup power.			Availability of redundant pump or pump around capabilities.		
Asset ID												
1	**Station Summary**			**3**	**(3) Limited access and/or requires specialized skills or equipment available in-house**		**3**	**(3) Parts available within a week**		**5**	**(5) No backup power**		**4**	**(4) Limited ability to pump around.**	
2	Wet Well			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	5	(5) Parts available within multiple months or no parts available and/or no vendor support		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
3	Wet Well Hatch			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	3	(3) Parts available within a week		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
4	Wet Well Ladder			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	4	(4) Parts available within a month		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
5	Wet Well Wall			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	5	(5) Parts available within multiple months or no parts available and/or no vendor support		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
6	Influent Pipe			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	4	(4) Parts available within a month		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
7	Float Controls			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	3	(3) Parts available within a week		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
8	Sump Pump and Piping			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	4	(4) Parts available within a month		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
9	Control Panels			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	4	(4) Parts available within a month		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
10	Main Switch			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	4	(4) Parts available within a month		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
11	Electrical Systems			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	4	(4) Parts available within a month		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
12	SCADA			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	3	(3) Parts available within a week		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
13	Pump 1			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	3	(3) Parts available within a week		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
14	Valve, Pump 1, Discharge Isolation			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	3	(3) Parts available within a week		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score
15	Valve, Pump 1, Check			3	(3) Limited access and/or requires specialized skills or equipment available in-house	Based on station score	3	(3) Parts available within a week		5	(5) No backup power	Based on station score	4	(4) Limited ability to pump around.	Based on station score

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

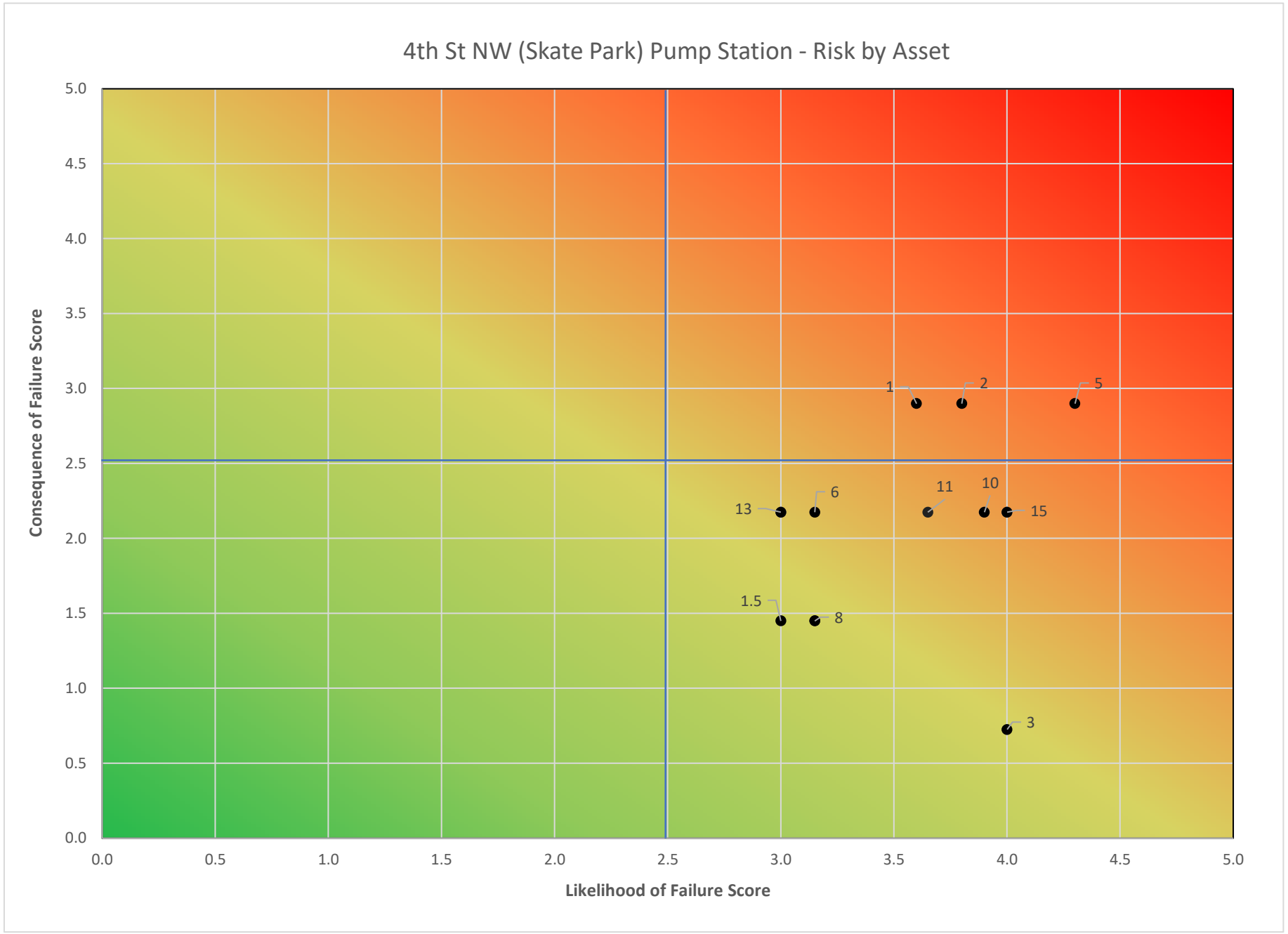
Facility ID	Facility Name	Facility Type	Capacity (gpm)	Install Date	Station Type
D7-00193	4th ST NW (Skate Park)	Storm/Flood		1978	Underground

