City of Portland
Bureau of Environmental Services

Fanno/Tryon Water Quality and TMDL CIP Pre-design #7622 Report

2008

June 2008 Final Report

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Appendices

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1.0 Introduction

Purpose

This *Fanno Tryon Water Quality and TMDL CIP Pre-design #7622 Report* (Pre-design) recommends a comprehensive and strategic set of projects for the Fanno Creek and Tryon Creek watersheds to improve watershed health and meet regulatory obligations.

Bureau of Environmental Services (BES) staff from Watershed Services, Engineering Services, Systems Analysis, and Maintenance Engineering collaborated throughout the entire development of this report. This collaboration is reflected in the breadth of the recommended projects.

Watershed Approach

The watershed approach moves away from watershed management that responds individually to different environmental regulations with independent and single-focus efforts that don't consider overlapping issues. Built on a scientifically sound foundation, the watershed approach addresses the sources and causes of environmental problems rather than focusing on symptoms or meeting specific regulatory requirements. This approach seeks efficiencies and greater flexibility to find creative, multi-objective solutions that meet multiple requirements and save money. By identifying goals, objectives, strategies, and actions, this approach aims to protect the best remaining resources and improve watershed functions and conditions citywide.

The Pre-design is based on the watershed approach. It recommends projects that address multiple watershed goals to improve watershed health and meet regulatory obligations.

Regulatory Background

TMDLs and MS4 Permit

The Clean Water Act (CWA) of 1972 and later amendments regulate discharges of pollutants to waters of the United States from both point sources (such as wastewater treatment plants and industrial discharges) and non-point sources (such as stormwater runoff). Under section 303(d) of the CWA, states are required to develop lists of impaired waters that do not meet state water quality standards designed to protect beneficial uses. Beneficial uses range from water contact recreation and fish and aquatic life to irrigation and public water supply. The Oregon Department of Environmental Quality (DEQ) has developed a statewide 303(d) list that identifies water body reaches that are "water quality limited" because they do not meet instream water quality standards set for certain pollutants to ensure support for the beneficial uses designated for that reach. DEQ then establishes total maximum daily loads (TMDLs) that specify the maximum amounts of the designated pollutants the water body can receive from all point and non-point sources.

TMDLs for total phosphorus and ammonia were established for Fanno Creek (Tualatin Subbasin TMDL) in 1988. The TMDLs were revised in 2001, and additional TMDLs were established for temperature, bacteria, and dissolved oxygen. The TMDLs include both waste load allocations (for point sources) and load allocations (for non-point sources).

In 1995, DEQ issued an NPDES Municipal Separate Storm Sewer System (MS4) permit to the City of Portland. The permit required the City to implement various categories of stormwater quality best management practices (BMPs) in order to reduce pollutants in runoff to the maximum extent practicable (MEP).

A renewed MS4 permit was issued in 2004; following a reconsideration process, the permit was reissued in 2005. The MS4 permit retained the requirement to reduce pollutants to the MEP. In addition, it required the establishment of pollutant load reduction benchmarks for all existing TMDL parameters with waste load allocations, including the Fanno Creek TMDLs. These benchmarks were submitted to DEQ as part of a revised Stormwater Management Plan (SWMP) in 2006.

In 2006, DEQ established TMDLs for temperature and bacteria in Tryon Creek (Lower Willamette Subbasin TMDL).

See Section 8.1: TMDL and MS4 Technical Memorandum for additional details and specific requirements of the TMDLs and MS4 permit.

Endangered Species Act (ESA)

The Endangered Species Act (ESA) of 1973 provides for the conservation of threatened and endangered plant and animal species and the ecosystems on which they depend. The National Marine Fisheries Service has enacted regulations that make it unlawful to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect listed aquatic species or even to attempt to engage in such conduct. The definition of "harm" includes habitat modification if the modification kills or injures fish by significantly impairing essential behavioral patterns such as feeding, sheltering, rearing, migrating, breeding, and spawning.

Lower Tryon Creek (up to Highway 43) is designated critical habitat for Upper Willamette and lower Columbia River Chinook, and all mainstem reaches of Tryon Creek (up to Marshall Cascades) are designated critical habitat for lower Columbia River coho (threatened) and lower Columbia River steelhead (threatened). Upper Willamette River steelhead (threatened) historically populated the Fanno Creek Basin.

The City of Portland (COP) is committed to ensuring that ongoing activities do not jeopardize listed and threatened species and to supporting the recovery of ESA listed and proposed species.

Any project that directly or indirectly impacts listed coho, steelhead, or Chinook or the habitats in which they reside will require federal consultation with NOAA Fisheries. Projects that enhance aquatic habitat, improve habitat connectivity, and manage stormwater runoff will contribute toward the recovery of ESA-listed species. A number of projects described in this report will assist in recovery.

Watershed Planning Background

The Pre-design recommends projects that address multiple watershed goals to improve watershed health and meet regulatory obligations. This comprehensive approach to improving Portland's watershed conditions is reflected in the 2005 *Portland Watershed Management Plan* (PWMP), adopted by Portland's City Council in March 2006. Built on a scientifically sound foundation, the watershed approach addresses the sources and causes of environmental problems rather than focusing on symptoms or meeting specific regulatory requirements.

The PWMP identifies 20 actions, organized into 6 strategies: aquatic and terrestrial enhancement, revegetation, stormwater management, policy and protection, education and outreach, and operations and maintenance. The PWMP describes and maps the strategies to show where they can be applied throughout the City to advance the PWMP's goals and objectives. The PWMP also identifies existing projects, programs, and areas of opportunity to incorporate improvement strategies into existing City priorities. From this analysis, a Watershed Priority Areas map highlights priority areas of interest and strategies for improving watershed conditions over the next 2 to 5 years. This list of priorities will be updated every 5 years to reflect monitoring results of implemented projects and continuing research and evaluation of watershed conditions.

The *Fanno and Tryon Creeks Watershed Management Plan* (FTCWMP) (BES, 2005) provides a detailed characterization of conditions in the Fanno Creek and Tryon Creek watersheds, identifies specific problems and opportunities, describes goals and objectives, and outlines projects and programs to improve watershed health. Major factors that limit watershed health in these watersheds are:

- Development and high levels of impervious surface cover contribute to increased stormwater runoff volumes and velocities that can cause streambank instability, undercutting, erosion, in-stream sedimentation, and channel incision.

- Water quality is impaired for certain water quality parameters. Stormwater runoff from upland sources and from development contributes pollutants to streams, and erosion contributes to high levels of total suspended solids. Fanno Creek has TMDLs for total phosphorus, temperature, dissolved oxygen, and bacteria. Tryon Creek has TMDLs for temperature and bacteria. The Oregon Water Quality Index ranks water quality for both Fanno Creek and Tryon Creek as poor.

- Physical habitat conditions are generally simplified and disconnected. Development has narrowed and disconnected streams and riparian corridors. In-stream habitat suffers from lack of structure (e.g., wood and boulders) and from high proportions of sand and silt substrate; the latter is contributed by eroding streambanks caused partly by increased stormwater runoff from upland development. Numerous culverts severely constrain fish passage.

- Existing sanitary sewers are commonly located in sensitive stream corridors where they can potentially impact water quality and stream habitat. For example, the Tryon Creek interceptor sanitary sewer runs along Lower Tryon Creek, with numerous stream crossings.

The FTCWMP identifies and recommends various actions and programs to address these conditions. Actions include stormwater retrofits, revegetation, land acquisition, ditch-to-swale conversions, and stream enhancement. Most actions are identified on maps; some are specific sites, while others are general target areas. A general implementation approach is outlined for each watershed.

CIP Pre-design Project and Report

Following completion of the FTCWMP, BES conducted the Pre-design project to further analyze, coordinate, and prioritize the potential actions identified in the FTCWMP and to develop important projects up to the pre-design phase. This Pre-design report documents the pre-design process, findings, and recommendations. It contains the following chapters:

2.0 Watershed Overview

This chapter briefly describes watershed conditions and the recommended actions and approach described in the FTCWMP.

3.0 Goals and Objectives

Goals and objectives were used to develop project prioritization and design criteria.

4.0 Approach

This chapter describes how the Pre-design project was organized and conducted.

5.0 Project Summaries

This chapter summarizes pre-design projects and describes the basis for cost estimates.

6.0 Evaluation of Benefits

This chapter describes the process used to evaluate projects in relation to the multi-objective pre-design goals.

7.0 Recommendations and Implementation Plan

This chapter presents a prioritized list of recommended projects.

8.0 Technical Documents

This chapter contains the technical memorandums and pre-designs.

2.0 Watershed Overview

Purpose

The purpose of chapter is to briefly describe watershed conditions and summarize the recommended actions and approach described in the Fanno and Tryon Creeks Watershed Management Plan (FTCWMP) (BES, 2005).

Fanno Creek Watershed

Watershed Characteristics

The Fanno Creek Watershed, located within the southwest Portland metropolitan area, covers an area of approximately 20,259 acres, or 32 square miles (90 square kilometers) (Figure 2-1). Approximately 4,528 acres are within Portland's city limits. This number does not include areas of northwest Portland along Skyline Boulevard and in the Cedar Mill Creek basin that also drain into the Tualatin Watershed. The remaining watershed area is within the jurisdictions of Durham, Tigard, and Beaverton. Unless otherwise noted, the data provided in this chapter apply to the portion of the watershed within Portland's jurisdiction.

The Fanno Creek Watershed is divided into eight subwatersheds, as shown in Table 2-1. These subwatersheds contain about 23 miles of open streams. Approximately 5 miles of streams are in culverts or pipes.

Table 2-1: Fanno Creek Subwatersheds—Acreage and Streams

Subwatershed	Area (acres)	Open Channel (miles)	Pipe or Culvert (miles)
Fanno Creek Mainstem	1,830	12.2	2.7
Pendleton Creek	230	0.9	0.2
Vermont Creek	758	3.5	0.6
Woods Creek	575	2.9	0.4
North Ash Creek	282	1.3	0.3
South Ash Creek	359	1.2	0.3
Red Rock Creek	413	0.4	0.1
Sylvan Creek	79	0.3	0.0
Total (Watershed)	**4,528**	**22.6**	**4.6**

The current major land use in the watershed is single-family residential (Table 2-2). Commercial land uses are located primarily along major transportation routes, particularly Beaverton Hillsdale Highway along Fanno Creek mainstem. Impervious surfaces, such as streets, parking lots, and buildings, are concentrated along these transportation and commercial corridors. Overall, impervious surfaces cover about 33 percent of the Fanno Creek Watershed. Parks and open space, including public and private property, total about 6 percent of the watershed. Major

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parks and open space include Gabriel Park (84 acres), Woods Memorial Park (33 acres), and Mt. Calvary Cemetery (17 acres).

Table 2-2: Base Zoning within the Fanno Creek Watershed

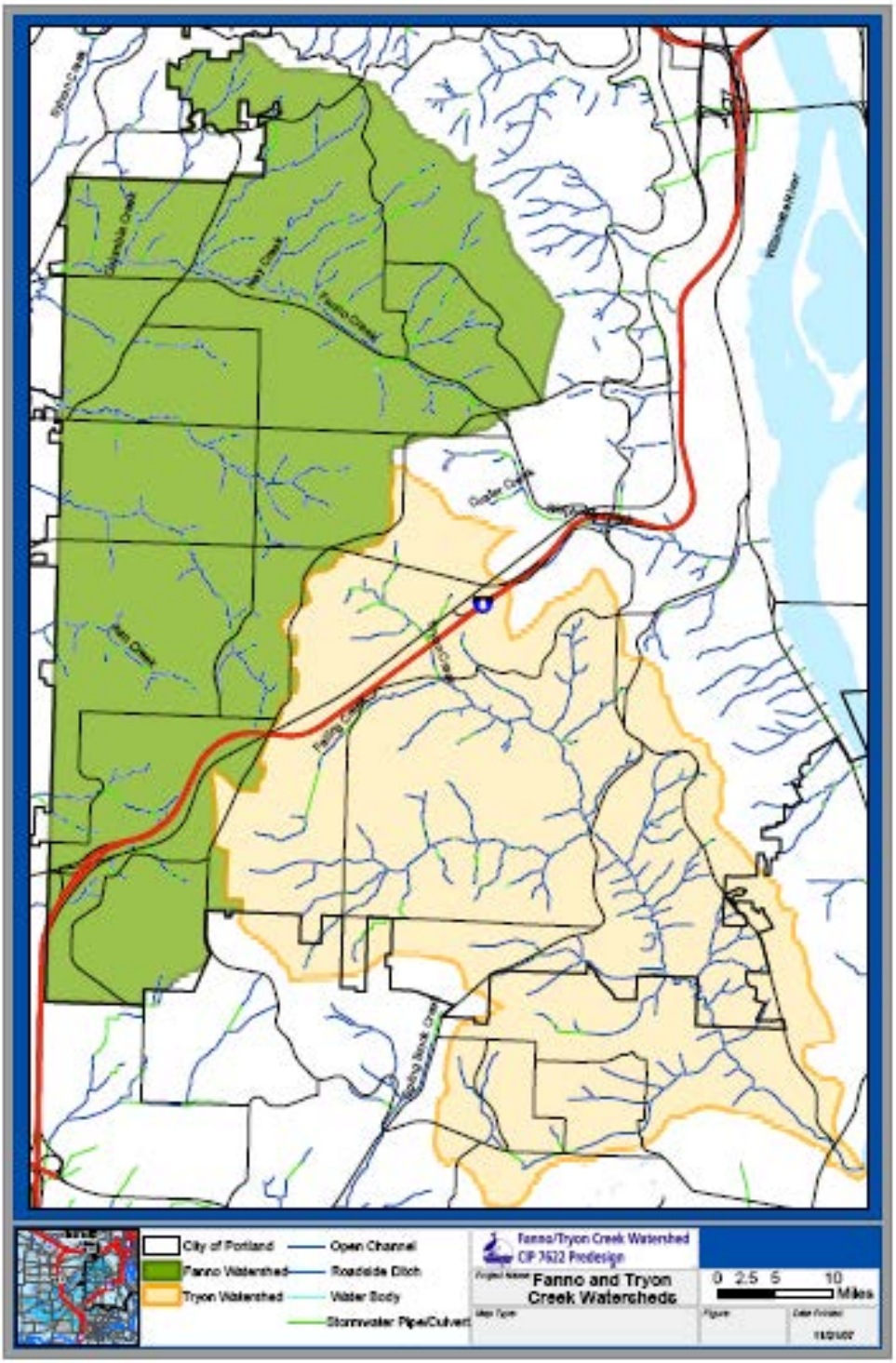
Land Use Category	Current Area	
	Acres	***Percentage***
Commercial	173	4
Multi-family Residential	353	8
Parks/Open Space	261	6
Single-family Residential	3,741	82
Total	**4,528**	**100**

Fanno Creek Watershed's topographic features, soils and hydrology, and impervious surfaces are closely linked to the physical stability of the watershed and stream systems. They are critical in defining channel morphology and structure, slope stability, and soil erosion and sediment transport. Overall, the topography is characterized by steep slopes, soils that are slow to infiltrate rainfall, and impervious surfaces that result in a "flashy" urban stormwater system.

In 2001, the Oregon Department of Fish and Wildlife (ODFW) conducted habitat surveys in Fanno Creek mainstem, North Ash Creek, South Ash Creek, Woods Creek, and Vermont Creek. Development has altered physical habitat throughout all of these subwatersheds. Riparian corridors are generally narrow, and vegetation cover is low along much of the creeks. The creeks do not substantively interact with the floodplain. In-stream habitat suffers from lack of structure (e.g., wood and boulders) and from high proportions of sand and silt substrate contributed by eroding stream banks, resulting partly from increased stormwater runoff from upland development. Numerous culverts severely constrain fish passage.

In 1999-2001, ODFW conducted Index of Biotic Integrity (IBI) fish evaluations and surveys to assess the biological integrity of Fanno Creek and Ash Creek. The results show that Upper Fanno Creek is severely impaired much of the year. Ash Creek is severely impaired year round.

Figure 2-1: Fanno and Tryon Creek Watersheds



Watershed Problems and Opportunities

Based on the characterization and analysis of watershed conditions, the following critical problems that limit watershed health were identified, as well as opportunities for improvement.

Problems

- Fanno Creek's hydrology and hydraulics have been altered as a result of changes in natural drainage complexity, loss of vegetation, and development, particularly along Beaverton Hillsdale Highway, which is parallel to Fanno Creek. Impervious surfaces increase stormwater runoff and decrease summer base flows. These altered conditions affect natural stream channel-forming processes, contribute to aquatic habitat degradation (e.g., stream channel incision, simplification of channel complexity), and degrade water quality.

- Water quality in Fanno Creek is impaired for certain water quality parameters. Monitoring indicates that summer in-stream temperatures exceed the water quality standard of 64 degrees F necessary for protection of salmonid rearing. E. coli levels exceed the water quality standard in 50 percent of samples in summer and 25 percent during winter. Fanno Creek was ranked as poor on the Oregon Water Quality Index because of high levels of nutrients (total phosphorus and ammonia+nitrate nitrogen), total solids, and bacteria. Alterations in hydrology, hydraulics, and habitat, particularly resulting from development, contribute to water quality impairment. Stormwater runoff from existing sources and development contributes pollutants to streams.

- Physical habitat throughout the Fanno Creek mainstem has been altered by development. The riparian corridor is narrow, and vegetation cover is low along most of the creek. The creek does not substantively interact with the floodplain. In-stream habitat suffers from lack of structure (e.g., wood, and boulders) and from high proportions of sand and silt substrate contributed by eroding stream banks, resulting partly from increased stormwater runoff from upland development. Fish passage is severely constrained by numerous culverts.

- Biological communities are limited in Fanno Creek. Sensitive macroinvertebrate populations are lacking throughout the watershed, largely because of a lack of suitable substrate and possibly because of water quality impairment. Index of Biotic Integrity (IBI) assessments indicate that upper Fanno Creek lacks diverse fish communities and is severely impaired in the summer, fall, and winter.

Opportunities

- Opportunities exist to retrofit existing development to manage stormwater runoff. This includes installation of site-specific retrofits such as parking lot swales, water quality and detention facilities, and improvements to existing highway drainage facilities. These actions will filter stormwater runoff and help attenuate flows, helping to improve water quality and return hydrologic conditions toward a more natural hydrograph.

- Opportunities exist to improve aquatic habitat connectivity for native fish communities by retrofitting or replacing culverts.

FTCWMP Actions and Recommended Approach

To address watershed problems and take advantage of opportunities, the FTCWMP recommends specific actions and an overall approach to guide implementation of the actions.

Actions are divided into the following categories:

- Stormwater Management
- Revegetation
- Aquatic and Riparian Enhancement
- Protection and Policy
- Operations and Maintenance
- Outreach, Stewardship, and Education

Two main elements of the overall implementation approach for Fanno Creek are:

1. Implementation of programs and stormwater retrofit actions in highly developed portions of the watershed to manage stormwater runoff from impervious areas onsite. Actions and programs will initially focus on transportation and commercial corridors.

2. Implementation of actions and programmatic and policy measures to protect and improve aquatic and riparian habitat.

Implementation of these actions will meet FTCWMP goals and objectives. Benefits include:

- Treatment and detention of stormwater runoff, helping to protect in-stream habitat, biological communities, and meet total maximum daily load (TMDL) water quality regulatory obligations.

- Enhancement of aquatic and riparian habitat through stream restoration and revegation, improving habitat for fish and other biological communities and restoring the natural watershed functions.

- Protection and rehabilitation of City sanitary sewer infrastructure to provide long-term service and protect water quality.

- Rehabilitation and replacement of stream culverts to improve fish passage and meet City design standards.

- Protection of land that connects and/or expands existing natural areas to protect existing natural watershed functions and provide critical habitat connectivity for biological communities.

Tryon Creek Watershed

Watershed Characteristics

The Tryon Creek Watershed in southwest Portland covers an area of approximately 4,142 acres, or 6.5 square miles (Figure 2-1). Approximately 3,058 acres (nearly 80 percent of the watershed) is within Portland's city limits. The remaining watershed area is within the jurisdictions of Multnomah County, Clackamas County, and the City of Lake Oswego. Unless otherwise noted, the data provided in this chapter apply to the portion of the watershed within Portland's jurisdiction.

The Tryon Creek Watershed is divided into three subwatersheds, as shown in Table 2-3. These subwatersheds contain about 27 miles of open streams. Approximately 3 miles of streams are in culverts or pipes.

Table 2-3: Tryon Creek Subwatersheds Acreage and Streams

Subwatershed	Area (acres)	Open Channel (miles)	Pipe or Culvert (miles)
Tryon Creek Mainstem	3,083	20.9	2.1
Arnold Creek	775	5.6	0.9
Falling Creek	283	1.0	0.5
Total (Watershed)	**4,142**	**27.5**	**3.4**

The predominant land use in the Tryon Creek Watershed is single-family residential (Table 2-4). Commercial and multi-family residential land uses are concentrated along major transportation corridors, particularly along Interstate 5 and Barbur Boulevard in the upper Tryon Creek Watershed. Impervious surfaces, such as streets, parking lots, and buildings, are concentrated along these transportation and commercial corridors. Overall, impervious surfaces cover about 24 percent of the Tryon Creek Watershed. Parks and open space, including public and private property, total over 14 percent of the watershed. The most significant open space is Tryon Creek State Natural Area (approximately 630 acres, a portion of it is outside Portland), located in lower and middle Tryon Creek. Other major parks and open space throughout the watershed include Marshall Park (25 acres), West Portland Park (21 acres), and Maricara Nature Park (17 acres).

Table 2-4: Base Zoning within the Tryon Creek Watershed

Land Use Category	Current Area	
	Acres	***Percentage***
Commercial	127	3
Multi-family Residential	185	5
Parks/Open Space	592	14
Single-family Residential	2,289	55
Outside City Boundary	857	21
Insufficient Data	**92**	**2**
Total	**4,142**	**100**

Tryon Creek Watershed's topographic features, soils and hydrology, and impervious surfaces are closely linked to the physical stability of the watershed and stream systems. They are critical in

defining channel morphology and structure, slope stability, and soil erosion and sediment transport. Overall, the topography is characterized by steep slopes, soils that are slow to infiltrate rainfall, and impervious surfaces that result in a "flashy" urban stormwater system.

In 2001, the ODFW conducted habitat surveys of Tryon Creek and its tributaries. Conditions in lower and middle Tryon Creek and portions of Arnold Creek are best. Generally, development has altered physical habitat throughout the watershed. In-stream habitat suffers from lack of structure (e.g., wood and boulders) and from high proportions of sand and silt substrate contributed by eroding stream banks, resulting partly from increased stormwater runoff from upland development. Numerous culverts severely constrain fish passage.

In 2002, ODFW conducted extensive (spring, summer, and fall) and intensive (summer) stream surveys in Tryon Creek. Coho, Chinook, steelhead, and cutthroat were observed in different parts of Tryon Creek during different seasons of the year. Of all the salmonid species observed, cutthroat trout were most abundant. While large numbers of steelhead, Chinook, coho, and cutthroat were not encountered in Tryon Creek, individuals are present and use Tryon Creek during all or parts of their freshwater life stage.

Watershed Problems and Opportunities

Based on the characterization and analysis of watershed conditions, the following critical problems that limit watershed health were identified, as well as opportunities for improvement.

Problems

- Tryon Creek hydrology and hydraulics have been altered as a result of changes in natural drainage complexity, loss of vegetation, and high-density impervious surfaces in upper Tryon Creek. Impervious surfaces increase stormwater runoff and decrease summer base flows. These altered conditions affect natural stream channel-forming processes, contribute to aquatic habitat degradation (e.g., stream channel incision and simplification of channel complexity), and affect water quality.

- Water quality in Tryon Creek is impaired for certain water quality parameters. Monitoring indicates that summer in-stream temperatures exceed the water quality standard of 64 degrees F for protection of salmonid rearing. E. coli levels exceed water quality standard in about 20 percent of samples. Tryon Creek was ranked as poor on the Oregon Water Quality Index because of high levels of nutrients (total phosphorus, ammonia+nitrate nitrogen), total solids, and bacteria. High silt and sediment loads are transported from upland urban sources to the stream and accumulate in depositional areas in lower portions of the watershed. Alterations in hydrology, hydraulics, and habitat, particularly resulting from development, contribute to water quality impairment. Stormwater runoff from development in upper portions of the watershed may contribute a number of pollutants.

- Aquatic habitat conditions are degraded because of narrow riparian corridors (particularly in upper Tryon Creek), degraded and poorly connected floodplains, lack of in-stream and channel complexity, and silt that covers spawning gravels. Stream connectivity is severely degraded by the Highway 43 culvert and the Boones Ferry Road culvert.

Highway 43 is a seasonal fish passage barrier, and the Boones Ferry Road culvert completely prevents fish passage to upper Tryon Creek.

- Biological communities are limited in Tryon Creek. Sensitive macroinvertebrate populations are low throughout the watershed. Coho salmon, Chinook salmon, steelhead, and cutthroat have recently been observed in different parts of Tryon Creek, but abundance is low. Distribution is limited by culverts; particularly the Highway 43 and Boones Ferry Road culverts. Generally, the Index of Biotic Integrity (IBI) indicates that much of the watershed is severely impaired throughout most times of the year.

- City infrastructure is often located in stream channel corridors; in particular, a sanitary sewer interceptor is located along much of Tryon Creek mainstem. Natural channel-forming processes can expose and undermine these facilities, making them vulnerable.

Opportunities

- Opportunities exist to retrofit existing development to manage stormwater runoff. This includes installation of site-specific retrofits such as parking lot swales, water quality and detention facilities, and improvements to existing highway drainage facilities. These actions will filter stormwater runoff and help attenuate flows, helping to improve water quality and return hydrologic conditions toward a more natural hydrograph.

- Opportunities exist to protect, enhance, and restore aquatic habitat throughout Tryon Creek. This includes acquiring key parcels to connect existing natural areas, retrofitting or replacing fish passage barriers to reconnect aquatic habitat, enhancing existing aquatic and riparian habitat through restoration (particularly on public lands), and daylighting existing storm pipes where feasible to create open streams. These actions improve habitat and water quality and provide significant benefits to biological communities and recreation.

- Opportunities exist to protect and rehabilitate BES stormwater and sanitary sewer infrastructure and simultaneously improve aquatic habitat. These opportunities are most prevalent in lower and middle Tryon Creek, where a BES sanitary sewer interceptor is located in the stream corridor.

FTCWMP Actions and Recommended Approach

To address watershed problems and take advantage of opportunities, the FTCWMP recommends specific actions and an overall approach to guide implementation of the actions.

Actions are divided into the following categories:

- Stormwater Management
- Revegetation
- Aquatic and Riparian Enhancement
- Protection and Policy
- Operations and Maintenance
- Outreach, Stewardship, and Education

Two main elements of the Tryon Creek implementation approach are:

- Implementation of programs and stormwater retrofit actions in upper Tryon Creek to manage stormwater runoff from impervious areas onsite. Actions and programs will initially focus on transportation and commercial corridors.

- Implementation of actions and programmatic and policy measures to protect and restore habitat, initially below Boones Ferry Road, and to increase fish access to Tryon Creek State Natural Area. Breaks in longitudinal stream connectivity, particularly at Highway 43 and Boones Ferry Road culverts, severely impede resident and anadromous fish movement.

Implementation of these actions will meet FTCWMP goals and objectives. Benefits include:

- Treatment and detention of stormwater runoff, helping to protect in-stream habitat, biological communities, and meet total maximum daily load (TMDL) water quality regulatory obligations.

- Enhancement of aquatic and riparian habitat through stream restoration and revegation, improving habitat for fish and other biological communities and restoring the natural watershed functions.

- Protection and rehabilitation of City sanitary sewer infrastructure to provide long-term service and protect water quality.

- Rehabilitation and replacement of stream culverts to improve fish passage and meet City design standards.

- Protection of land that connects and/or expands existing natural areas to protect existing natural watershed functions and provide critical habitat connectivity for biological communities.

- Improvements to water quality, aquatic habitat, and fish passage to further the recovery of ESA listed species.

3.0 Goals and Objectives

Introduction

Watershed goals represent the primary domains of the natural environment. The *Framework for Integrated Management of Watershed Health* (BES, 2005) established four watershed health goals: hydrology, physical habitat, water quality, and biological communities. As part of the development of the *Fanno and Tryon Creeks Watershed Management Plan* (FTCWMP), three additional goals were added for the Fanno and Tryon watersheds: infrastructure; public involvement, education, and stewardship; and consistency with other plans, policies, and regulations.

Objectives are specific outcomes in watershed functions and conditions that will help achieve these goals. Generally, several objectives must be met to achieve a given goal.

Improving watershed conditions toward these goals and objectives demonstrates progress toward improving watershed health. For the *Fanno Tryon Water Quality and TMDL CIP Pre-design #7622 Report* (Pre-design), goals and objectives were used for the following purposes:

- Technical Memorandums: Used to develop project-specific prioritization and design criteria/guidance (e.g., for culvert repair and replacement).
- Pre-designs: Used as guidance for project design and for prioritization of projects.
- Benefits Evaluation: Used to develop project indicators and scoring guidance, which were used to score and rank projects based on benefits.

Watershed Goals and Objectives

Hydrology Goal

Move toward normative[1] flow conditions to protect and improve watershed and stream health, channel functions, and public health and safety.

Objectives

HYD1 - Restore stream flows to a normative hydrograph to protect in-stream habitat, minimize channel erosion, and limit impacts on water quality.

> *Rationale: High flows can degrade stream channels by eroding banks, scouring, and channel incision. Reducing peak flows fosters stable streambanks, protects in-stream complexity, and reduces channel incision. Volume control can greatly increase flood*

[1] A normative flow regime provides characteristics of flow magnitude, frequency, duration, and timing essential to support diverse and productive salmonids and other flow-dependent resources.

control, especially in closed basins; help recharge aquifers and maintain stream baseflow; minimize stream channel erosion and habitat loss; and protect water quality by reducing loadings.

Physical Habitat Goal

Protect, enhance, and restore aquatic and terrestrial habitat conditions to support key ecological functions and improved productivity, diversity, capacity, and distribution of native fish and wildlife populations and biological communities.

Objectives

HAB1 - Improve spawning and rearing habitats for native fish communities.

Rationale: Deposition of sediment from erosion on stream substrate degrades aquatic habitat. Reducing bank and channel erosion can reduce the deposition of sediment over salmon-spawning stream substrate.

HAB2 - Increase stream channel complexity to improve bank form habitats, protect and stabilize stream banks, provide areas for wood and substrate (e.g., fine sediment) to accumulate and settle (e.g., deep pools), and aid channel-building processes, such as pool riffle formation, flood flow attenuation, etc.

Rationale: Channel complexity provides critical rearing and refuge habitat that benefits all native aquatic communities.

HAB3 - Protect existing natural areas to help retain existing natural watershed functions and critical habitat.

Rationale: Remaining natural areas provide natural watershed functions and critical habitat. Further degradation of these remaining areas could critically undermine overall habitat restoration efforts.

HAB4 - Protect and restore riparian and floodplain condition and connectivity to help restore normative flow regimes and aquatic and terrestrial habitat conditions.

Rationale: Floodplain interactions provide wood, gravel, organic matter, and off-channel habitat to streams. Restoring floodplains improves aquatic habitat. Improving riparian areas improves both aquatic and terrestrial habitat. Wide, contiguous, and vegetated riparian buffers provide critical organic matter to streams and habitat for a variety of species.

HAB5 - Remove significant fish passage barriers (physical and hydraulic) to improve stream connectivity and potential fish population productivity.

Rationale: Fish barriers, such as long perched culverts, prevent fish migration within a stream system. Removing these barriers makes additional aquatic habitat available to fish. Increasing the distribution of fish in a stream system can enhance the resilience of the species.

Water Quality Goal

Protect and improve surface water and groundwater quality to protect public health and support native fish and wildlife populations and biological communities.

Objectives

WQ1- Reduce summer in-stream temperatures to improve surface water quality.

Rationale: Cooler water is necessary for the health of aquatic communities and to support salmonid rearing and spawning.

WQ2 - Reduce in-stream bacteria concentrations to improve surface water quality.

Rationale: Reducing in-stream bacteria concentrations helps protect public health.

WQ3 - Reduce in-stream pollutant concentrations to levels that do not threaten aquatic life or human health.

Rationale: Stormwater runoff can contain a variety of pollutants, including heavy metals, nutrients, and sediment. Reducing loads of these pollutants from various known/ suspected sources, such as transportation corridors and spills, will improve aquatic habitat.

WQ4 - Reduce total suspended solids (TSS) to improve in-stream water quality.

Rationale: Suspended sediment in streams impacts water quality and can be deposited on channel substrate, both of which degrade aquatic habitat. Reducing sediment loads helps to improve aquatic habitat.

WQ5 - Reduce phosphorus concentrations in stormwater.

Rationale: High phosphorus concentrations spur algal growth, resulting in reduced concentrations of dissolved oxygen.

WQ6 – Meet dissolved oxygen standard.

Rationale: Maintaining an adequate dissolved oxygen level in streams is critical for native fish populations.

Biological Communities Goal

Protect, enhance, and restore native aquatic and terrestrial species and biological communities to improve and maintain biodiversity in Portland's watersheds.

Objectives

BC1 - Restore healthy, self-sustaining populations of all native fish communities.

Rationale: Fish need clean and cool streams with large woody debris, off-channel habitat, and sediment-free gravel substrate for spawning and rearing. Improving these and other habitat conditions will help increase native fish populations and benefit other aquatic species.

BC2 - Increase macroinvertebrate abundance and production.

Rationale: More study is needed. However, macroinvertebrate production is connected to all processes occurring in the aquatic - terrestrial continuum. By improving riparian vegetation (e.g., overhanging vegetation), getting marine-derived nutrients back into the system, and improving water quality (such as reducing fine sediment and toxins), the overall habitat conditions for macroinvertebrates will improve.

Infrastructure Goal

Provide adequate sanitary and stormwater infrastructure to protect public health and safety while preserving natural watershed functions.

Objectives

INF1 - Restore infrastructure such that all storm drainage facilities within the closed conduit system are designed to pass a 10-year storm without surcharge and provide conveyance of the 100-year storm meeting health and safety requirements.

Rationale: Public stormwater facilities protect human health and safety, as well as protect public and private properties from catastrophic damages.

INF2 - Remove physical and hydraulic barriers for fish passage. Physical barriers include culverts with downstream invert elevations that are 12 inches above residual pools, lengths greater than 100 feet, and/or with gradients >0.5 percent. Hydraulic barriers include lack of flow depth and flow velocities greater than 2 feet per second.

Rationale: Culverts and in some cases storm drainpipes impact the ability of fish to access spawning and rearing habitats and to migrate throughout the system.

INF3 - Replace or rehabilitate sewer and stormwater infrastructure that is in poor condition.

Rationale: Degraded, failing, and/or exposed (in active stream channels) sanitary sewer infrastructure can fail, resulting in the discharge of sanitary sewer flow into southwest streams. This threatens the health and safety of residents and the natural environment. Rehabilitating, replacing, and/or protecting vulnerable sewer infrastructure ensures sewer service and protects the environment and human health and safety.

Public Involvement, Education, and Stewardship Goal

Maintain long-term community-wide commitment to improve and sustain watershed health.

Objectives

PI1 - Establish strategies for promoting and carrying out community stewardship projects and programs to improve watershed health.

> *Rationale: The strategies will identify City services to be provided, establish targeted opportunities for stewardship activities, and identify partnerships and funding opportunities for implementation of community- and City-initiated projects.*

PI2 - Raise community awareness by educating citizens about the impacts that their actions have on watershed health.

> *Rationale: People affect watershed health everyday by the choices they make. Public outreach strategies should be geared toward educating citizens about pollutant sources of concern to evoke behavioral changes that will reduce non-point source pollutants and restore natural functions to the watershed.*

PI3 – Foster citizen involvement in the development and implementation of watershed plans, programs, and projects.

Consistency with Other Plans, Policies, and Regulations Goal

Meet watershed goals and objectives, and achieve consistency with applicable plans, policies, and regulations.

Objectives

CP1 - Establish strategies and actions for coordination with agencies and organizations within and external to the Bureau of Environmental Services (BES) to ensure that projects, programs, and plans are compatible and that watershed plan goals and objectives are met.

> *Rationale: The actions of many different agencies affect the health of the watershed. Through coordination and collaboration with other agencies, watershed staff can help to ensure that these agencies' projects, programs, and plans incorporate goals and objectives to improve watershed health.*

CP2 - Establish strategies, projects, and programs that satisfy regulatory requirements and address watershed health goals.

> *Rationale: Watershed plan strategies, projects, and programs should meet the requirements of existing regulations designed to improve the health of the watershed.*

4.0 Approach

This chapter briefly describes how projects in the *Fanno Tryon Water Quality and TMDL CIP Pre-design #7622 Report* (Pre-design) were organized, evaluated, prioritized, and pre-designed. Figure 4-1 depicts the approach.

Further information on the approach is available in the pre-designs contained in the Chapter 8.0 technical documents.

Project Scope, Workplan, and Schedule

The Pre-design recommends projects based on actions identified in the *Fanno and Tryon Creeks Watershed Management Plan* (FTCWMP) (BES, 2005) and the *Portland Watershed Management Plan* (BES, 2005). Analysis and multi-objective evaluation demonstrates that these projects will provide significant environmental and infrastructure system benefits, helping the City reach watershed health and regulatory compliance goals.

The scope of work, workplan, and schedule for the Pre-design were developed in consultation with the Bureau of Environmental Services (BES) Engineering Services group and endorsed by BES leadership. These documents follow established procedures and protocols.

The Pre-design scope of work (Appendix A), finalized September 15, 2005, established the following:

- Components of the CIP Pre-design project.
- Tasks required to develop the Pre-design report and related deliverables.
- Expectations for the Pre-design report and deliverables, and the resources needed to complete the required tasks.

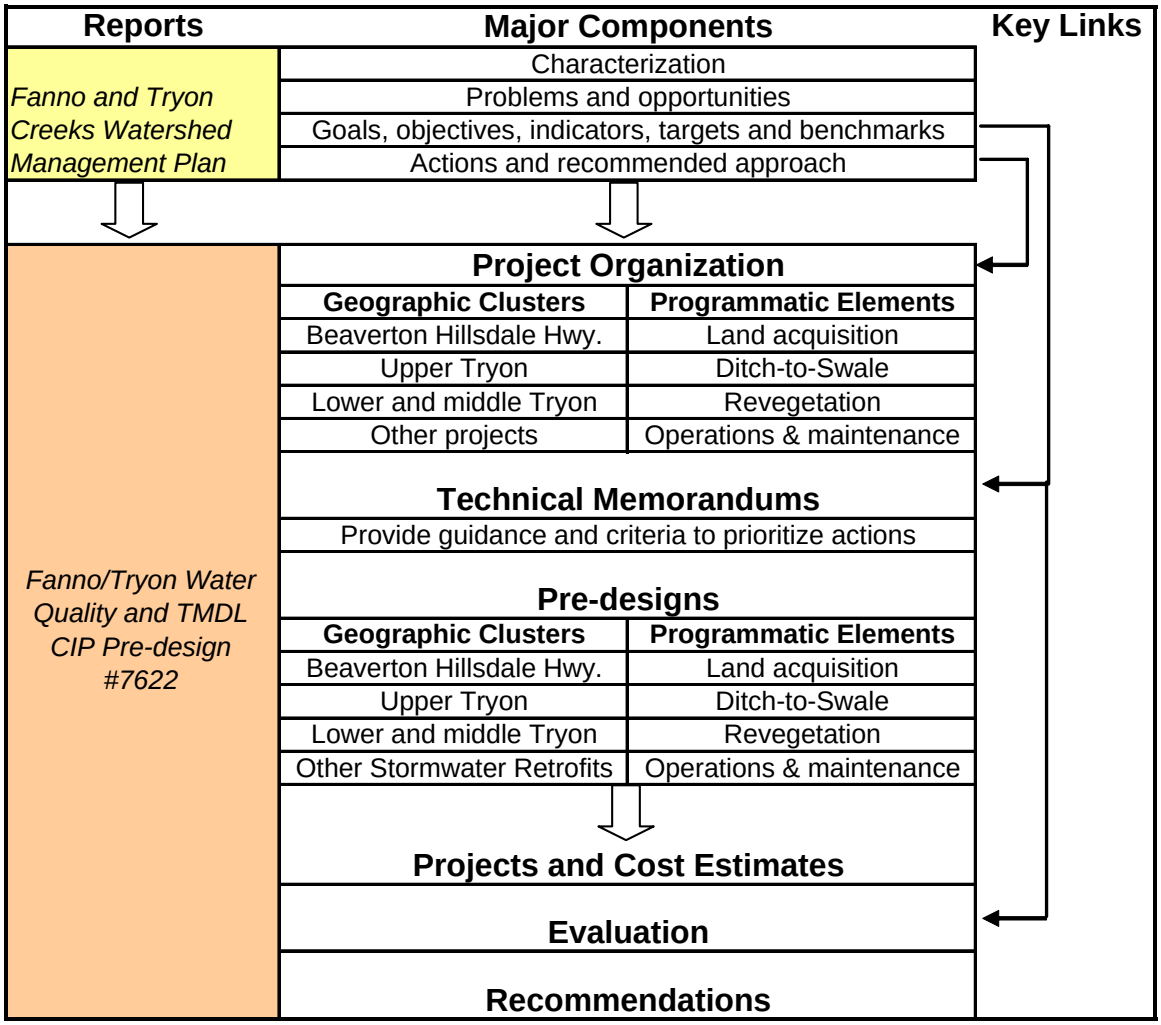
The level of detail in the scope of work reflected the understanding of each task at that time. Additional details were developed as the CIP Pre-design project proceeded, and revisions were made to the scope of work as required.

The Pre-design workplan (Appendix B), finalized September 15, 2005, provided the framework to complete the CIP Pre-design project within CIP guidelines. The CIP guidelines are specified in the *Implementation Procedures for Capital Projects* (BES, June 30, 2003). Key elements of the Pre-design workplan included project management, scope of work, project budget, and schedule.

The Pre-design schedule provided initiation and completion dates for the tasks described

in the CIP Pre-design project scope of work, as well as milestones and anticipated product delivery dates. As the CIP Pre-design project was implemented, the Oversight Committee made and approved adjustments to the schedule when required.

Figure 4-1: Pre-design Approach Chart



Project Organization

The FTCWMP identifies over 100 actions in the Fanno and Tryon Creek watersheds to meet established watershed goals and objectives. The actions include stormwater retrofits, stream restoration, culvert repair and replacement, land acquisition, revegetation, ditch-to-swale conversions, and water quality facilities. In accordance with the Pre-design scope of work, these multi-component and multi-objective actions were organized into geographic and programmatic groupings to facilitate analysis, coordination, and further development of individual projects. Table 4-1 shows the groupings.

Table 4-1: Geographic and Programmatic Groupings

Geographic Clusters	Programmatic Elements
Beaverton Hillsdale Highway Cluster	Land Acquisition
Upper Tryon Creek Cluster	Ditch-to-Swale
Lower and Middle Tryon Creek Cluster	Revegetation
Other Projects	Operations and Maintenance

Geographic clusters contain groups of similar projects concentrated in a particular area that are evaluated together in order to prioritize and sequence actions to maximize benefits. Projects in these geographic clusters can target watershed-specific concerns, such as Tualatin Basin total maximum daily load (TMDL) water quality requirements in the Beaverton Hillsdale Highway cluster and fish passage and sewer infrastructure/ stream enhancement in the Lower and Middle Tryon Creek cluster.

Programmatic elements are groups of similar projects that are distributed throughout the watersheds. Projects are grouped by type to facilitate prioritization and development of recommendations. For example, potential land acquisition sites are located throughout the watersheds. The pre-design describes potential acquisition methods, describes each site and the benefits of acquisition in detail, prioritizes sites, and includes an estimated cost for acquisition. The Pre-design would support establishment of a willing-seller acquisition program.

Stakeholder and Community Involvement

The Pre-design included development and implementation of a stakeholder and community involvement plan, as described in the public involvement technical memorandum. The activities described below were implemented.

Advisory Committee

The Advisory Committee included representatives from BES, other City bureaus, state and local agencies, and community groups. The Advisory Committee met six times from April 2006 through December 2007. It provided review and feedback throughout the project.

Open Houses
Periodic community open houses were held to present Pre-design project elements to the community. Comments were received, documented, and incorporated into the Pre-design. A total of over 200 people attended four open houses.

Educational Materials and Website
All draft and final Pre-design project materials were made available on BES's website. Fact sheets were developed for the overall Pre-design project, as well as for specific project elements.

Community Group Presentations
Specific Pre-design project elements were presented to many interested community groups throughout the project. These included the Multnomah Village Business Association and the Tryon Creek Watershed Council.

Project-specific Involvement
Presentations and meetings were held with Portland Public Schools, Oregon Department of Transportation, Portland Community College, and TriMet to discuss involvement in pre-designs for specific project sites.

Stormwater retrofit pre-design projects on private properties also required project-specific involvement. This included at least two letters: (1) An initial letter informing the property owners of the project and selection of their site, and (2) Follow-up letters and phone calls as needed to discuss the stormwater pre-designs. In some cases, BES staff met with property owners to discuss projects. These are documented in the project-specific pre-designs.

Ongoing Involvement
Ongoing involvement included responding to e-mails and phone calls about the project and providing project updates in the *Southwest Neighborhoods News*.

Technical Memorandums

Technical memorandums (TMs) were developed to provide background information, design guidance, and alternatives analysis and prioritization criteria. The TMs also ensured consistency with City standards and practices. The following TMs were prepared:

- Land Acquisition
- Revegetation
- Ditch-to-Swale
- TMDL (total maximum daily loads) and MS4 (municipal separate storm sewer system)
- ESA (Endangered Species Act)
- Culverts

- Culvert Ranking
- Public Involvement
- Operations and Maintenance
- Stormwater Retrofits

Pre-design

The actions located within each geographic cluster were organized by the following types for the pre-design:

- Stormwater Retrofits
- Highway Drainage
- Stormwater Outfalls
- Culverts
- Water Quality Facilities
- Stream Daylighting
- Infrastructure Protection and Stream Enhancement

A pre-design was developed for each geographic cluster. The pre-design includes the pre-designs of individual projects, including analyses, pre-designs, and cost estimates. An analysis of alternatives on a project-specific level and/or pre-design type level was performed, as appropriate, along with development of recommendations for project implementation.