							LIKELIHOOD OF FAILURE			**CONSEQUENCE OF FAILURE**									
							Design/Construction Based												
							Condition			**Reputation and public relations impacts**			**Community and stakeholder impacts**			**Health and safety impacts**		
						Criteria Weight	**25**			**15**			**20**			**20**		
							Physical or Performance Condition Worst score based on condition assessment			**Effect of reputation and public perception impacts based on media attention/story (i.e., attention the failure draws)**			**Number of customers, assets, and/or facilities impacted due to due to a failure.**			**Public health and safety impacts, and employee safety**		
Asset ID	**Asset Name**	**Asset Type**	**Capacity (gpm)**	**Install Date**	**Station Type**	**# of Assets**													
1	**Station Summary**			**1978**	**Underground**					**3**	**(3) Corresponce with elected city officials or city manager**		**2**	**(2) Local roadway impacted or fewer than 100 community members impacted**		**5**	**(5) Flood control pump station, pump station is underground, or high traffic risk**	
2	Wet Well			1978			3	(3) Visible Degradation	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
3	Wet Well Hatch						5	(5) Integrity of Component Severely Compromised	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
4	Wet Well Ladder						1	(1) Excellent	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
5	Wet Well Wall						5	(5) Integrity of Component Severely Compromised	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
6	Influent Pipe						1	(1) Excellent	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
7	Float Controls						1	(1) Excellent	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
8	Sump Pump and Piping						1	(1) Excellent	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
9	Control Panels			1978			4	(4) Integrity of Component Moderatly Compromised	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
10	Main Switch			1978			4	(4) Integrity of Component Moderatly Compromised	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
11	Electrical Systems						3	(3) Visible Degradation	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
12	SCADA			2019			1	(1) Excellent	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
13	Pump 1			1978			1	(1) Excellent	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
14	Valve, Pump 1, Discharge Isolation			1978			5	(5) Integrity of Component Severely Compromised	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score
15	Valve, Pump 1, Check			1978			5	(5) Integrity of Component Severely Compromised	Based on condition assessment 4/3/24	3	(3) Corresponce with elected city officials or city manager	Based on station score	2	(2) Local roadway impacted or fewer than 100 community members impacted	Based on station score	5	(5) Flood control pump station, pump station is underground, or high traffic risk	Based on station score

FACILITY LIKELIHOOD AND CONSEQUENCE OF FAILURE: PUMP STATIONS

Facility ID	Facility Name	Facility Type	Capacity (gpm)	Install Date	Station Type
D7-00193	4th ST NW (Skate Park)	Storm/Flood		1978	Underground