The programmatic elements comprise watershed-wide actions at multiple locations, including within the various geographic clusters. A pre-design was developed for each programmatic element. These identify implementation opportunities, evaluate design alternatives, and estimate costs. They also provide a prioritized list of projects for implementation.

Pre-design summaries for both the geographic clusters and programmatic elements are provided below.

Beaverton Hillsdale Highway Cluster

The Beaverton Hillsdale Highway cluster of projects was organized to address FTCWMP-recommended actions that are concentrated along the Beaverton Hillsdale Highway corridor. The Beaverton Hillsdale Highway corridor is the most highly developed area within the watershed and includes multi-family residential and commercial land uses. Hydraulic and pollutant load modeling has shown that the highly impervious areas within this cluster, including Beaverton Hillsdale Highway, impact water quality and flow in Fanno Creek. Ecosystem diagnosis and treatment (EDT) modeling has shown that high flows, pollutants, and fish passage are limiting factors for resident native trout in Fanno Creek. Fanno Creek also has established TMDLs for total phosphorus, dissolved oxygen, bacteria, and temperature.

The pre-design for this geographic cluster addresses the project types described below.

Stormwater Retrofits

Pre-designs were developed for stormwater management retrofits at seven private property sites identified in the FTCWMP. The pre-designs were developed through contracts with private consultants, using a prototype developed by BES's Sustainable Stormwater group and in accordance with the City's *Stormwater Management Manual*. The pre-designs include site analysis, recommended concept designs, and cost estimates.

In addition to the seven site pre-designs, additional opportunities for stormwater retrofits within the cluster were identified, with estimated costs and benefits.

Highway Drainage

The FTCWMP identifies stormwater runoff from Beaverton Hillsdale Highway as having a significant impact on water quality and flows in Fanno Creek. The stormwater retrofits are designed to maximize reduction of pollutants in stormwater runoff discharged into Fanno Creek.

The 2 miles of highway were divided into 27 separate drainage subcatchments for analysis and pre-design of stormwater retrofits. A stormwater retrofit concept design was developed for each subcatchment, based on a review of existing information, field investigations, delineation of drainage, flow calculations, and BMP sizing. A recommended stormwater retrofit concept plan was developed for all subcatchments, including a site map, estimated BMP performance, and cost estimates.

Stormwater Outfalls

The FTCWMP identifies stormwater outfalls as having a significant impact on water quality in Fanno Creek from localized erosion and bank stability issues. To accommodate time and budget constraints of the Pre-design project, the 22 MS4 basins with the most total impervious area were selected for additional investigation. Combined, these 22 outfalls drain 80 percent of the impervious area in the MS4 system within this cluster.

Field investigations were completed for each of the 22 outfalls to obtain data related to the structural condition of the outfall, as well as the condition of the adjacent stream channel and banks. Based on the field investigation results, potential repairs or retrofits were identified for each outfall. These results were evaluated, and five outfalls were selected for development of more detailed designs. A pre-design was completed for each of the five outfalls, including site maps, flow analysis, proposed solutions, and cost estimates.

Culverts

The Beaverton Hillsdale Highway cluster includes 38 culverts, located either on the mainstem or tributaries of Fanno Creek. Available data and previous hydraulic modeling results were compiled for all 38 culverts. Field investigations were conducted to gather additional data where required. The culverts were then prioritized for further pre-design, using the criteria and ranking system developed in two culvert technical memorandums

(see Section 8.1).

Based on the results, the four highest-ranked culverts were selected for pre-design. Individual detailed pre-designs were developed for the four selected culverts. At each site, additional field investigations were performed, survey information was collected, and additional hydraulic analysis and modeling were conducted. Pre-design alternatives were then developed and evaluated for hydraulic capacity, fish passage, operation and maintenance, and cost. The final pre-design for each site includes a recommended alternative for implementation, along with engineering drawings and cost estimates.

Water Quality Facilities

Two potential water quality treatment facilities were identified during field assessments conducted for the pre-design of outfall and culvert projects. Both sites would treat stormwater runoff primarily from Beaverton Hillsdale Highway. A pre-design was developed for each site, including site maps, proposed facility concept and sizing, and cost estimates.

Upper Tryon Creek Cluster

The Upper Tryon Creek cluster of projects was organized to address FTCWMP-recommended actions that are concentrated in the upper Tryon Creek Watershed, specifically along the Barbur Boulevard and Interstate 5 highway corridors. These corridors are the most highly developed areas in the Tryon Creek Watershed. Hydraulic modeling has shown that the concentration of impervious areas in the upper Tryon Creek Watershed increases peak flows and modifies hydrology throughout Tryon Creek. Grid pollutant load modeling indicates that these highly impervious areas also generate high pollutant loads. EDT modeling indicates that high flows and pollutants from the upper Tryon Creek Watershed degrade in-stream conditions and are a limiting factor for ESA-listed steelhead in Tryon Creek. Tryon Creek also has established TMDLs for total bacteria and temperature.

The pre-design for this geographic cluster addresses the project types described below.

Stormwater Retrofits

Pre-designs were developed for stormwater management retrofits at seven private property sites identified in the FTCWMP and for Multnomah Village and Jackson Middle School.

The pre-designs for the seven private property sites were developed through contracts with private consultants, using a prototype developed by BES's Sustainable Stormwater group and in accordance with City stormwater management and design criteria. The pre-designs include site analysis, recommended concept designs, and cost estimates.

The FTCWMP identifies Multnomah Village as a watershed area with a high percentage of impervious area and recommends additional stormwater management for this area. As part of the Pre-design project, BES staff conducted site assessments and identified over 30 potential stormwater management projects on both public and private properties.

After evaluation of these potential projects, staff developed concept designs and cost estimates for five high-priority street stormwater management projects. In addition, cost estimates were developed for all of the remaining potential projects.

The FTCWMP also identifies the Jackson Middle School site for multiple actions, including stream daylighting and stormwater retrofits. As part of the Pre-design project, a site assessment of stormwater management opportunities was conducted, in conjunction with proposed stream daylighting at this site. Based on the site assessment, a pre-design for stormwater retrofits was developed, including recommended concept designs and cost estimates.

Highway Drainage

The FTCWMP identifies stormwater runoff from Barbur Boulevard and adjacent streets as having a significant impact on water quality and flows in Tryon Creek. The stormwater retrofits are designed to maximize reduction of pollutants in stormwater runoff discharged into Tryon Creek.

The 2 miles of highway were divided into 15 separate drainage subcatchments for analysis and pre-design of stormwater retrofits. A stormwater retrofit concept design was developed for each subcatchment, based on a review of existing information, field investigations, delineation of drainage, flow calculations, and BMP sizing. A recommended stormwater retrofit concept plan was developed for all subcatchments, including a site map, estimated BMP performance, and cost estimates.

Stormwater Outfalls

The FTCWMP identifies stormwater outfalls as having potential impacts on water quality in Tryon Creek from localized erosion and bank stability issues. During field investigations for culverts in the Upper Tryon cluster, outfalls above the I-5 highway were also investigated. No obvious problems were noted. Additional field investigations were conducted to address outfalls from the Upper Tryon Creek cluster area that discharges to Falling Creek. Field investigation teams gathered data related to the structural condition of the outfalls and the stream and bank condition of the surrounding areas. Based on evaluation of these data, one outfall was determined to need repair. A pre-design for this outfall was developed, including a site map, recommended solutions, and cost estimate.

Culverts

The Upper Tryon Creek cluster includes 11 culverts, located either on the mainstem or tributaries of Tryon Creek. Available data and previous hydraulic modeling results were compiled for all 11 culverts. Field investigations were conducted to gather additional data where required. The culverts were then prioritized for further pre-design, using the criteria and ranking system developed in two culvert TMs. Based on the results, no culverts within the upper Tryon Creek cluster were recommended for pre-design.

Stream Daylighting

The FTCWMP identifies stream daylighting as an action to improve watershed health.

The FTCWMP identifies daylighting of Falling Creek at the Jackson Middle School site as one opportunity. Field assessments conducted as part of the Pre-design project identified daylighting an unnamed tributary of Tryon Creek in Spring Garden Park as another opportunity. Pre-designs were developed for each of these sites, including flow analysis, concept designs, and cost estimates.

Water Quality Facilities

Two potential water quality treatment facilities were identified during Barbur Boulevard highway drainage field assessments. Both sites would treat stormwater runoff primarily from Barbur Boulevard and adjacent streets. A pre-design was developed for each site, including site maps, proposed facility concept and sizing, and cost estimates.

Lower and Middle Tryon Creek Cluster

The FTCWMP identifies lower and middle Tryon Creek as a priority project area for the following reasons:

- A BES sanitary sewer interceptor runs along and crosses Tryon Creek in this cluster area. BES has conducted two recent projects to protect sanitary sewer infrastructure exposed in the active stream channel. Further field work was needed to identify any additional exposed infrastructure.

- ESA-listed steelhead are located in this portion of Tryon Creek. EDT modeling indicates that this area is critical habitat for listed species, but that additional stream enhancement is needed. In particular, Highway 43 and Boones Ferry Road are impediments to fish passage; Highway 43 is a seasonal barrier, and Boones Ferry Road is a complete barrier.

- BES and the Oregon Department of Transportation are working collaboratively to retrofit the Highway 43 culvert, a major fish passage impediment. This project is under design, and construction is anticipated for summer 2009. This work will improve fish passage up to Boones Ferry Road.

The pre-design in this geographic cluster addresses the project elements described below.

Boones Ferry Road Culvert

The FTCWMP identifies the Boones Ferry Road culvert as a critical barrier to fish passage. A pre-design for replacement of the culvert was developed through a contract with a private consultant. The pre-design report includes background, project objectives, site description, modeling, alternatives development and evaluation, and a recommended alternative and cost estimate. The pre-design drawings include a proposed site plan, channel profile, cross-sections, culvert and roadway profile, and rock weir details.

Lower and Middle Tryon Creek Infrastructure Protection and Stream Enhancement

BES staff conducted field investigations in fall 2006 and winter 2007 to assess stream condition and identify any sewer infrastructure problems. Four sites were identified for

infrastructure protection/rehabilitation and stream enhancement. Pre-designs were developed for each of the four sites, including documentation of existing conditions, site-specific objectives, alternatives evaluation criteria, concept-level alternatives, evaluation and selection of a preferred concept alternative, and a preliminary cost estimate.

Other Stormwater Retrofits

This cluster of projects was organized to address stormwater retrofit projects for sites that are outside the other geographic clusters of the Pre-design project.

Pre-designs were developed for stormwater management retrofits at seven private property sites identified in the FTCWMP. The pre-designs were developed through contracts with private consultants, using a prototype developed by BES's Sustainable Stormwater group and in accordance with City stormwater management and design criteria. The pre-designs include site analysis, recommended concept designs, and cost estimates.

Operations and Maintenance (O&M)

The purpose of this pre-design is to identify and prioritize O&M projects and actions that meet the Pre-design project goals and objectives. The pre-design summarizes the O&M needs of the sanitary collection and stormwater drainage systems in the Fanno and Tryon Creek watersheds, including CIP-funded maintenance reliability projects. The pre-design provides evaluation criteria and a method for prioritizing O&M projects; the criteria and method were then used to prioritize identified O&M projects.

Ditches-to-Swales

The purpose of this pre-design is to provide a programmatic approach for converting ditches to swales in the Fanno and Tryon Creek watersheds. The ditch-to-swale conversions replace suitable roadside ditches with roadside swales.

Criteria developed in a ditch-to-swale technical memorandum (see Section 8.1) were used to prioritize potential ditch-to-swale sites identified in the FTCWMP, as well as additional sites identified during the pre-design. A total of eight high-priority sites (30,100 feet) and nine medium-priority sites (37,450 feet) were identified for conversion. A site description and cost estimate for implementation were developed for each site. This pre-design also includes design criteria, implementation protocols, and site-specific considerations. For high-priority Fanno Creek sites, flow modeling was conducted to support development of designs and to estimate benefits.

Land Acquisition

The purpose of this pre-design is to provide a land acquisition strategy for the Fanno and Tryon Creek watersheds. The strategy can serve as a basis to apply for CIP funding, grants, and other funding sources to acquire ownership and/or protection of these priority areas as opportunities arise.

Potential land acquisition sites identified in the FTCWMP, along with additional sites identified during the pre-design, were prioritized, using the criteria developed in the land

acquisition technical memorandum (see Section 8.1). A total of 10 high-priority, 12 medium-priority, and 8 low-priority sites were identified for land acquisition. The pre-design includes a detailed description of each site, including a site description and map, benefits of acquisition, potential acquisition methods, and cost estimates.

Revegetation

The purpose of this pre-design is to provide a revegetation strategy for the Fanno and Tryon Creek watersheds. The strategy can serve as a basis to apply for CIP funding, grants, and other funding sources to revegetate proposed sites.

Potential revegetation sites identified in the FTCWMP were prioritized, using the criteria developed in the revegetation technical memorandum (see Section 8.1). Three high-priority sites and seven medium-priority sites were identified for revegetation. The pre-design includes detailed descriptions, site maps, and estimated costs for each revegetation site.

5.0 Project Summaries

Purpose

The purpose of this chapter is to briefly describe pre-design projects, their estimated costs, and implementation considerations.

Beaverton Hillsdale Highway Cluster

Impervious surfaces cover over 30 percent of the Beaverton Hillsdale Highway corridor. Impervious surface cover in this range reduces rainfall infiltration, increases stormwater runoff volume and velocity, and degrades stormwater quality. Research shows that impervious cover greater than 10 percent reduces urban stream stability, resulting in unstable and eroding channels. These changes degrade in-stream habitat and affect fish communities.

To address these problems, projects in this cluster focus on stormwater management. These projects will help the Bureau of Environmental Services (BES) meet regulatory obligations under the City's NPDES Municipal Separate Storm Sewer System (MS4) permit, help meet total maximum daily load (TMDL) requirements, and improve watershed health.

See Section 8.2.1 for more information on the projects summarized below.

Stormwater Retrofits

The BES Sustainable Stormwater team developed a stormwater retrofit pre-design for the Nevah Shalom site. This pre-design was subsequently used as a template for consultants, through on-call contracts with BES, to develop stormwater management pre-designs to retrofit six additional sites within the Beaverton Hillsdale Highway Cluster (Figure 5-1).

Table 5-1 summarizes the sites, impervious area treated, and construction costs. The average construction cost per square foot of impervious area managed for the seven sites is $1.99. At this average construction cost, approximately 72 percent of the impervious area at each site is managed.

Table 5-1: Beaverton Hillsdale Highway Cluster Stormwater Retrofits Summary

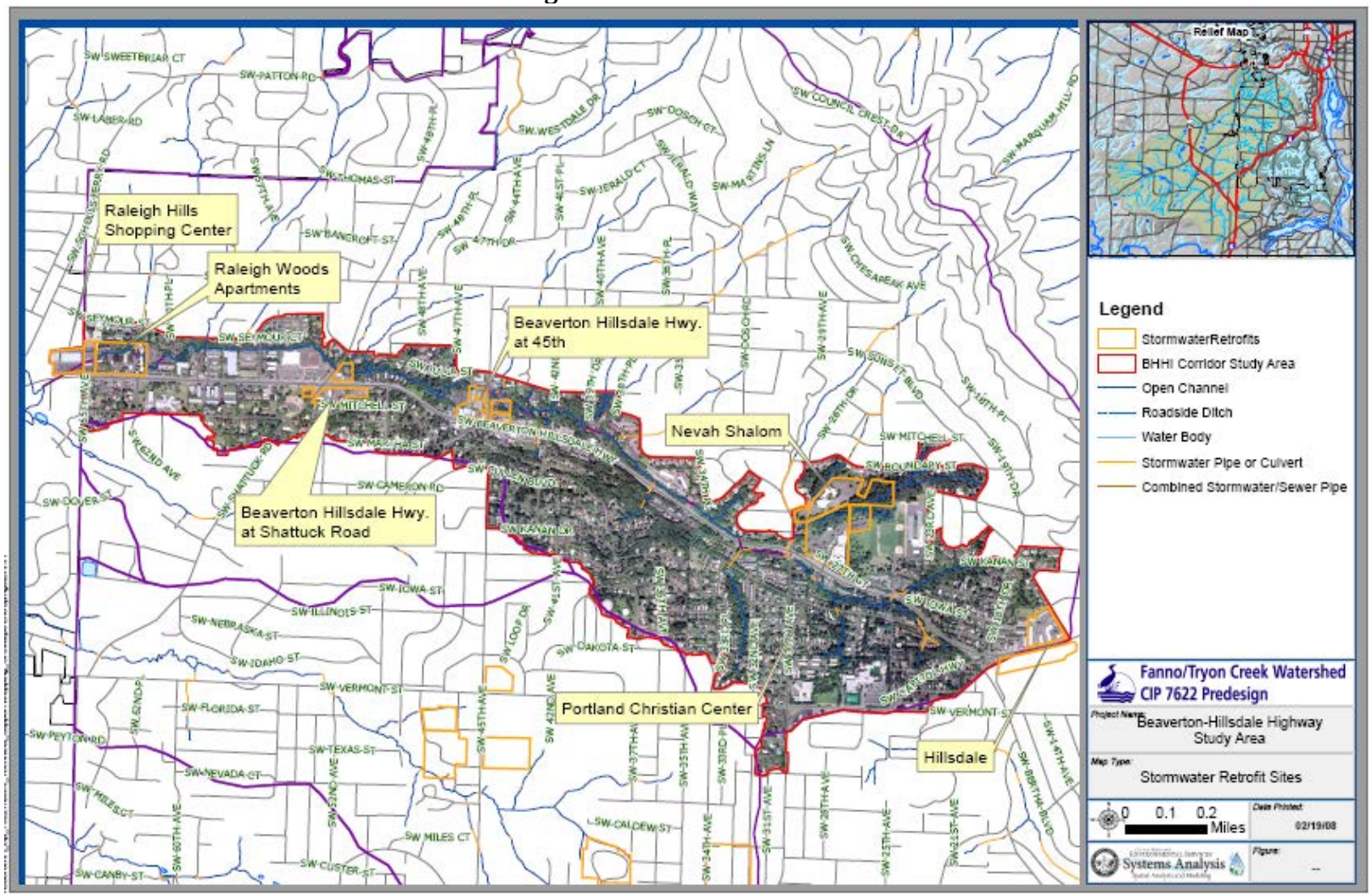
Site	Impervious Area Treated (square feet)	Percent Impervious Area (IA) Treated	Construction Cost	Cost/Square Foot
Raleigh Hills Shopping Center	132,450	68%	$545,411	$4.12
Hillsdale	183,050	42%	$303,232	$1.66
Raleigh Woods Apartments	128,650	93%	$314,146	$2.44
Beaverton Hillsdale Highway at Shattuck Road	105,661	51%	$140,088	$1.33
Beaverton Hillsdale Highway at 45th	94,450	77%	$121,349	$1.28
Portland Christian Center	211,500	100%	$266,500	$1.26
Nevah Shalom	125,250	73%	$228,488	$1.82
Total	**981,011**	**72%**	**$1,919,214**	**$1.99**

Estimated Costs

Construction	$1,919,214
Design (20%)	$ 383,842
Startup – 0&M (10%)	$ 191.921
Contingency (20%)	$ 383,842
Total	$2,878,819

These retrofit projects are located on private property. Policies are not yet in place to spend BES capital funds to design and construct stormwater facilities on private property. In addition, permission to construct any facilities on private property would need to be obtained. Because of their proximity to Fanno Creek, many of these properties discharge stormwater directly to the creek and therefore are not subject to the MS4 permit. Implementation priority should be given to properties within the City's MS4 system.

Figure 5-1: Stormwater Retrofit Sites



Beaverton Hillsdale Highway Stormwater Drainage Retrofits

This project will provide stormwater treatment for runoff from Beaverton Hillsdale Highway, which drains into Fanno Creek. The project area includes 2 miles of the Beaverton Hillsdale Highway, from Southwest Sunset Boulevard to the City limits (Figure 5-2). This project will provide for treatment of highway runoff through installation of inlet, manhole, and small vault treatment systems.

These retrofits would be located primarily within the existing street right-of-way for the Beaverton Hillsdale Highway. The City is responsible for maintenance of this section of highway, and the stormwater facilities are part of the City's MS4 system. The choice of City-approved stormwater technologies that could be installed into the existing drainage system is extremely limited. The actual performance of these facilities and the ability to install them as a retrofit may be limited.

Estimated Costs

Unit Costs

For treatment of ¼ acre of impervious highway area:

- Filterra units: $9,898/unit
- Stormwater filter: (2 cartridge systems)
- Catch basin installation: $7,900/unit
- Manhole installation: $10,900/unit

Assumptions

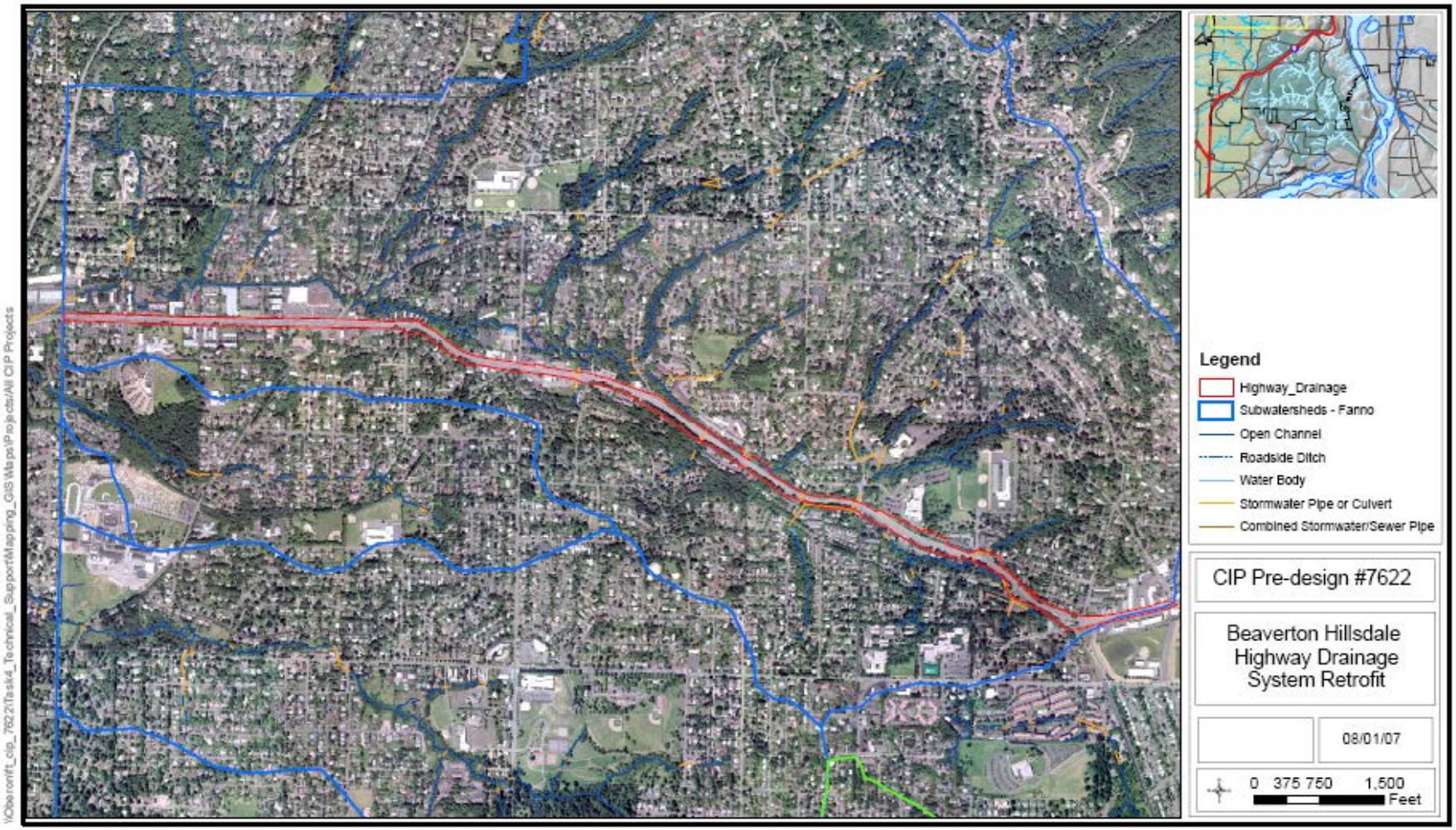
• Treatment unit/¼ acre		$10,000
• Installation		1,500
• Contingency (25%)		2,875
• Engineering (20%)		2,875
	Total	$17,250

Cost Estimate

- Cost/acre IA: 4 x $17,250 = $69,000/acre
- Total area: 20 acres IA less 4 acres other treatment = 16 acres

➢ Total Cost = 16 x 69,000 = $1,104,000

Figure 5-2: Beaverton Hillsdale Highway



Culvert Retrofits

The Pre-design project evaluated the existing culverts within the Beaverton Hillsdale Highway cluster based on ratings of hydraulic capacity, maintenance, and fish habitat (Figure 5-3). Based on the evaluation, four culverts were selected for preparation of detailed pre-designs, as prioritized in the following list:

1. SW 45th Avenue (crossing at the Fanno Creek mainstem)
2. SW Shattuck Road (crossing at the Fanno Creek mainstem)
3. SW 35th Avenue (crossing at the Fanno Creek mainstem)
4. SW 39th Drive (crossing at an unnamed tributary)

The pre-design recommendations for each culvert retrofit and the estimated construction costs are shown below. The cost estimates are based on the detailed engineering pre-designs.

SW 45th Avenue

The recommended alternative for the 45th Avenue crossing is a 32-foot-wide by 45-foot-long bridge (Figure 5-4). This design meets the required criteria; it provides fish passage and conveys the 25-year flow without surcharge.

Estimated Costs:

Construction	$ 775,674
Design (30%)	$ 232,696
Construction management (18%)	$ 41,185
Contingency (25%)	$ 193,194
Easement acquisition	$ 128,000
Total	$1,370,749

SW Shattuck Road

The recommended alternative for the Shattuck crossing is a 20- by 8-foot stream simulation culvert backfilled with 2 feet of streambed material (Figure 5-5). This design meets the required criteria; it provides fish passage and conveys the 25-year flow without surcharge. The solid bottom will protect the underlying sanitary sewer pipe from exposure.

Estimated Costs

Construction	$ 579,250
Design (30%)	$ 173,775
Construction management (18%)	$ 31,280
Contingency (25%)	$ 144,813
Easement acquisition	$ 58,000
Total	$ 987,118

SW 35th Avenue

The recommended alternative for the 35th Avenue crossing is a 16- by 7-foot stream simulation culvert backfilled with 2 feet of streambed material (Figure 5-6). This design meets the required criteria; it provides fish passage and conveys the 25-year flow without surcharge.

Estimated Costs

Construction	$ 559,740
Design (30%)	$ 167,922
Construction management (18%)	$ 30,226
Contingency (25%)	$ 139,935
Easement acquisition	$ 10,000
Total	$ 907,823

SW 39th Drive

The most immediate concern at this location is accumulation of debris at the upstream end of the culvert. Therefore, the recommended alternative is to retrofit the inlet to minimize problems with debris and reduce maintenance needs (Figure 5-7). Modifications will include upgrading the trash rack, smoothing the entrance to the culvert, and removing portions of the sedimentation box upstream from the culvert.

Estimated Costs

Construction	$ 6,950
Design (30%)	$ 2,085
Construction management (18%)	$ 1,251
Contingency (25%)	$ 1,738
Easement acquisition	$ 0
Total	$ 12,024

Figure 5-3: Beaverton Hillsdale Highway Culverts

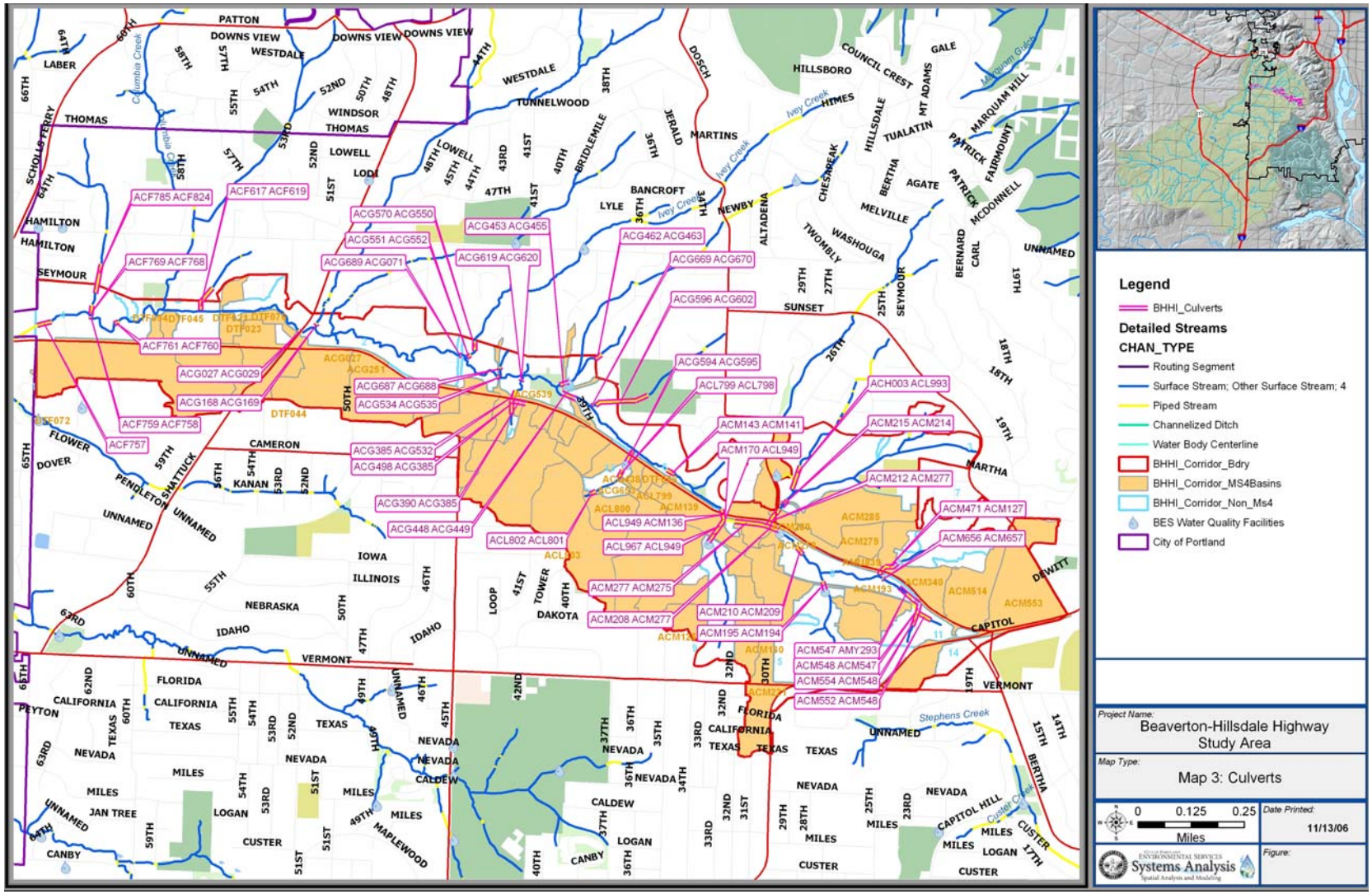


Figure 5-4: SW 45th Culvert Pre-design Plan and Profile

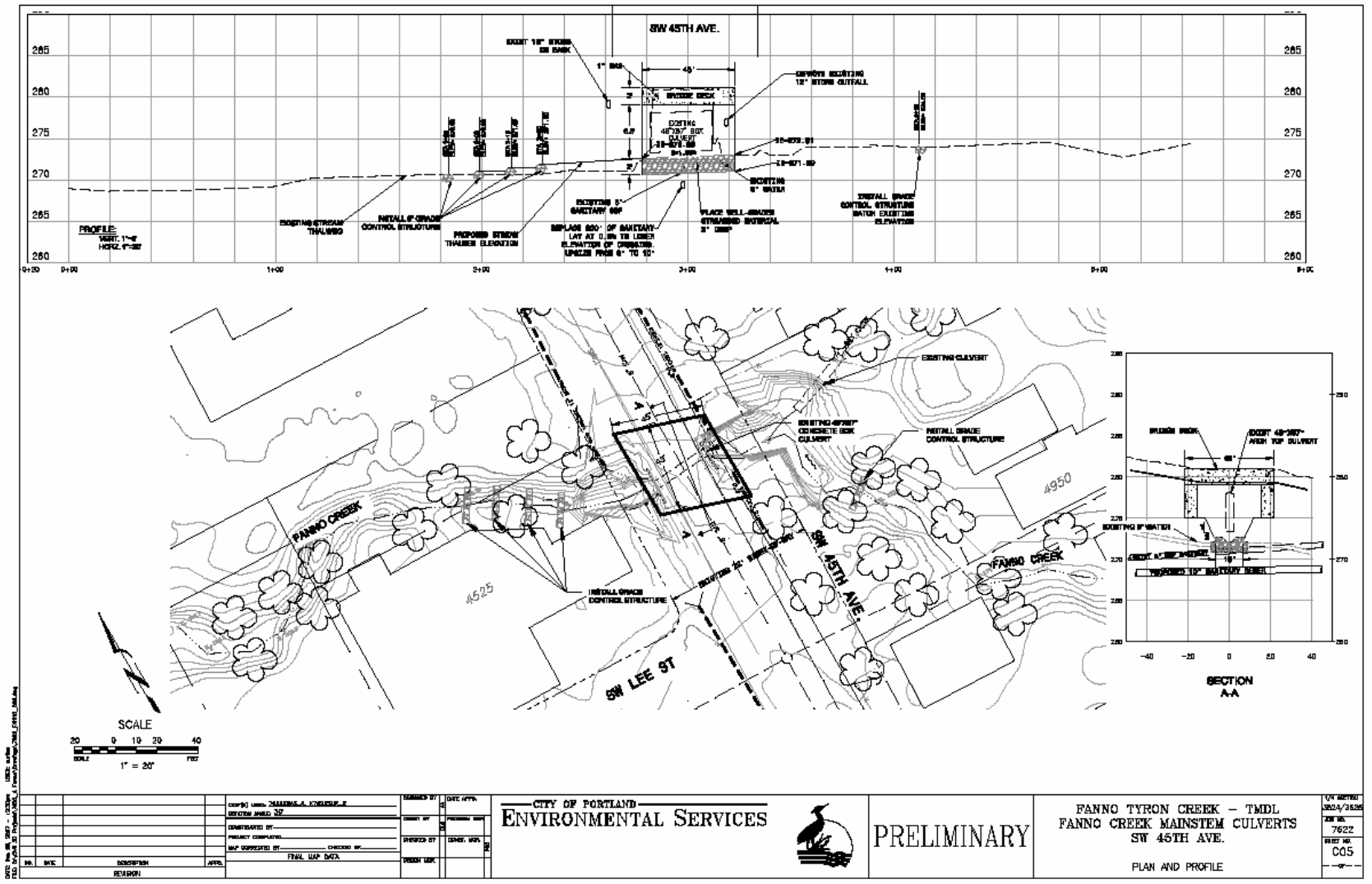


Figure 5-5: SW Shattuck Culvert Pre-design Plan and Profile

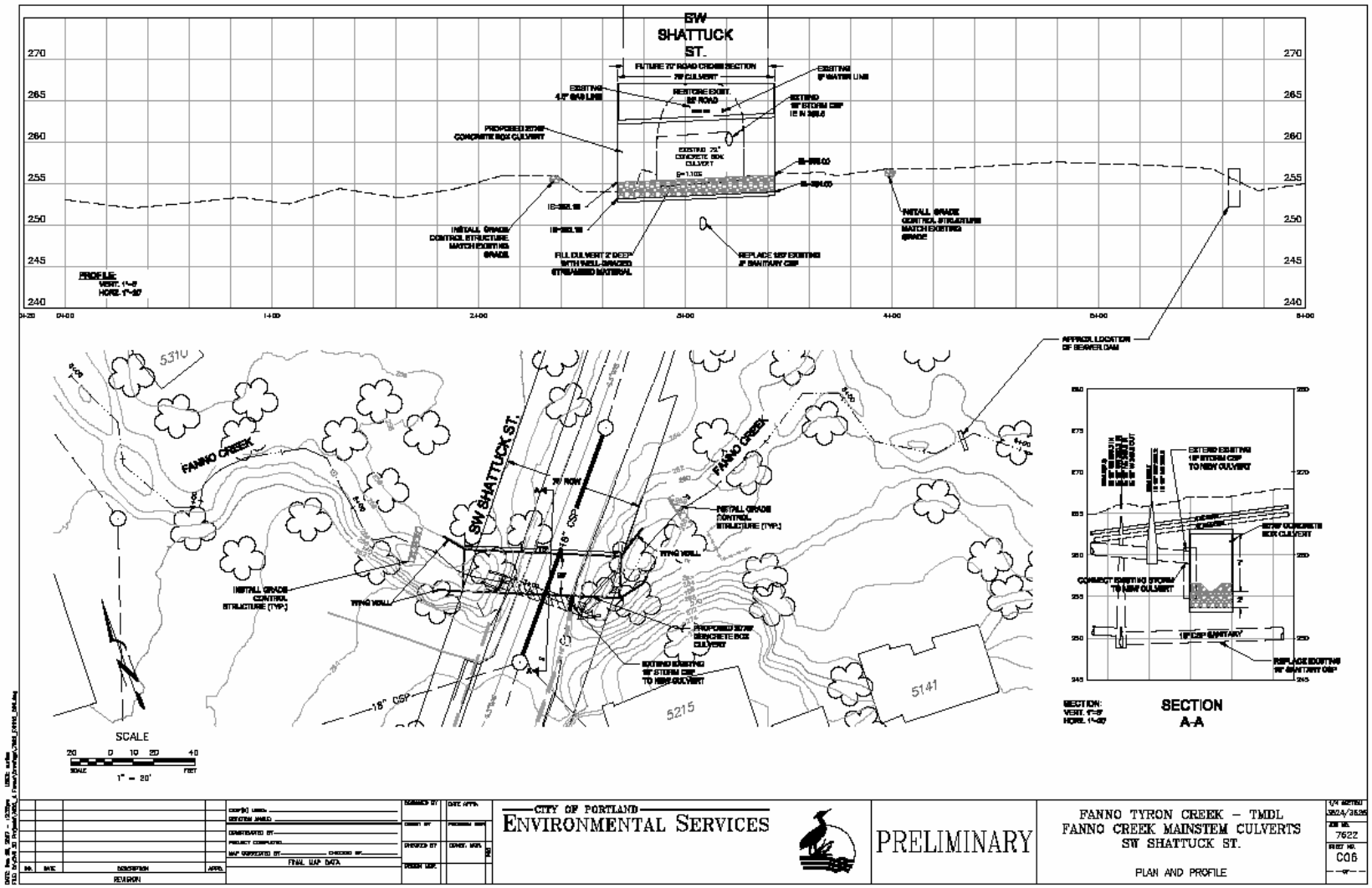


Figure 5-6: SW 35th Culvert Pre-design Plan and Profile

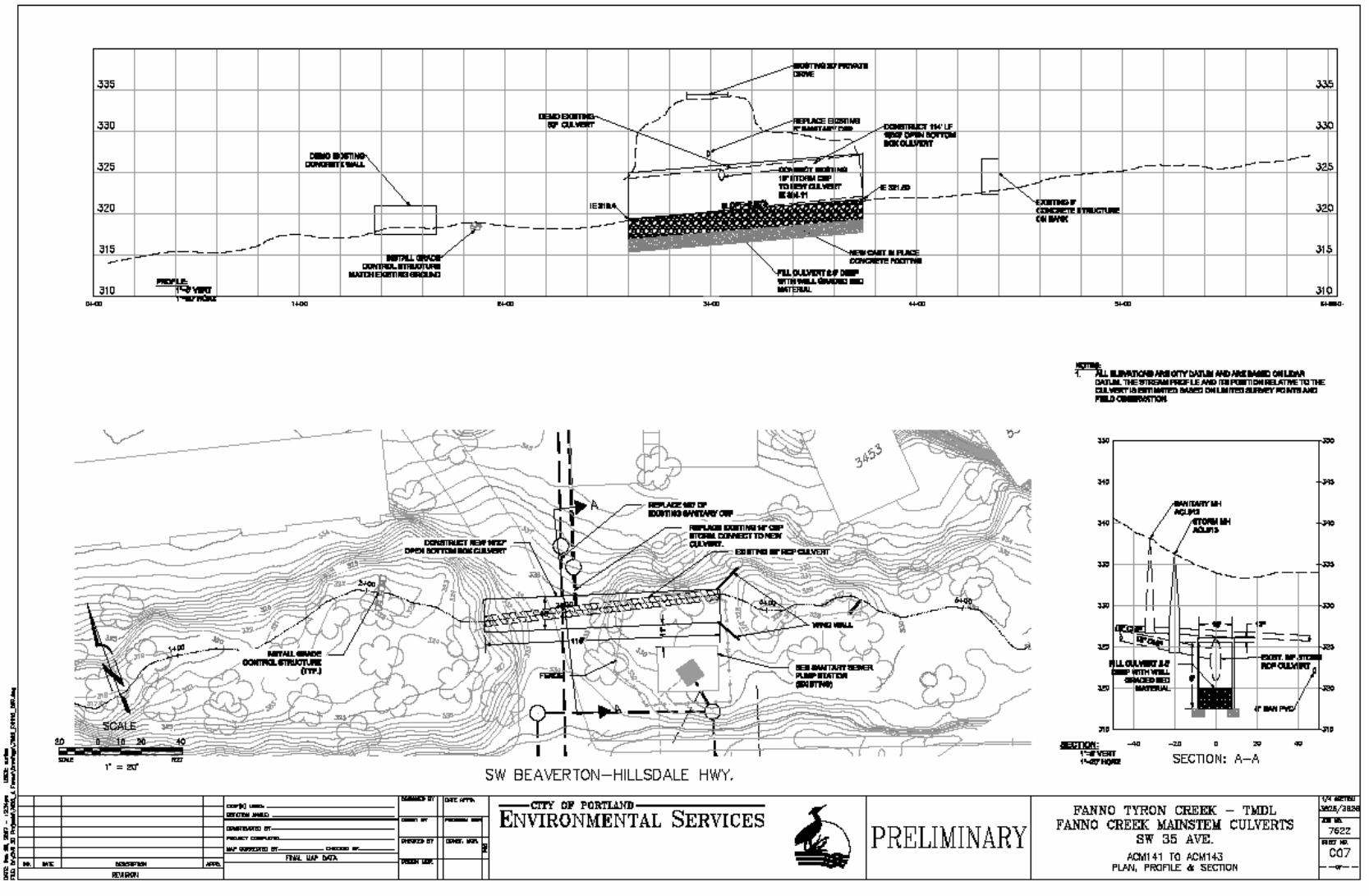
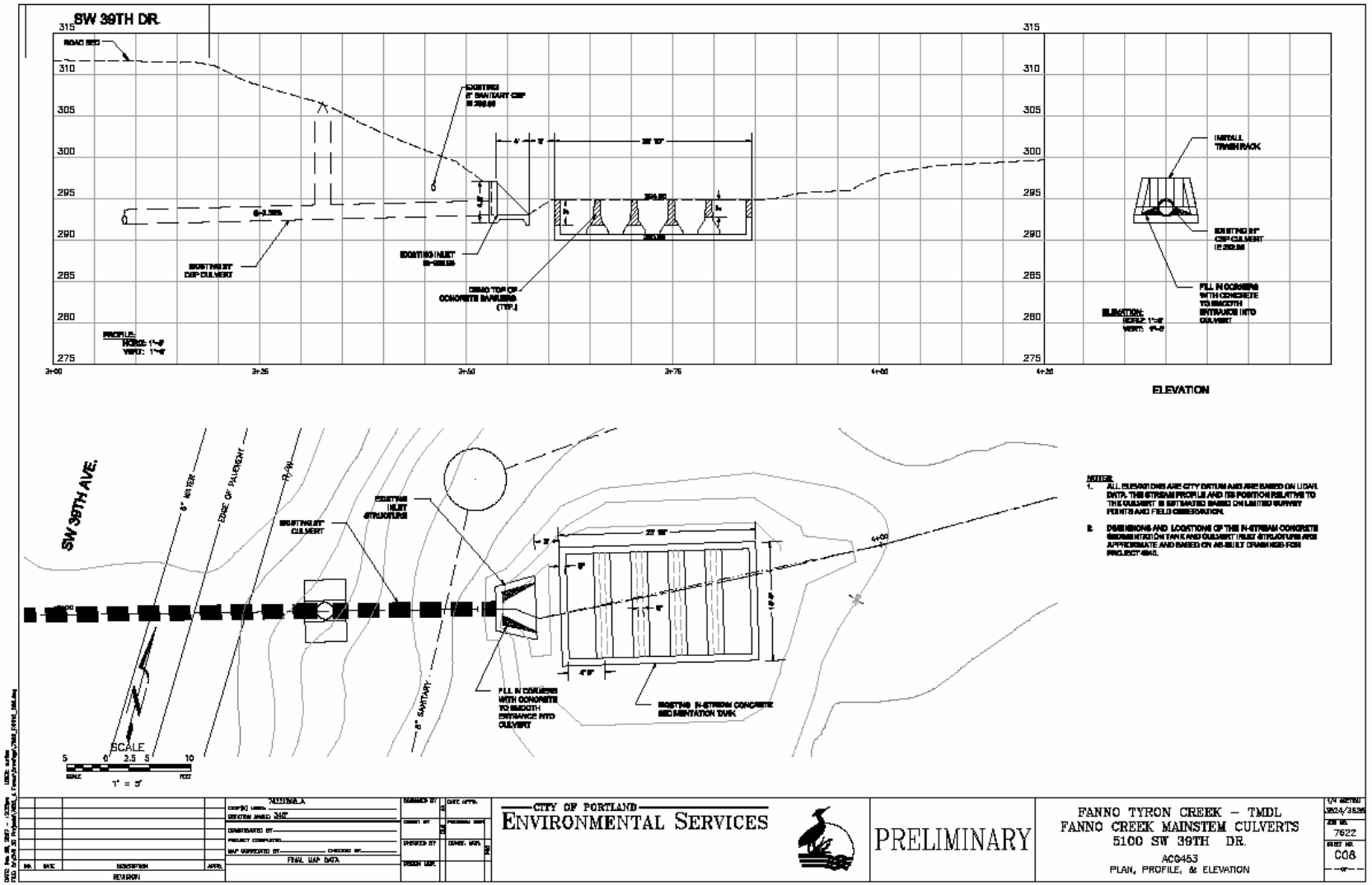


Figure 5-7: SW 39th Culvert Pre-design Plan and Profile



Outfall Retrofits

The Pre-design project evaluated the existing stormwater outfalls within the Beaverton Hillsdale Highway Cluster (Figure 5-8) and selected five outfalls for preparation of detailed pre-designs. The Pre-design recommended retrofits to the existing pipes at three of the outfalls and the construction of water quality facilities at the other two outfall locations.