							CONSEQUENCE OF FAILURE						Asset Consequence Factor					
							Indirect economic impacts			External economic impacts			Consequence Rating					
						Criteria Weight	15			30								
							Total repair or rehabilitation and/or replacement costs; increased operational costs			Liability costs, fines, property damage			Consequence of asset failure on function of station.			Total Weighted Likelihood of Failure Score	Total Weighted Consequence of Failure Score	Adjusted Consequence of Failure Score	Total Adjusted Risk Score
Asset ID	Asset Name	Asset Type	Capacity (gpm)	Install Date	Station Type	# of Assets													
1	**Station Summary**			**1978**	**Underground**		**3**	**(3) $250k to $500k or unknown**		**2**	**(2) $5k to $20k**		**4**	**Catasrophic**	**Full score of the station**	**3.6**	**2.9**	**2.9**	**10.4**
2	Wet Well			1978			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	4	Catasrophic		**3.8**	**2.9**	**2.9**	**11.0**
3	Wet Well Hatch						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	1	Station Upset		**4.0**	**2.9**	**0.7**	**2.9**
4	Wet Well Ladder						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	2	Station Interruption	Safety issue	**3.2**	**2.9**	**1.5**	**4.6**
5	Wet Well Wall						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	4	Catasrophic		**4.3**	**2.9**	**2.9**	**12.5**
6	Influent Pipe						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**3.2**	**2.9**	**2.2**	**6.9**
7	Float Controls						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**3.0**	**2.9**	**2.2**	**6.5**
8	Sump Pump and Piping						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	2	Station Interruption		**3.2**	**2.9**	**1.5**	**4.6**
9	Control Panels			1978			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**3.9**	**2.9**	**2.2**	**8.5**
10	Main Switch			1978			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**3.9**	**2.9**	**2.2**	**8.5**
11	Electrical Systems						3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**3.7**	**2.9**	**2.2**	**7.9**
12	SCADA			2019			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	2	Station Interruption	Assuming that the station can operate on local programming.	**3.0**	**2.9**	**1.5**	**4.4**
13	Pump 1			1978			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**3.0**	**2.9**	**2.2**	**6.5**
14	Valve, Pump 1, Discharge Isolation			1978			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**4.0**	**2.9**	**2.2**	**8.7**
15	Valve, Pump 1, Check			1978			3	(3) $250k to $500k or unknown	Based on station score	2	(2) $5k to $20k	Based on station score	3	Station Failure		**4.0**	**2.9**	**2.2**	**8.7**


4th St NW (Skate Park) Pump Station - Risk by Asset
Consequence of Failure Score
Likelihood of Failure Score
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
1
2
5
13
6
11
10
15
1.5
8
3

Asset Class	Inspection Date - 4/3/24		Inspection Date -		Inspection Date -		Inspection Date -		Inspection Date -		Inspection Date -		Inspection Date -		Inspection Date -	
	Condition Score	Performance Score	Condition Score	Performance Score	Condition Score	Performance Score	Condition Score	Performance Score	Condition Score	Performance Score	Condition Score	Performance Score	Condition Score	Performance Score	Condition Score	Performance Score
Site																
Sidewalks	1	1														
Landscaping	2	1														
Fencing	1	1														
Access Road/Vehicle Access	2	3														
Structure and Wet Well																
Building	N/A	N/A														
Dry Well/Basement	N/A	N/A														
Dry Well Ladder	N/A	N/A														
Dry Well Wall	N/A	N/A														
Door	N/A	N/A														
Wet Well	2	1														
Hatch	5	N/A														
Wet Well Ladder	1	N/A														
Wet Well Wall	5	N/A														
Intermediate Slab	N/A	N/A														
Influent Pipe	1	N/A														
Float Controls	1	N/A														
Sump Pump and Piping	1	N/A														
Scratch Test		N/A														
Influent Valve #1	N/A	N/A														
Influent Valve #2	N/A	N/A														
HVAC																
Dry Well HVAC	N/A	N/A														
Wet Well HVAC	N/A	N/A														
Electrical Systems																
Control Panels	4	2														
Lighting Panels	N/A	N/A														
Main Switch	4	1														
Transfer Switch	N/A	N/A														
Surge Suppressor Panel	N/A	N/A														
Electrical Systems	3	3														
Generator																
Emergency Generator	N/A	N/A														
Emergency Generator Connector	N/A	N/A														
Fuel Tank	N/A	N/A														
Instrumentation																
SCADA	1	1														
Level Transducers	N/A	N/A														
Submersible Pumps																
Pump 1	1	1														
Piping and Valves																
Suction Isolation Valves																
Pump 1	N/A	N/A														
Discharge Isolation Valves																
Pump 1	5	3														
Check Valves																
Pump 1	5	3														

Appendix E: Capital Improvement Project Costs

Appendix F: Subbasin Map Book