The three recommended retrofits and associated cost estimates are shown below.

Outfall ACM514

The recommended retrofit is to line the existing 12-inch CMP with CIPP to repair holes created by corrosion. This requires difficult staging and traffic control because the pipe runs underneath Beaverton Hillsdale Highway. Additional work for this alternative would remove invasive vegetation and replant 0.4 acres with native plants.

Estimated Costs

Construction	$ 84,419
Design (25%)	$ 21,105
Construction management (15%)	$ 12,663
Total	$118,187

Outfall ACG251

The recommended retrofit is to replace 208 feet of 18-inch CSP with HDPE, using open trench construction. Additionally, the installation of rip-rap and vegetation will stabilize the bank and minimize future erosion.

Estimated Costs

Construction	$189,145
Design (25%)	$ 47,286
Construction management (15%)	$ 28,372
Right-of-way	$ 39,200
Total	$304,003

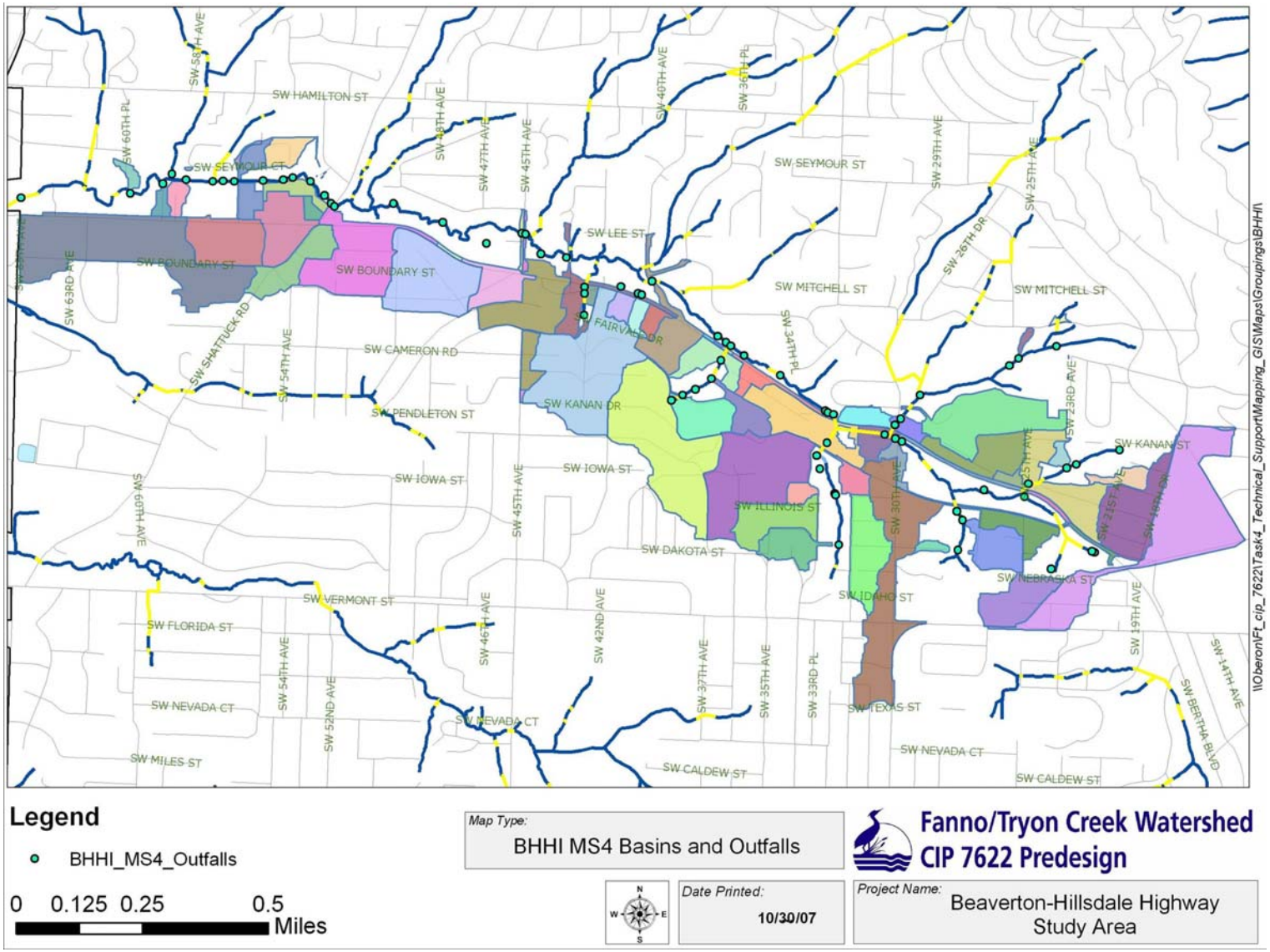
Outfall DTF026

The recommended retrofit is to remove the existing concrete collar and section of pipe extending beyond the bank and then line the remaining 333 feet of corrugated metal pipe. Additionally, the installation of rip-rap and vegetation will stabilize the bank and minimize future erosion.

Estimated Costs

Construction	$216,990
Design (25%)	$ 54,248
Construction management (15%)	$ 32,549
Right-of-way	$ 57,950
Total	$361,736

Figure 5-8: Beaverton Hillsdale Highway Stormwater Outfalls



Water Quality Facilities

The two outfall locations selected for retrofitting and construction of new water quality facilities are described below.

The outfall ACM139 site is within the existing right-of-way and City-owned property, which would make implementation of the project easier. The outfall ACG084 site would require either property purchase or an agreement with private property owners to implement. These sites are two of the only sites in the Beaverton Hillsdale Highway corridor with available land to treat highway drainage outside the right-of-way.

Outfall ID: ACM139

The Pre-design recommends constructing a water quality swale at this site (Figure 5-9). The available land allows for an adequately sized swale, but does not provide enough space for a pond.

Estimated Costs

Construction	$ 24,750
Design (25%)	$ 6,188
Construction management (15%)	$ 3,713
Total	$ 34,650

Outfall ID: ACG084

The Pre-design recommends constructing a water quality pond at this site (Figure 5-10). There is enough space for a pond, which, unlike a swale, can provide water quality as well as flow control benefits.

Estimated Costs

Construction	$148,390
Design (25%)	$ 37,097
Construction management (15%)	$ 22,258
Right-of-way	$223,000
Total	$430,745

Figure 5-9: Outfall ACM139 Pre-design

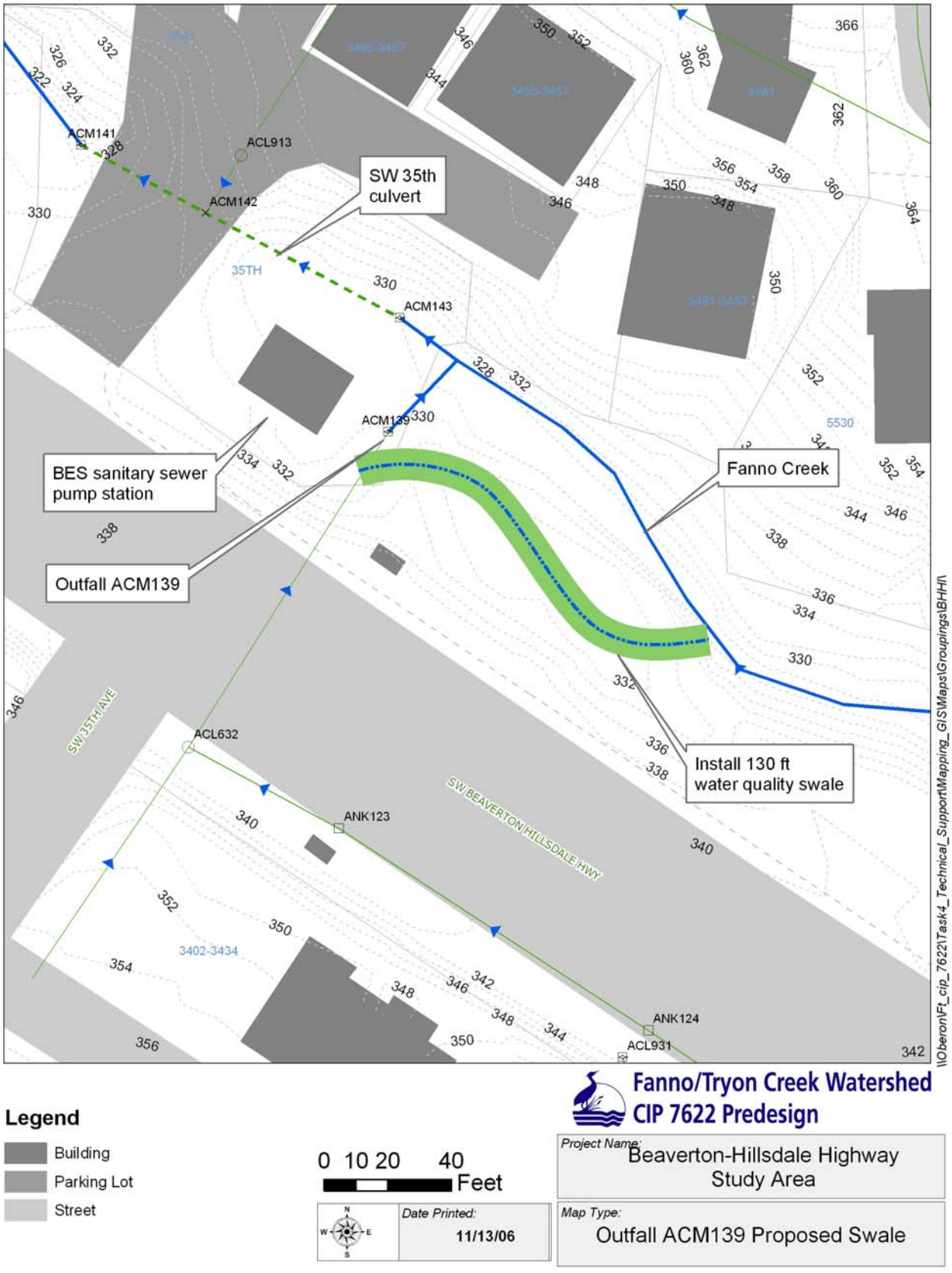
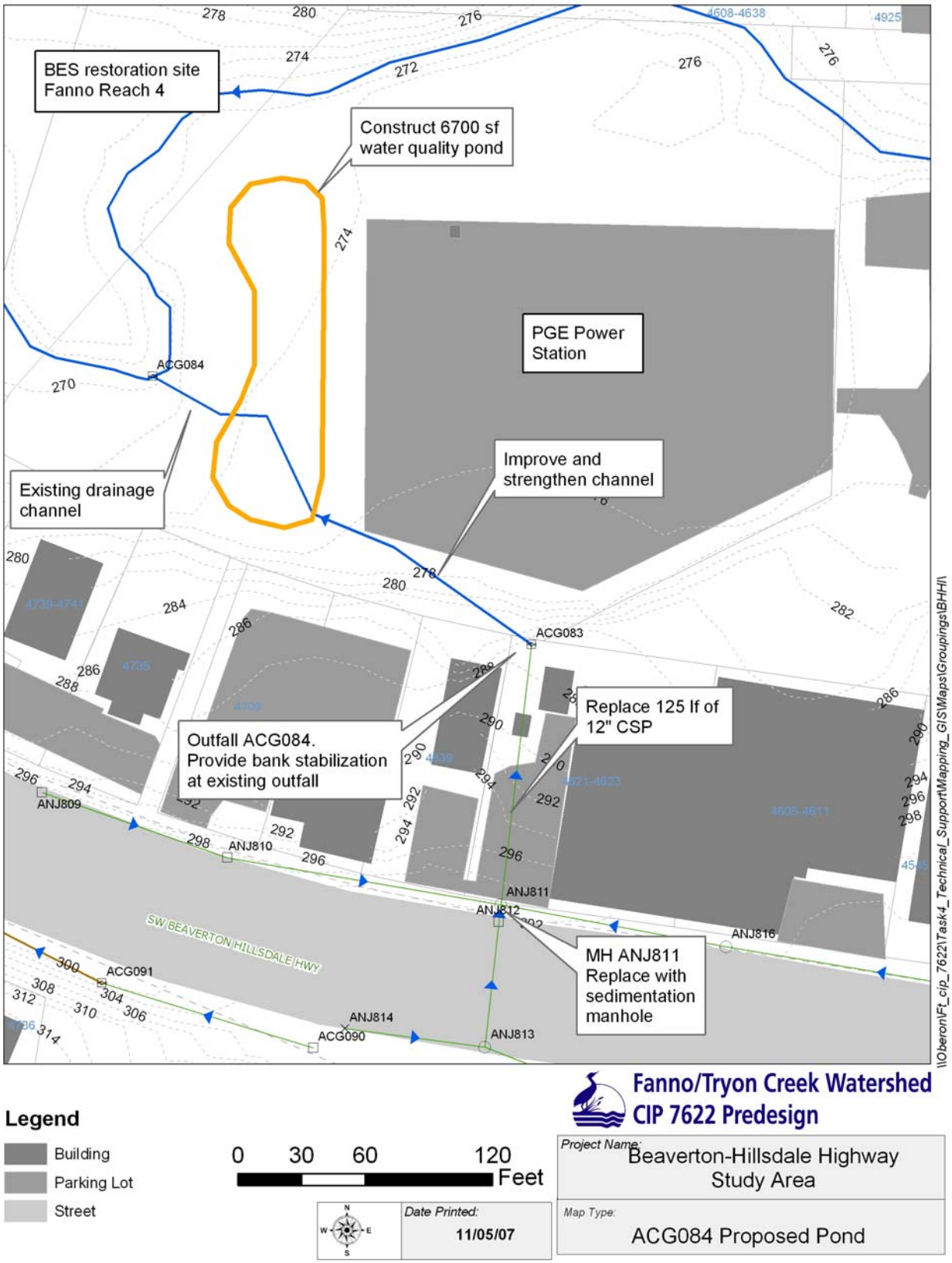


Figure 5-10: Outfall ACG084 Pre-design



Upper Tryon Creek Cluster

Impervious surfaces cover approximately 35 percent of Upper Tryon Creek. Impervious surface cover in this range reduces rainfall infiltration, increases stormwater runoff volume and velocity, and degrades stormwater quality. Research shows that impervious cover greater than 10 percent reduces urban stream stability, resulting in unstable and eroding channels. These changes degrade in-stream habitat and affect fish communities.

To address these problems, projects in this cluster focus on stormwater management and restoration of natural drainage complexity and functions. These projects will help BES meet regulatory obligations under the NPDES MS4 stormwater permit and contribute toward recovery of ESA-listed species in Tryon Creek.

See Section 8.2.2 for more information on the projects summarized below.

Stormwater Retrofits

Through on-call contracts with BES, consultants developed stormwater management pre-designs to retrofit seven sites in upper Tryon Creek (Figure 5-11). The BES Sustainable Stormwater team developed stormwater retrofit pre-designs for Multnomah Village and Jackson Middle School.

Table 5-2 summarizes the sites, impervious area treated, and construction costs. The average construction cost per square foot of impervious area managed for the nine sites is $4.20. At this average construction cost, approximately 70 percent of the impervious area at each site is managed.

Table 5-2: Upper Tryon Creek Stormwater Retrofits Summary

Site	Impervious Area Treated (square feet)	Percent Impervious Area Treated	Construction Cost	Cost/Square Foot
Multnomah Village*	194,182	20.7%	$368,025	$1.90
Capitol Hill Elementary School	138,243	89.1%	$196,346	$1.42
Barbur Boulevard Transit Center	140,613	69.1%	$207,398	$1.47
North of Barbur at SW 26th	81,449	64.5%	$1,002,013	$12.30
ODOT Maintenance Yard	130,957	74.1%	$255,657	$1.95
Westbrook Apartments	15,298	26.0%	$304,348	$19.89
West Portland Town Center	145,879	49.1%	$919,917	$6.31
Burlingame	40,268	45.6%	$536,456	$13.32
Jackson Middle School (includes cost to relocate tennis courts)	139,580	42.4%	$522,321	$3.74
Total	**1,026,469**	**43.3%**	**$4,312,381**	**$4.20**

* Multnomah Village stormwater retrofits target streets and large parking lots.

Estimated Costs

Construction	$ 4,312,381
Design (20%)	$ 862,476
Startup – 0&M (10%)	$ 431,238
Contingency (20%)	$ 862,476
Total	$ 6,468,571

Many of these retrofit projects are located on private property. Policies are not yet in place to spend BES capital funds to design and construct stormwater facilities on private property. In addition, permission to construct any facilities of private property would need to be obtained. Given the near-term difficulty of implementing projects on private property, stormwater retrofit projects located in the public right-of-way and/or on public agency property (e.g. Oregon Department of Transportation, TriMet) should be pursued first.

Two sites—Jackson Middle School and Multnomah Village—are treated as individual projects in the evaluation section of this report. Therefore, short summaries of these two projects are provided below.

Multnomah Village Stormwater Retrofits

Over 30 stormwater retrofit projects were identified in Multnomah Village (Figure 5-12). Most of these projects are located in the public right-of-way or on publicly owned property, such as the Multnomah Arts Center parking lot. As examples, Figures 5-13 and 5-14 depict pre-designs for two projects.

These stormwater projects should be relatively easy to implement because they do not have the same constraints that similar projects located on private property do, they have been presented to the Multnomah Village Business Association, and they have been reviewed by staff from the Bureau of Maintenance and Portland Office of Transportation (PDOT).

Jackson Middle School Stormwater Retrofits

Jackson Middle School is located in the headwaters of Falling Creek, a tributary of Tryon Creek (Figure 5-15). This pre-design contains a number of stormwater management projects throughout Jackson Middle School to manage stormwater runoff from nearly 140,000 square feet of impervious surfaces. Figures 5-16 and 5-17 depict pre-designs for two projects.

Figure 5-11: Upper Tryon Creek Stormwater Retrofit Sites

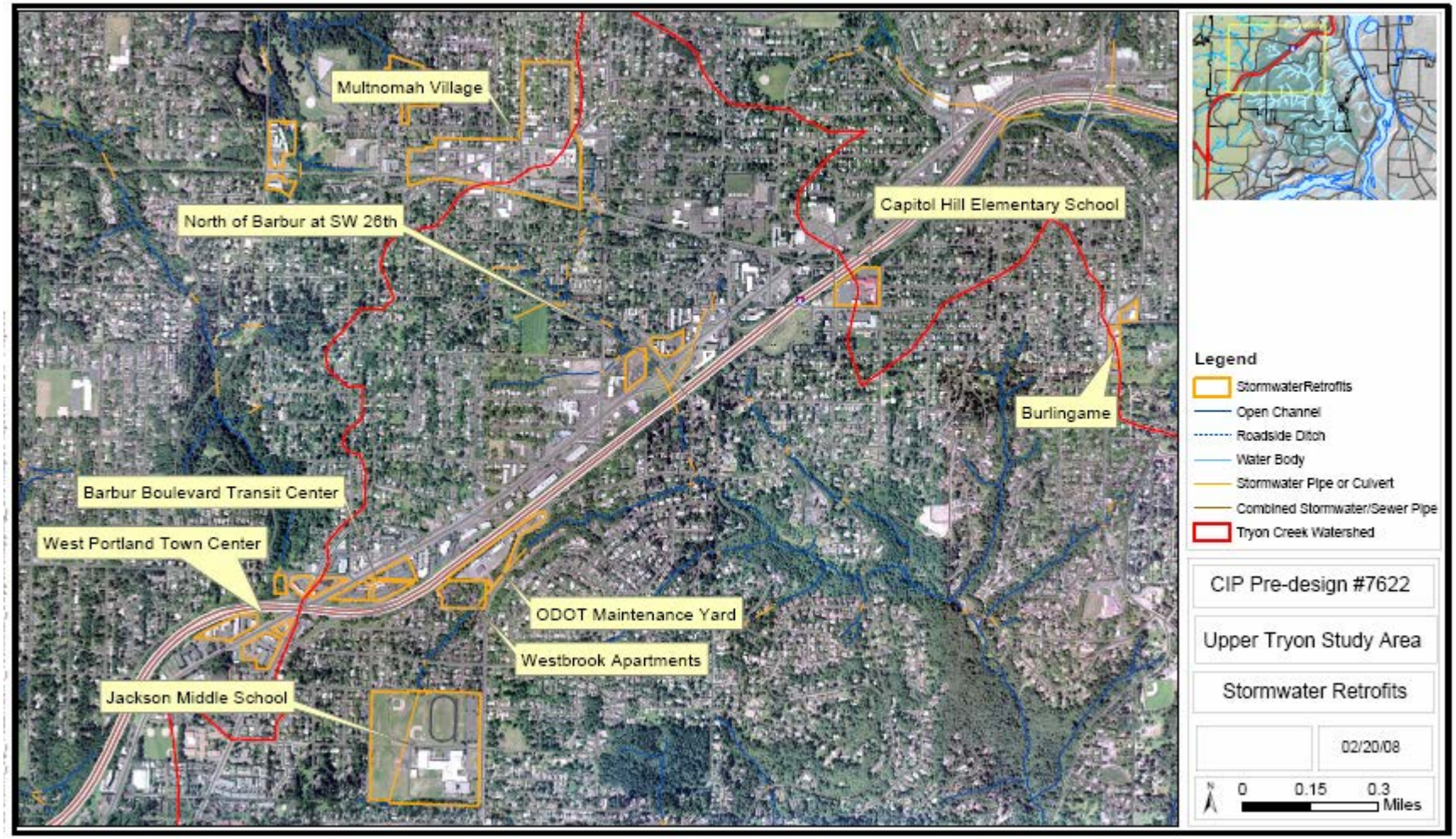
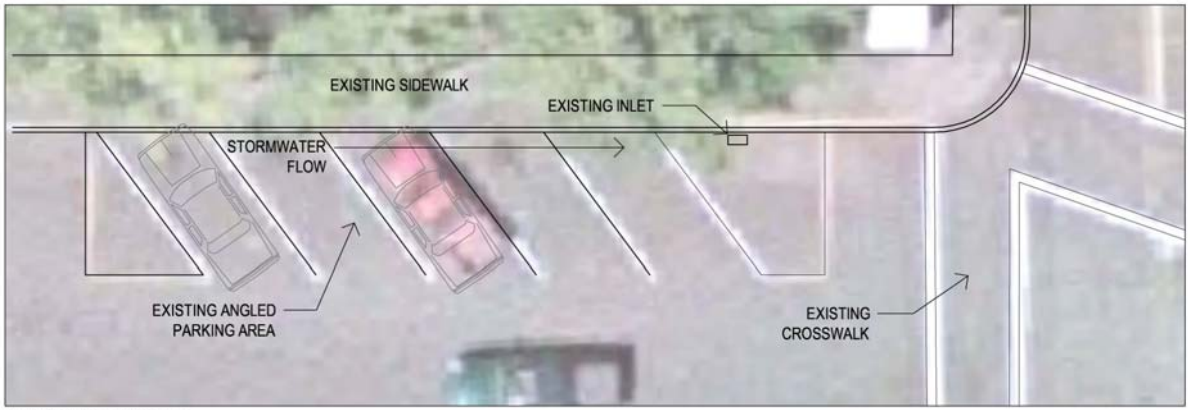
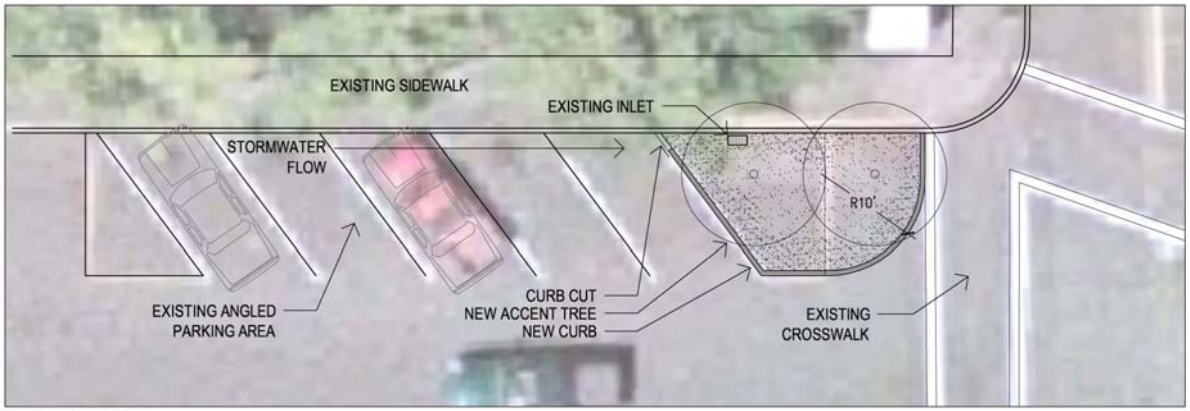


Figure 5-12: Upper Tryon Creek – Multnomah Village – Stormwater Retrofit Sites

Figure 5-13: Multnomah Village Stormwater Retrofit Pre-design Site MV-S7



Existing Conditions



Concept Design

PROJECT INFO:

Total Impervious Area Treated:	4,300 sf
Size of Proposed Facility:	290 sf
Gallons of Stormwater Treated per Year :	99,000 gal.
Parking Stalls Removed:	0

Notes:

1. This project should be installed in conjunction with project MV-S6, located at the west end of the angled parking zone. Together, these facilities will manage 9,300 square feet of impervious area.
2. The existing drain inlet will need to be reconfigured to an overflow drain for the new facility.

Project: MV-S7

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Figure 5-14: Multnomah Village Stormwater Retrofit Pre-design Site MV-S12

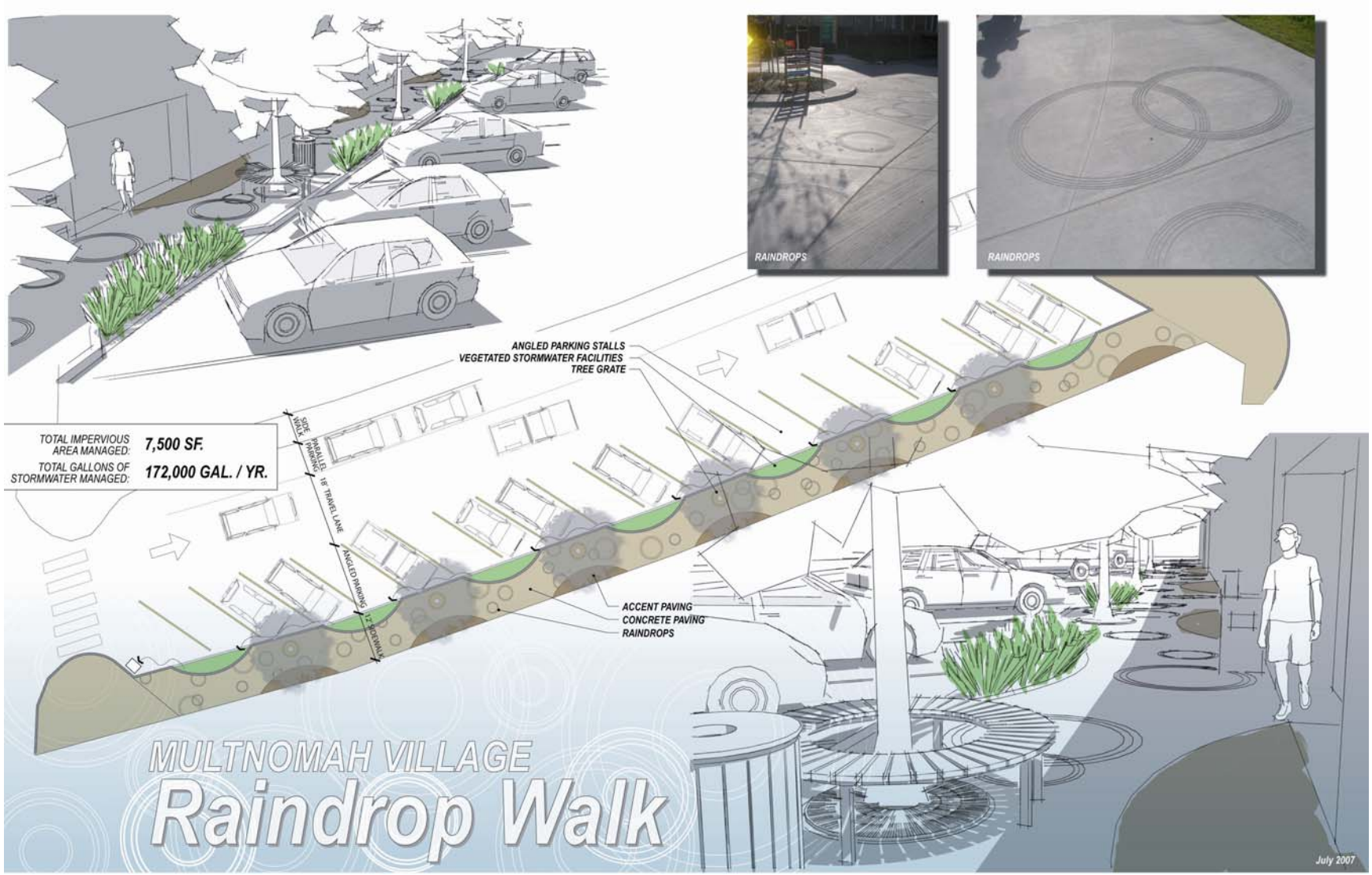


Figure 5-15: Jackson Middle School Aerial Map

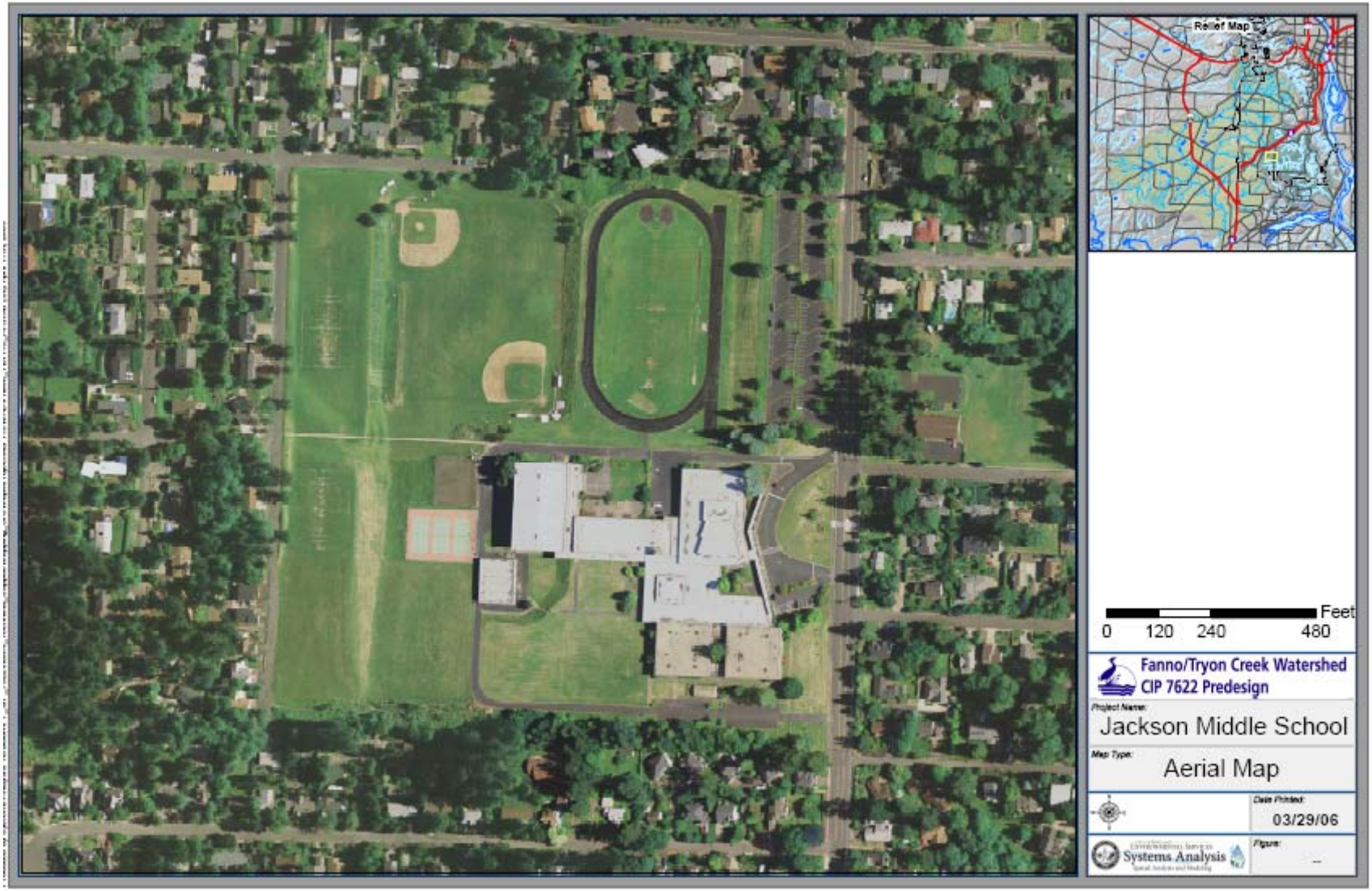
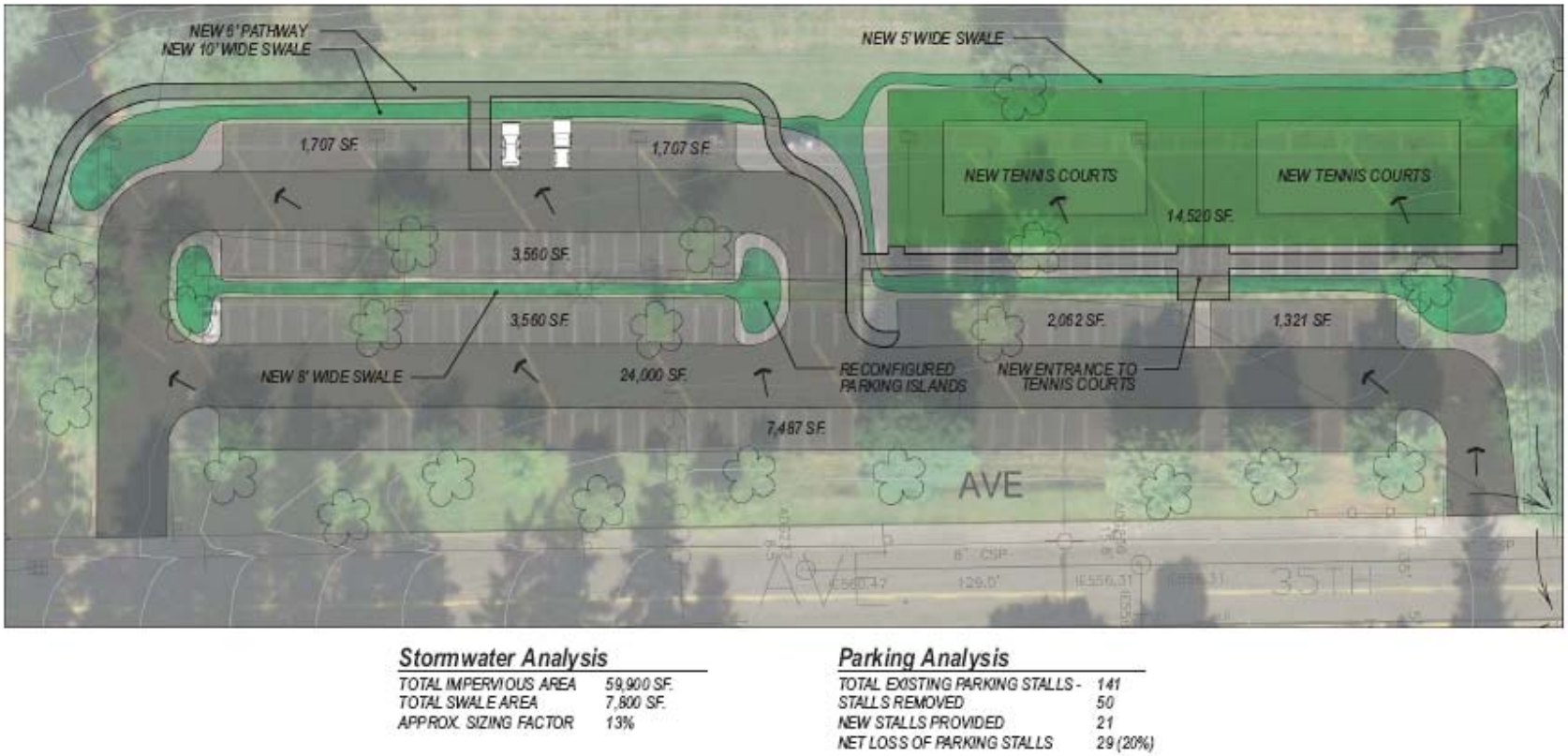


Figure 5-16: Jackson Middle School North Parking Lot Stormwater Retrofit Pre-design



Stormwater Analysis	
TOTAL IMPERVIOUS AREA	59,900 SF.
TOTAL SWALE AREA	7,800 SF.
APPROX. SIZING FACTOR	13%

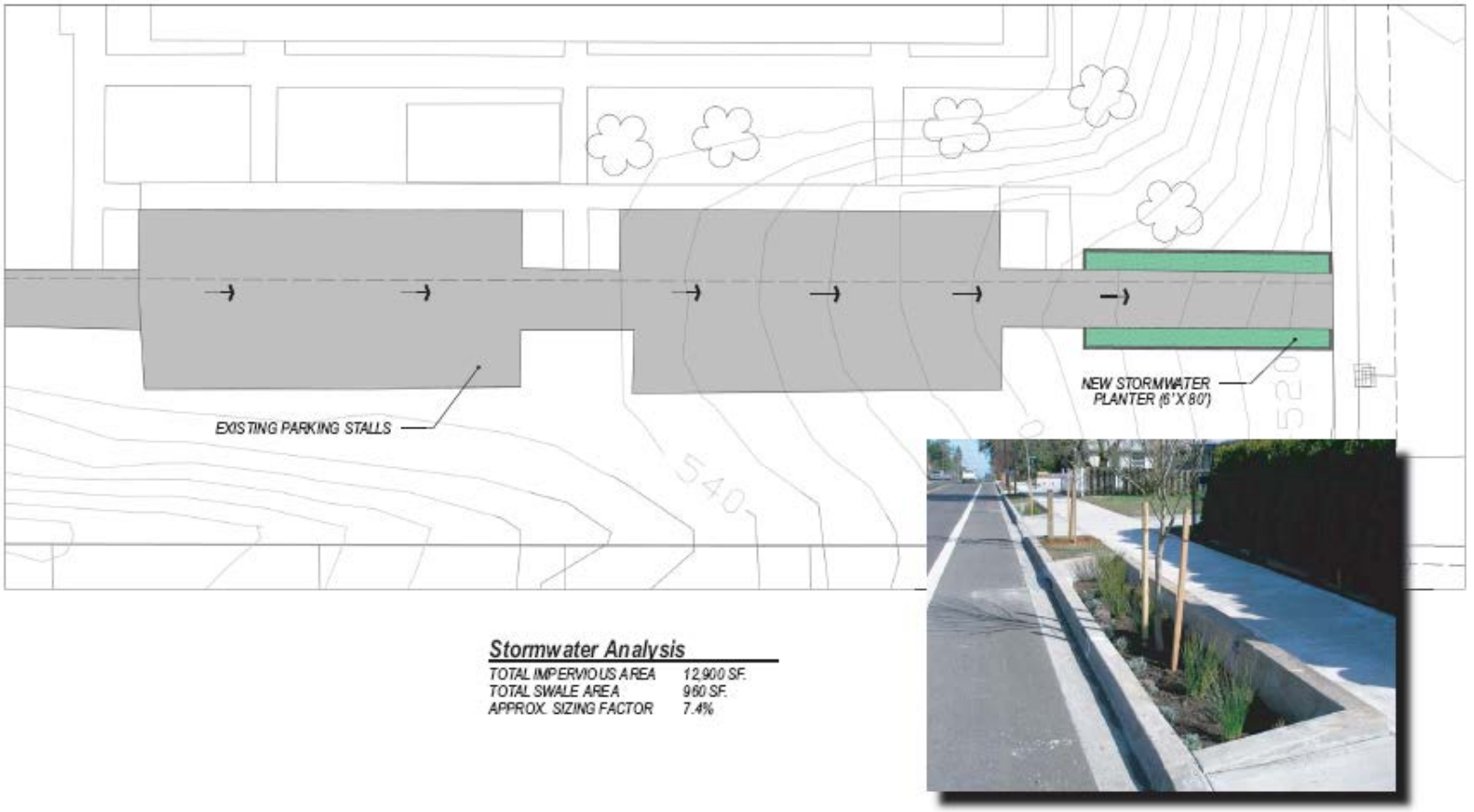
Parking Analysis	
TOTAL EXISTING PARKING STALLS -	141
STALLS REMOVED	50
NEW STALLS PROVIDED	21
NET LOSS OF PARKING STALLS	29 (20%)

North Parking Lot Stormwater Retrofit Concept

JACKSON MIDDLE SCHOOL - Fanno / Tryon Creek Watershed

Sustainable Stormwater Group

Figure 5-17: Jackson Middle School South Parking Lot Stormwater Retrofit Pre-design



Barbur Boulevard Drainage Improvements

Stormwater runoff from Barbur Boulevard is conveyed without treatment to the upper reaches of Tryon Creek through a system of small stormwater drainage systems and culverts. The Grid pollutant load model identifies high–traffic-volume streets such as Barbur Boulevard as significant sources of urban pollutants.

This project will provide stormwater treatment for runoff from Barbur Boulevard. The project area includes 1.3 miles of Barbur Boulevard, from Southwest Multnomah Boulevard to the City limits at SW Capitol Highway. It comprises over 13 acres of impervious pavement area, along with associated areas from the high-density commercial and multifamily development along the corridor (Figure 5-18). This project will provide for treatment of highway runoff through installation of inlet, manhole, and small vault treatment systems, along with improvement of open ditch conveyance facilities.

Estimated Costs

Unit Costs

For treatment of ¼ acre impervious of highway area:

- Filterra units: $9,898/unit
- Stormwater filter: (2 cartridge systems)
- Catch basin installation: $7,900/unit
- Manhole installation; $10,900/unit

Assumptions

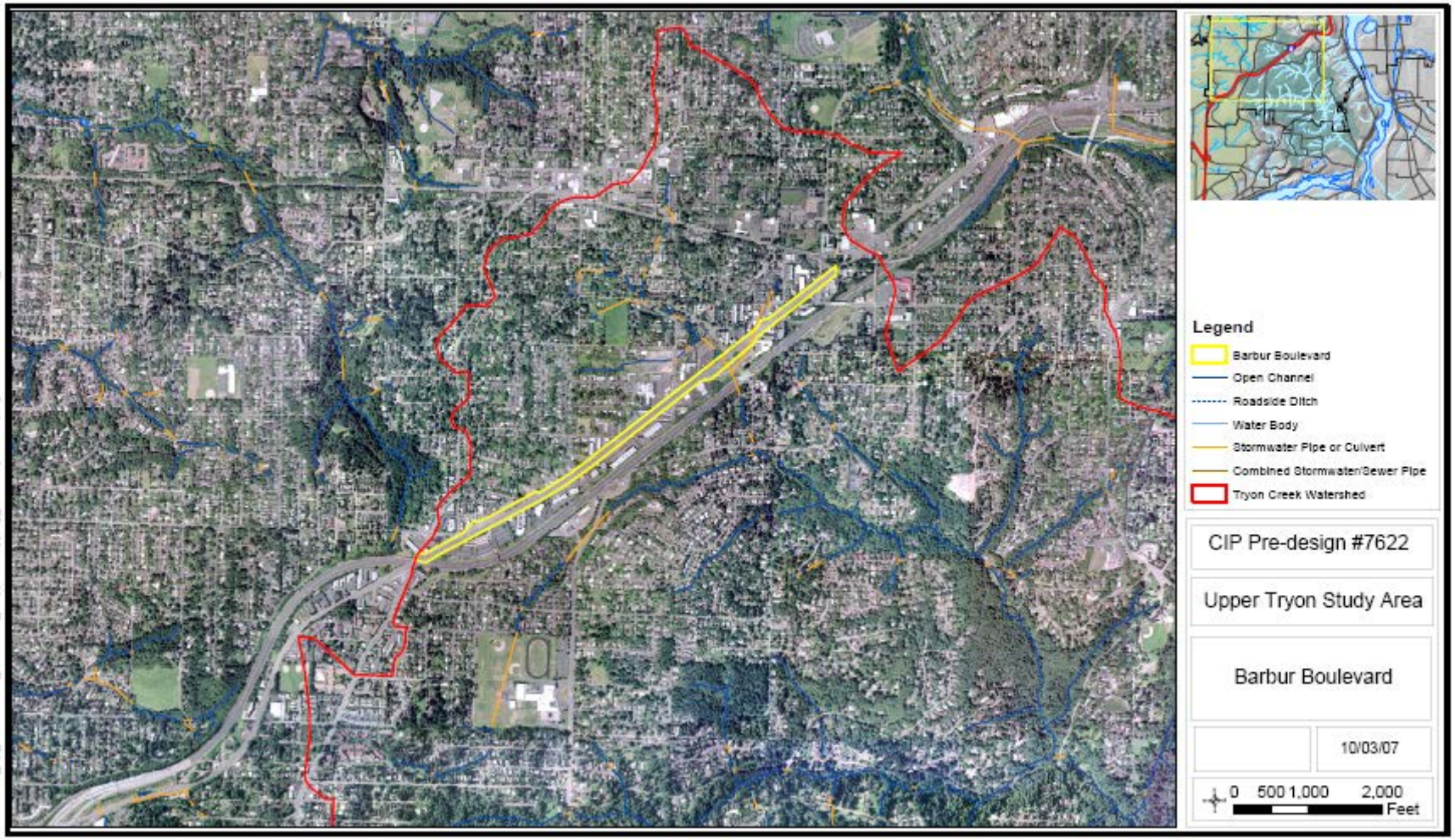
• Treatment Unit/¼ acre		$10,000
• Installation		1,500
• Contingency (25%)		2,875
• Engineering (20%)		2,875
	Total	$17,250

Cost Estimate

- Cost/acre IA: 4 x $17,250 = $69,000/acre
- Total area: 14 acres IA less 4 acres other treatment = 10 acres
- ➢ Total cost: 10 x 69,000 = $690,000

Two issues may effect implementation and performance. First, although these projects would be located in the public right-of-way, Barbur Boulevard is a state-owned and maintained highway. The design and installation of any facilities would need to be closely coordinated with the Oregon Department of Transportation (ODOT). Second, the choice of City-approved stormwater technologies that could be installed into the existing drainage system is extremely limited. The actual performance of these facilities and the ability to install them as a retrofit may be limited.

Figure 5-18: Barbur Boulevard



I-5 at SW 26th Water Quality Facility

BES Engineering Services developed the I-5 at SW 26th water quality and detention facility pre-design. This project comprises four separate water quality and detention facilities located in ODOT right-of-way (Figures 5-19 to 5-23) and would treat and detain stormwater runoff from over 20 acres. ODOT reviewed and commented on this pre-design and is discussing an agreement for using this site for a water quality facility. This ongoing discussion will facilitate future design and implementation and advance BES's working partnership with ODOT.

Estimated Costs

Construction	$ 799,045
Design (25%)	$ 199,761
Construction Management (15%)	$ 119,857
Contingency (25%)	$ 199,761
Total	$1,318,214

Costs are based on a detailed pre-design.

Figure 5-19: Project Site Map

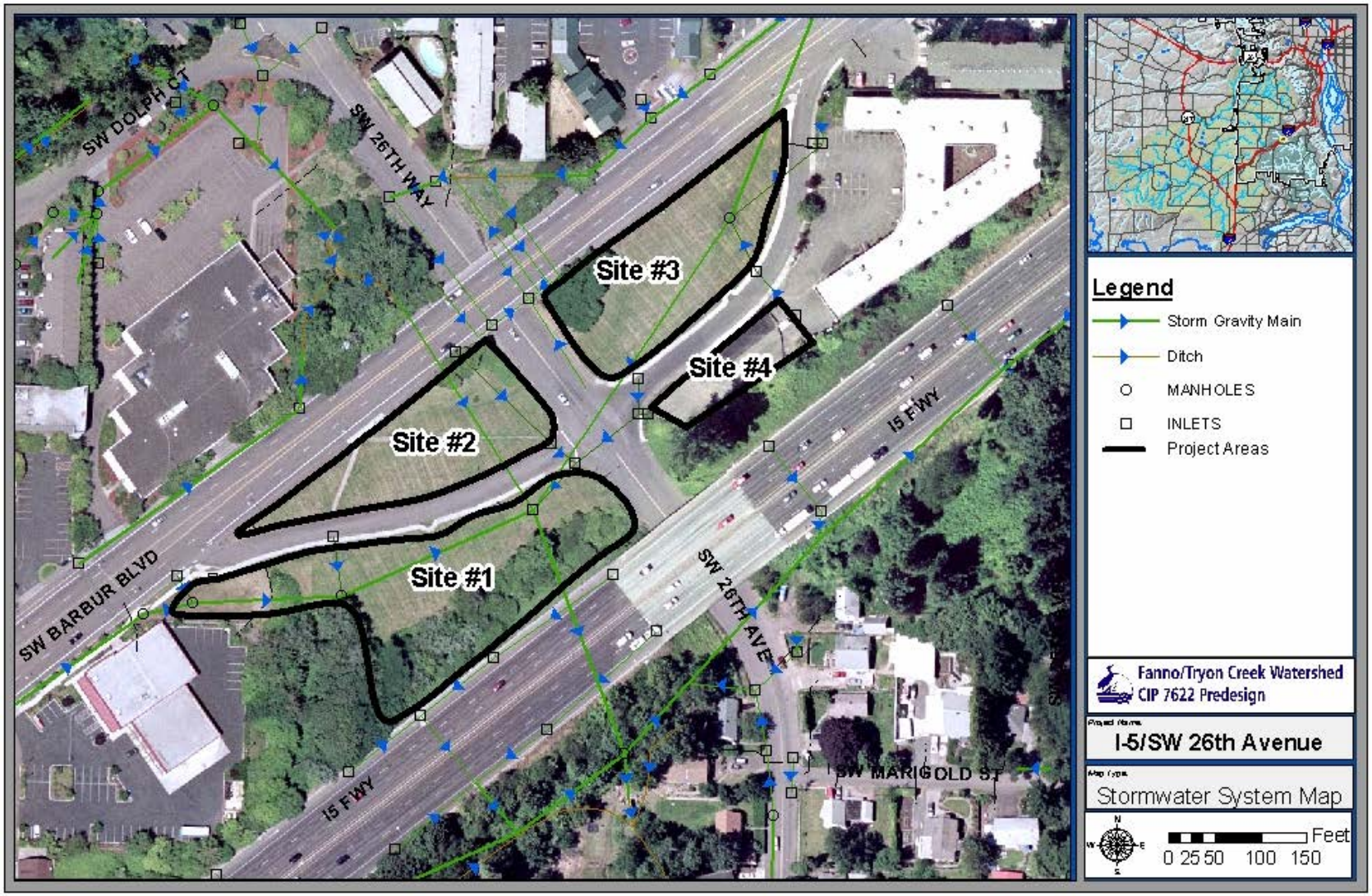


Figure 5-20: Site 1 Selected Alternative - Pond

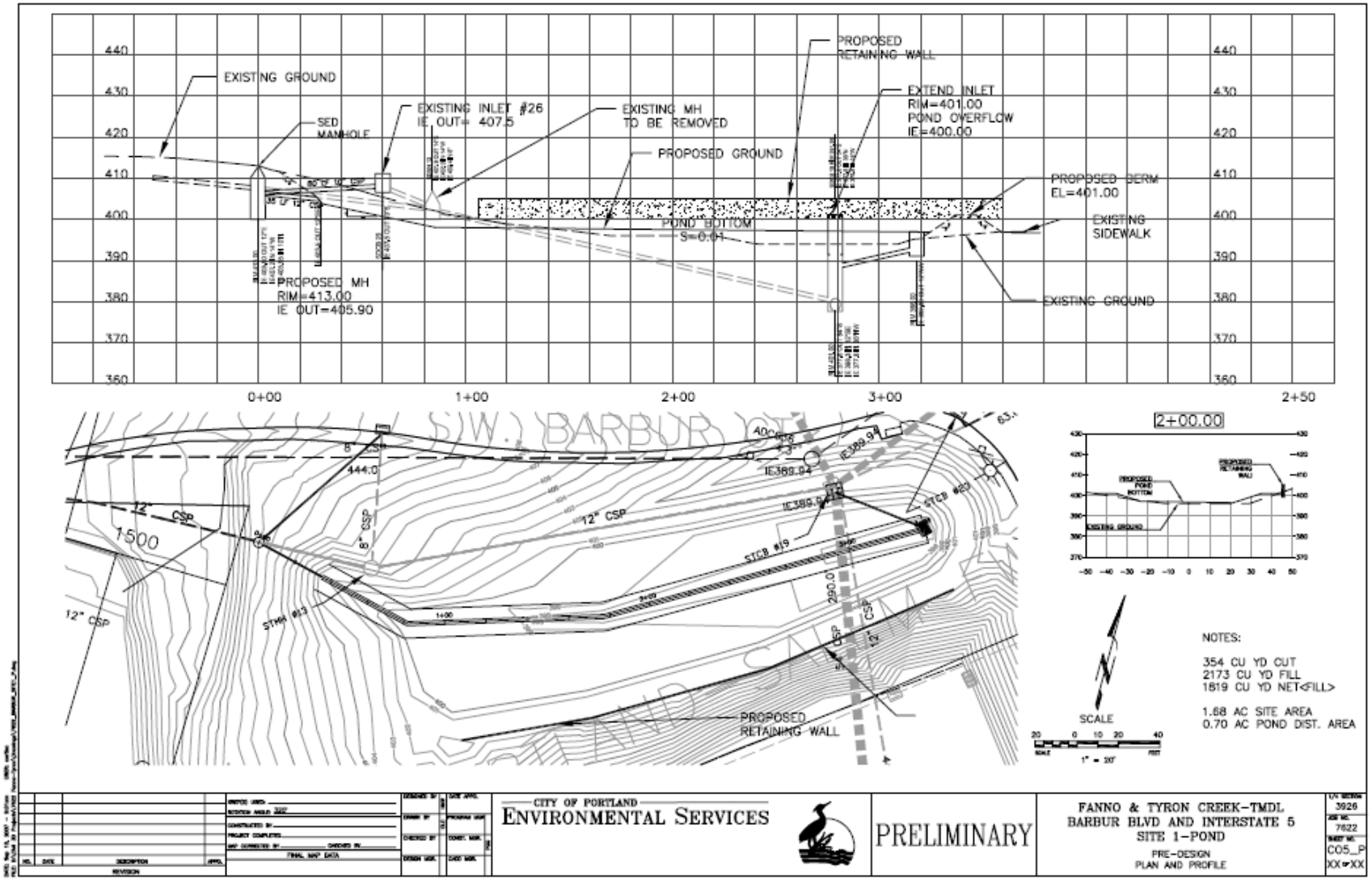


Figure 5-21: Site 2 Selected Alternative - Wide Body Swale

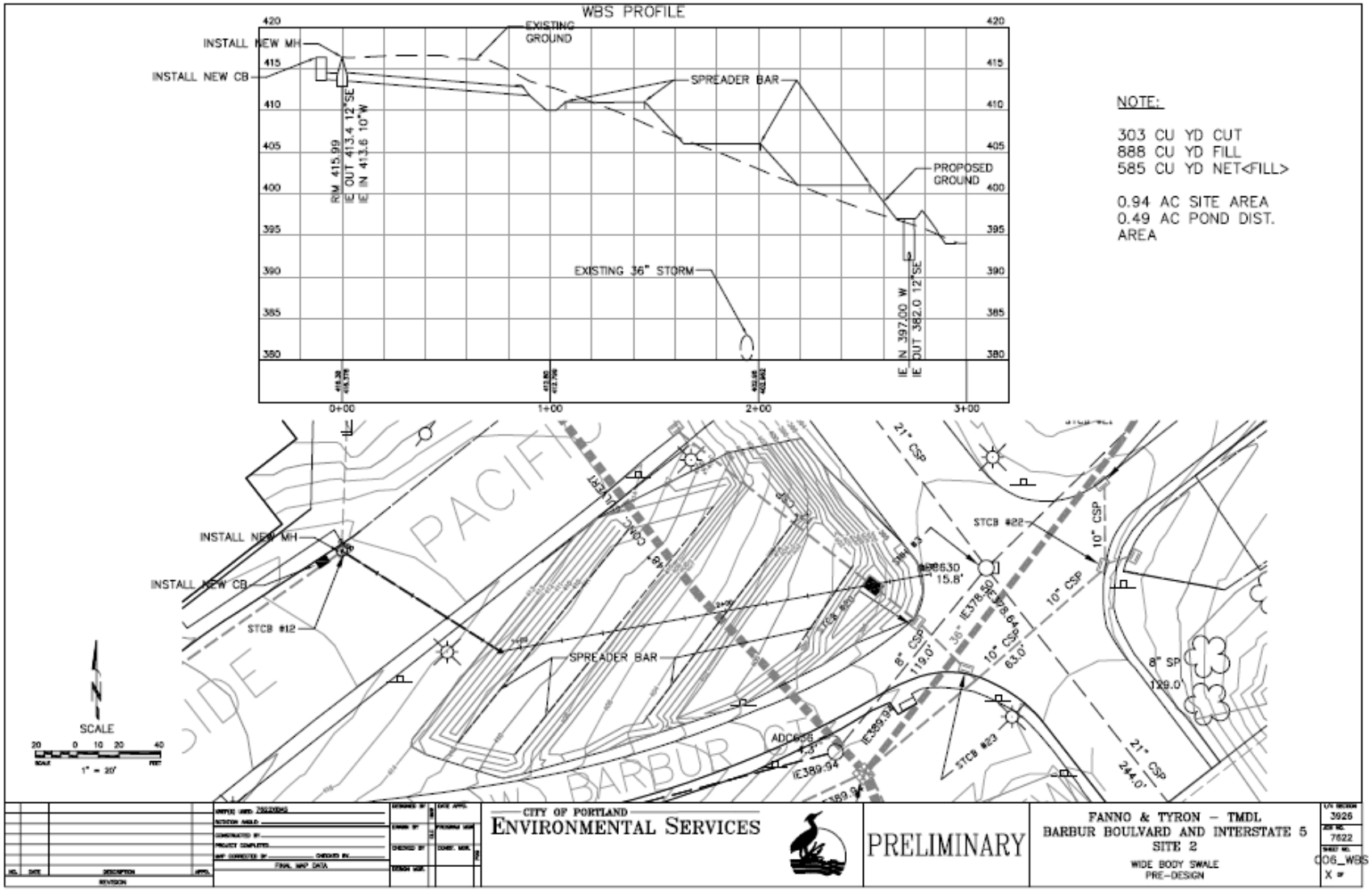


Figure 5-22: Site 3 Selected Alternative – Pond

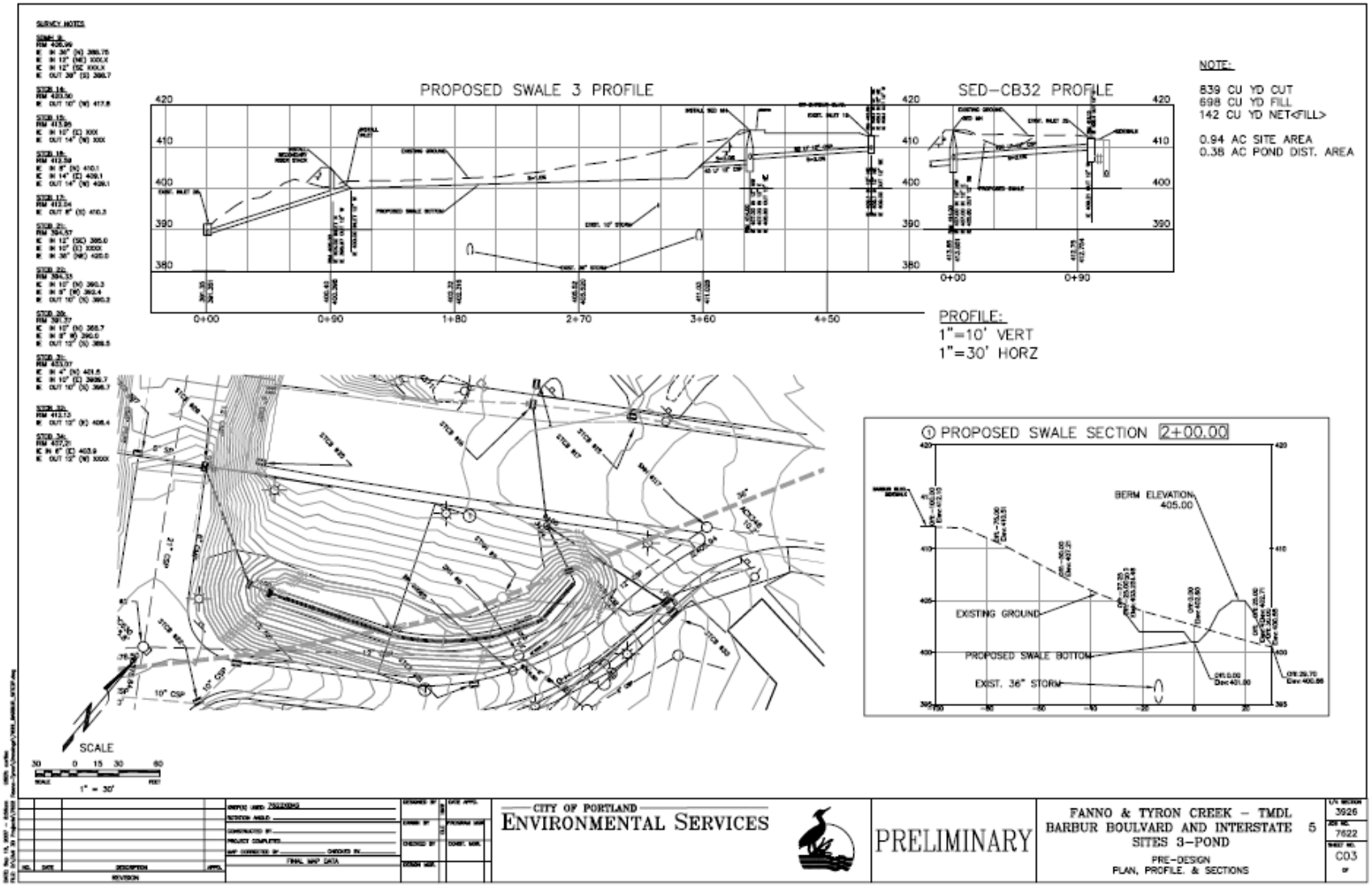
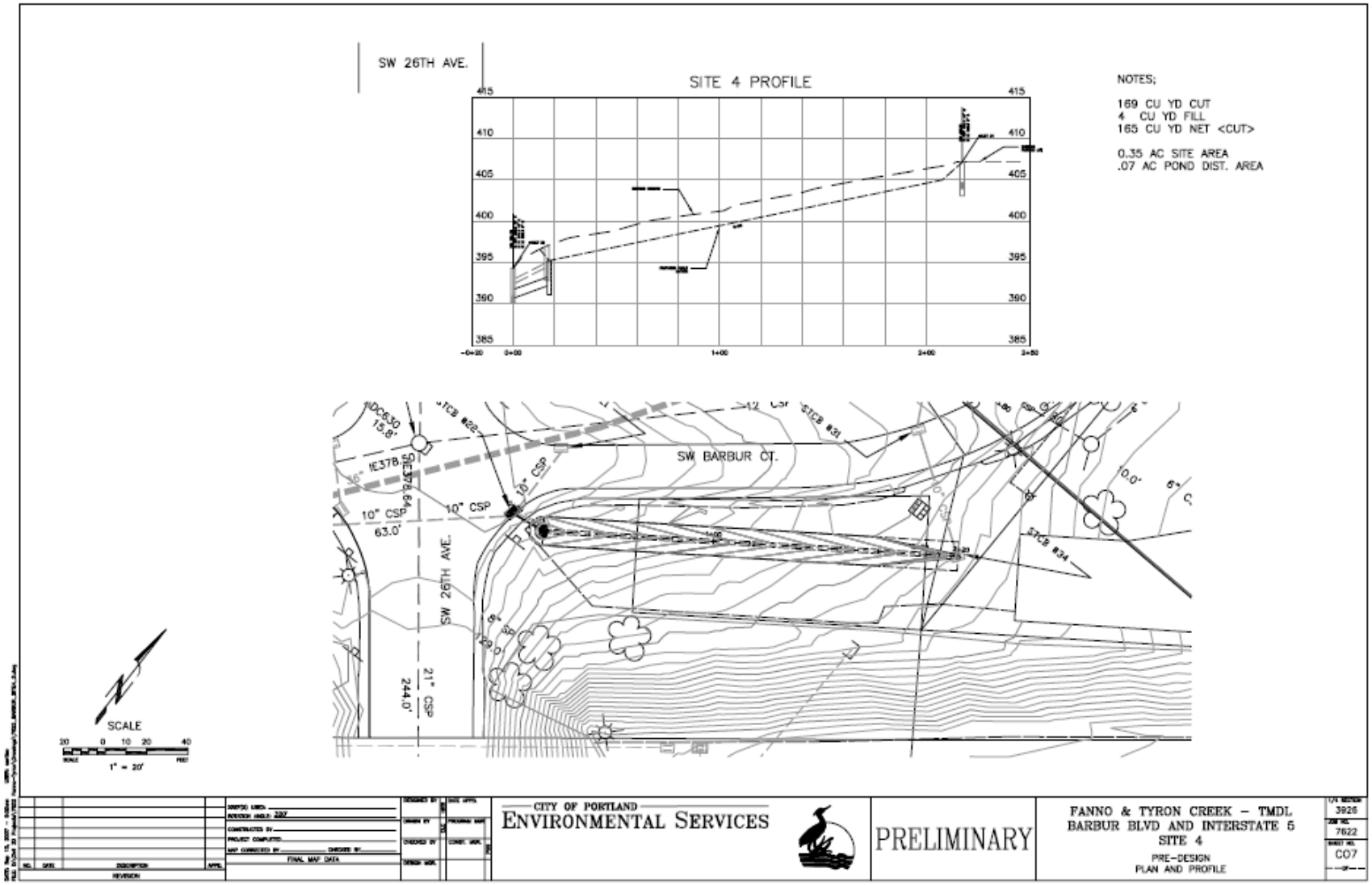


Figure 5-23: Site 4 Selected Alternative – Swale



Tryon Creek Water Quality Facilities (MS4 Basins DTT002 and ADC879)

Two sites south of Barbur Boulevard were identified as potential locations for water quality facilities in the Pre-design.

The water quality facility to treat stormwater runoff from MS4 Basin DTT002 would be located primarily in ODOT right-of-way (Figure 5-24). Stormwater runoff from MS4 basin DTT002 is currently conveyed to a 250-foot-long pipe in the ODOT right-of-way before entering a culvert under Interstate 5 and flowing to Falling Creek. This project would replace the pipe with a water quality swale. The facility would treat stormwater runoff from nearly 10 acres.

Estimated Costs

Construction	$ 120,000
Design (30%)	$ 36,000
Contingency (overall) (30%)	$ 46,800
Total	$ 202,800

The water quality facility to treat stormwater runoff from MS4 Basin ADC879 would be located partially in ODOT right-of-way and private property (Figure 5-25). The facility would be located at an existing low point and treat stormwater runoff from this basin. Disposal from the facility would be conveyed to an existing culvert under I-5 that drains into Falling Creek.

Estimated Costs

Construction	$ 120,000
Design (30%)	$ 36,000
Contingency (overall) (30%)	$ 46,800
Total	$ 202,800

Design and construction of these facilities would require a partnership with ODOT.

Cost estimates for these two facilities are based on construction costs of the BES water quality facility located at 17th and Taylors Ferry Road in Tryon Creek, which was designed by BES Engineering Services. The cost estimates do not include potential costs for land acquisition and/or easements.

Figure 5-24: Water Quality Facility DTT002

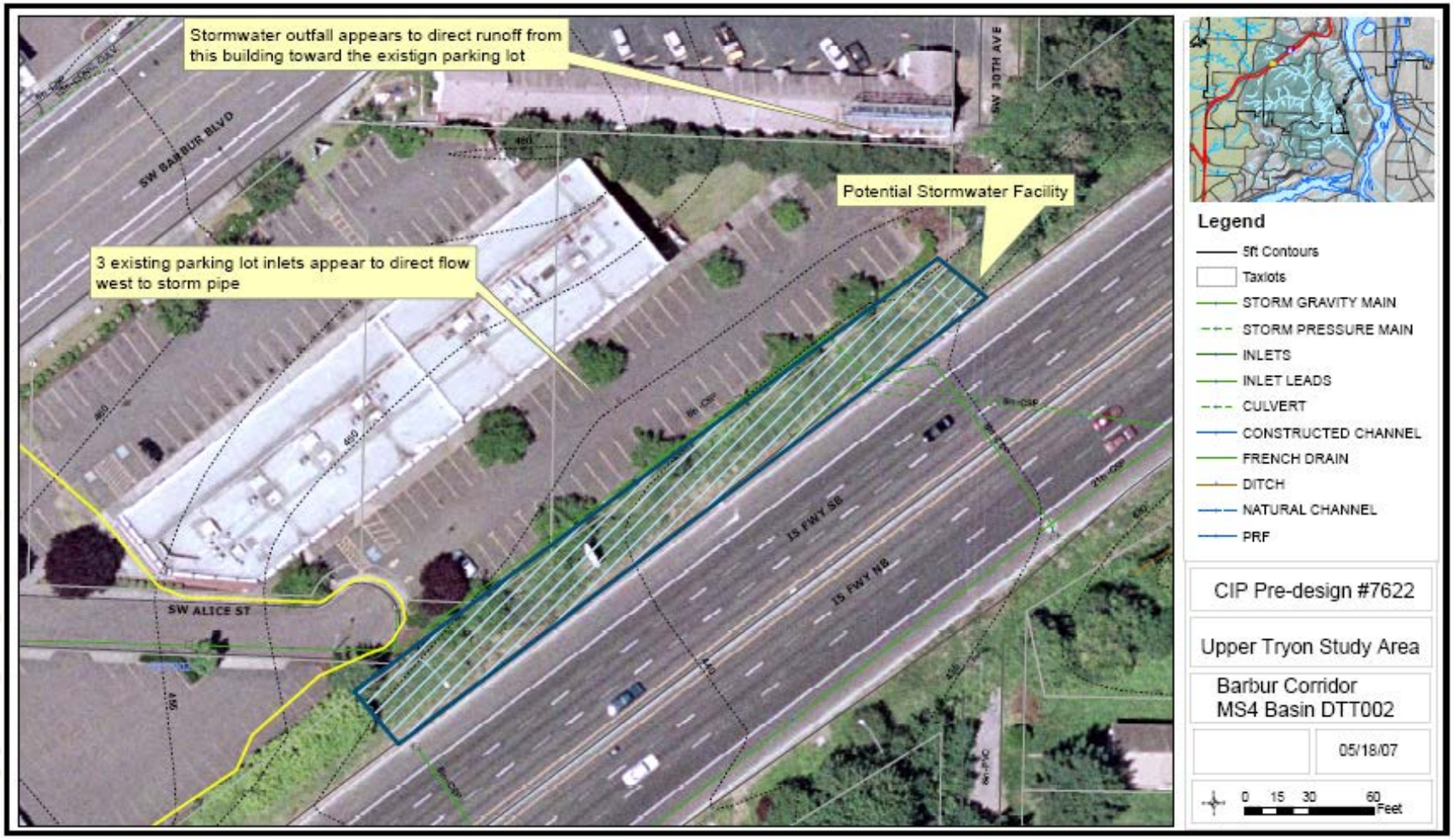
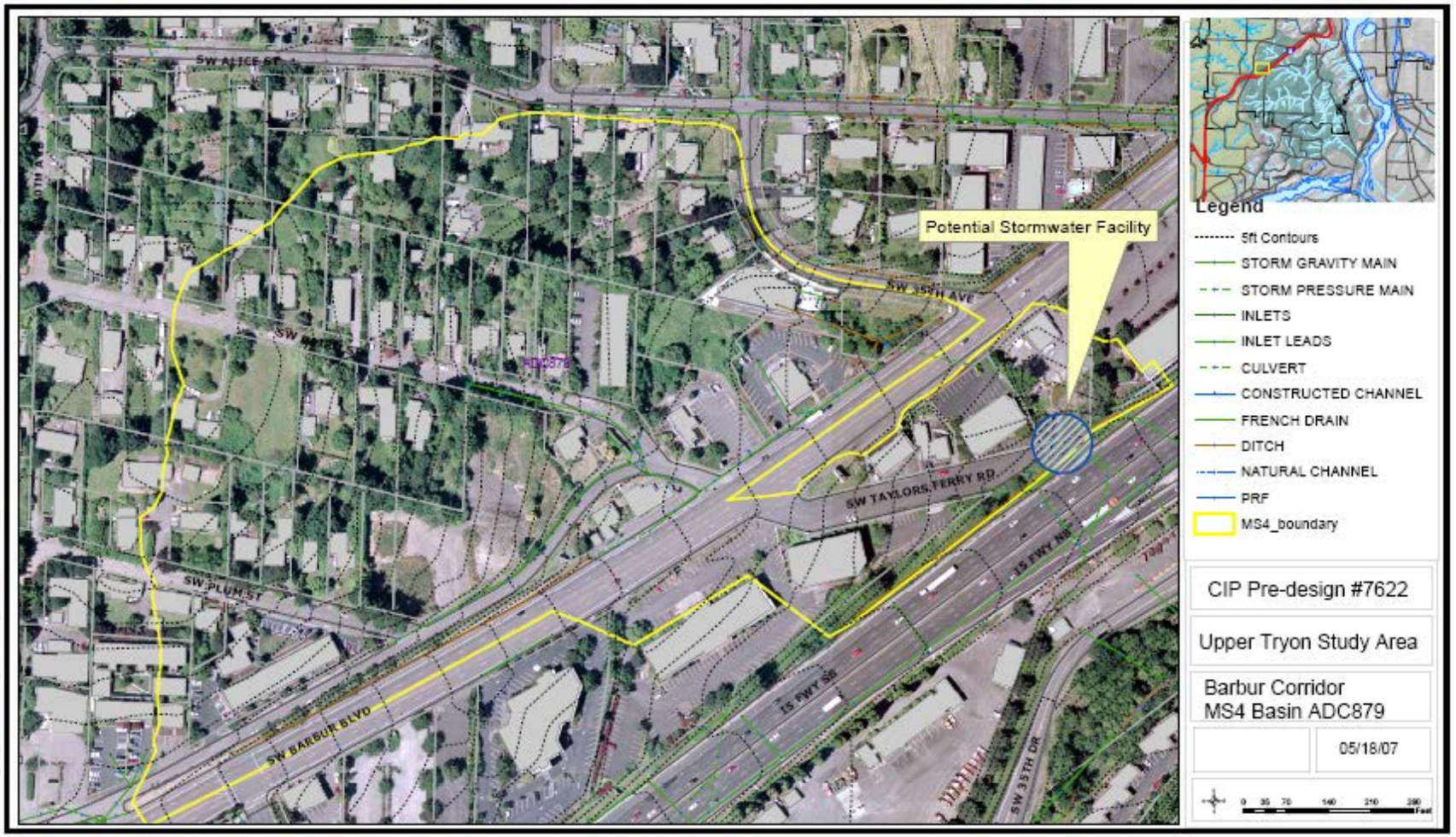


Figure 5-25: Water Quality Facility ADC879



Spring Garden Park Stream Daylighting

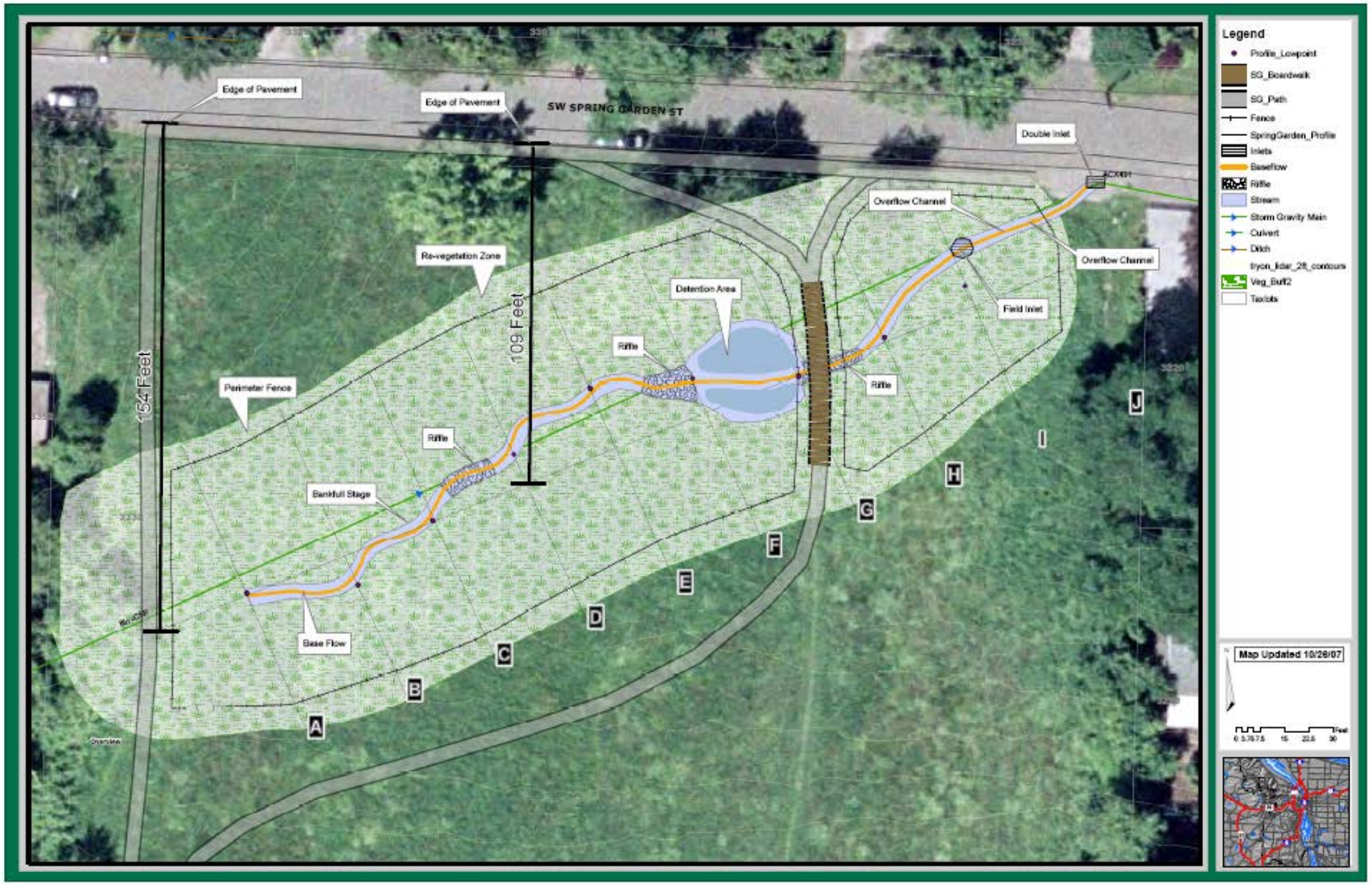
Approximately 3.5 miles of the 30 miles of mapped streams in Tryon Creek are in pipes or culverts. Restoring these piped streams to open channels would help restore the natural drainage complexity and functions provided by these streams.

This pre-design project, developed by BES Engineering Services, would daylight approximately 350 feet of an 8-inch stormwater pipe through Spring Garden Park (Figure 5-26). The daylighted stream would create habitat and floodplain and provide moderate detention.

Estimated Costs

Construction	$ 76,700
Design	$ 5,000
Contingency (35%)	$ 23,030
Total	$ 104,730

Figure 5-26: Spring Garden Park Stream Daylighting Pre-design



Jackson Middle School Stream Daylighting

Approximately 3.5 miles of the 30 miles of mapped streams in Tryon Creek are in pipes or culverts. Restoring these piped streams to open channels would help restore the natural drainage complexity and functions provided by these streams.

This project is to daylight approximately 500 feet of Falling Creek through the southern half of Jackson Middle School grounds, creating floodplain, wildlife and fish habitat, and a riparian buffer (Figures 5-27 and 5-28). The stream daylighting pre-design was developed by BES Engineering Services.

Estimated Costs

Construction	$ 460,570
Design (25%)	$ 115,143
Construction Management (15%)	$ 69,085
Contingency (25%)	$ 115,143
Total	$ 759,941

Figure 5-27: Jackson Middle School

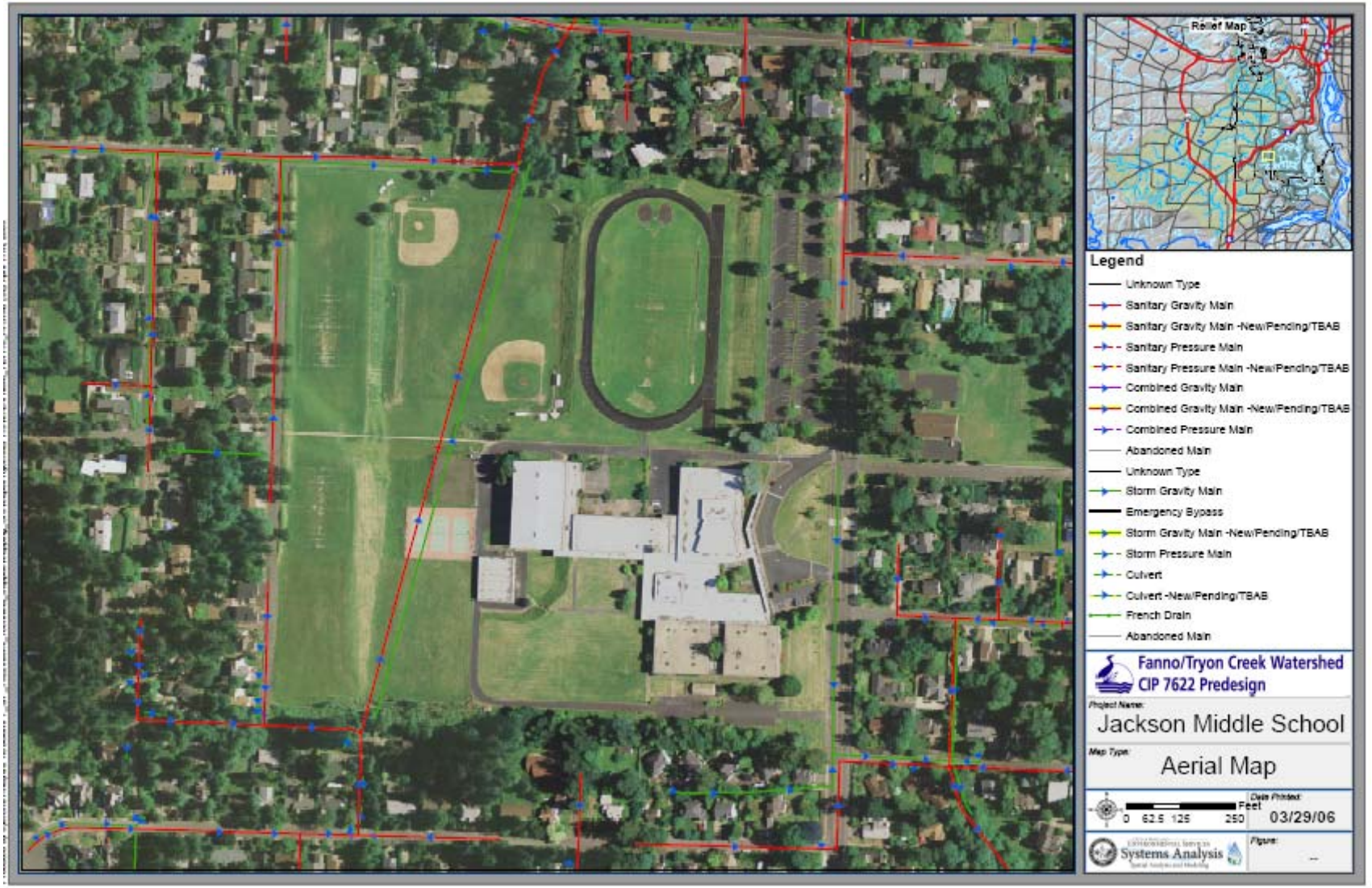
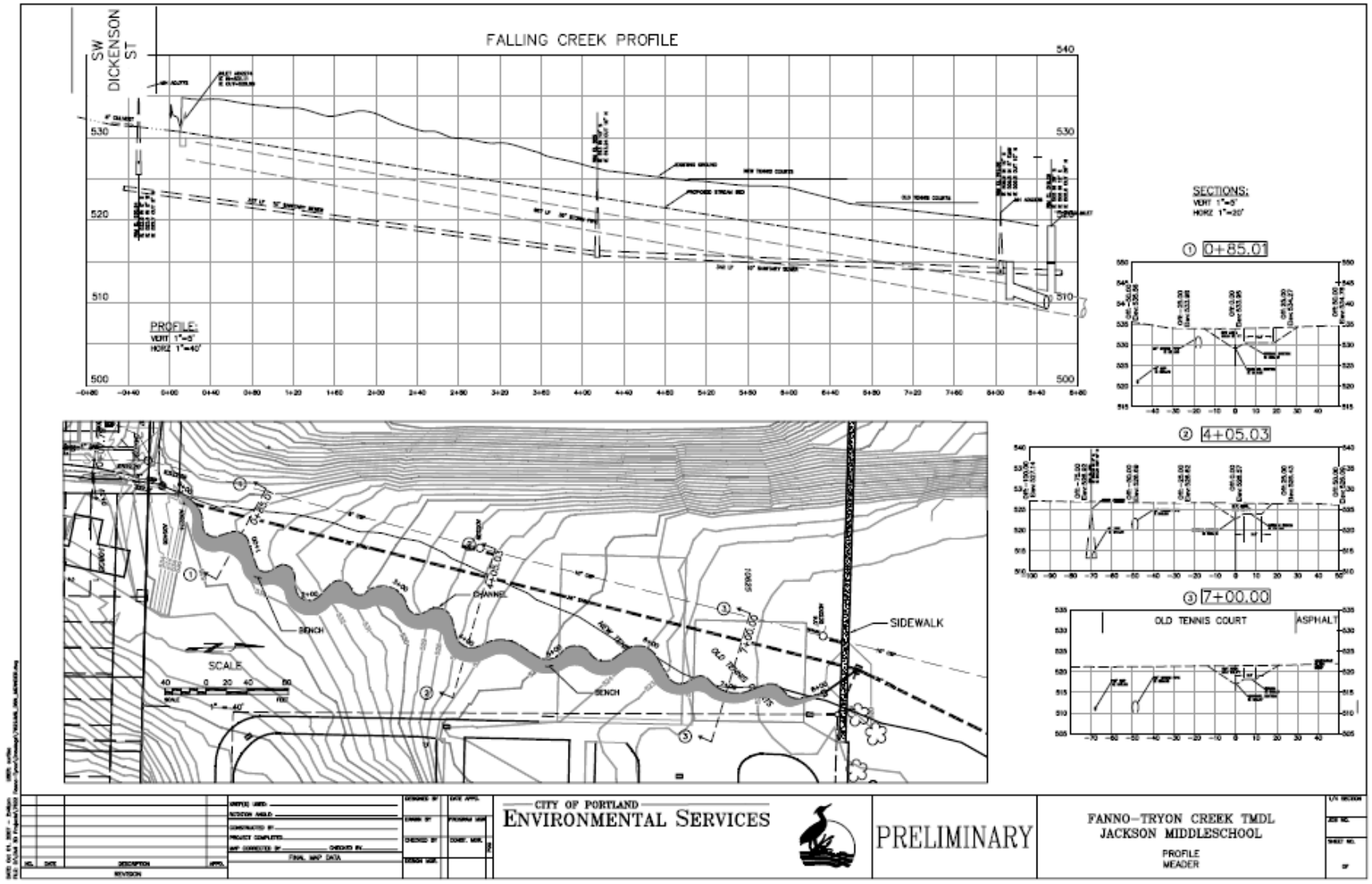


Figure 5-28: Jackson Middle School Stream Daylighting Selected Alternative



Tryon Creek MS4 Outfall ADC879

One stormwater outfall in upper Tryon Creek was identified for rehabilitation. This outfall conveys stormwater runoff from 24 acres of City MS4 basin. This 36-inch concrete outfall is undercut because of erosion. The slope around and below the outfall needs to be stabilized to prevent further erosion.

Pre-design construction cost estimates are based on BES Maintenance Engineering repair estimates.

Estimated Costs

Construction (w/30% contingency)	$ 23,400
Design (25%)	$ 5,850
Construction Management (15%)	$ 3,510
Total	$ 32,760

Lower and Middle Tryon Creek Cluster

Projects in this cluster target fish passage improvements, replacement and rehabilitation of exposed and/or degrading sanitary sewer infrastructure, and stream enhancements as part of sewer projects.

See Section 8.2.3 for more information on the projects summarized below.

Boones Ferry Road Culvert Replacement

The culvert is located in southwest Portland where Boones Ferry Road crosses Tryon Creek (Figure 5-29). Currently, the culvert is a year-round fish passage barrier and does not meet BES *Sewer Design Manual* criteria. ESA-listed steelhead and other resident fish species are present below the culvert, in Tryon Creek State Natural Area. Replacement of the culvert with a fish-passable alternative would significantly extend accessible aquatic habitat upstream.

Through an on-call contract with BES, Tetra Tech, Inc. developed the Boones Ferry Road culvert replacement pre-design. Four alternatives were considered to address these problems: (1) retrofit of existing culver, (2) enlarged culvert to meet sewer design criteria, (3) stream simulation sized culvert – box culvert, and (4) bridge. The recommended alternative is to replace the existing culvert with a box culvert (Figures 5-30 and 5-31).

Estimated Costs

Construction	$ 1,355,850
Design	$ 406,755
Construction Management	$ 244,053
Contingency	$ 338,963
Misc.	$ 73,000
Total	$ 2,418,621

Community groups have expressed an interest in the bridge alternative that was considered in the pre-design. The bridge would provide space for a trail connection below Boones Ferry Road. This option should be considered further in the design phases.

Figure 5-29: Boones Ferry Culvert Site Map

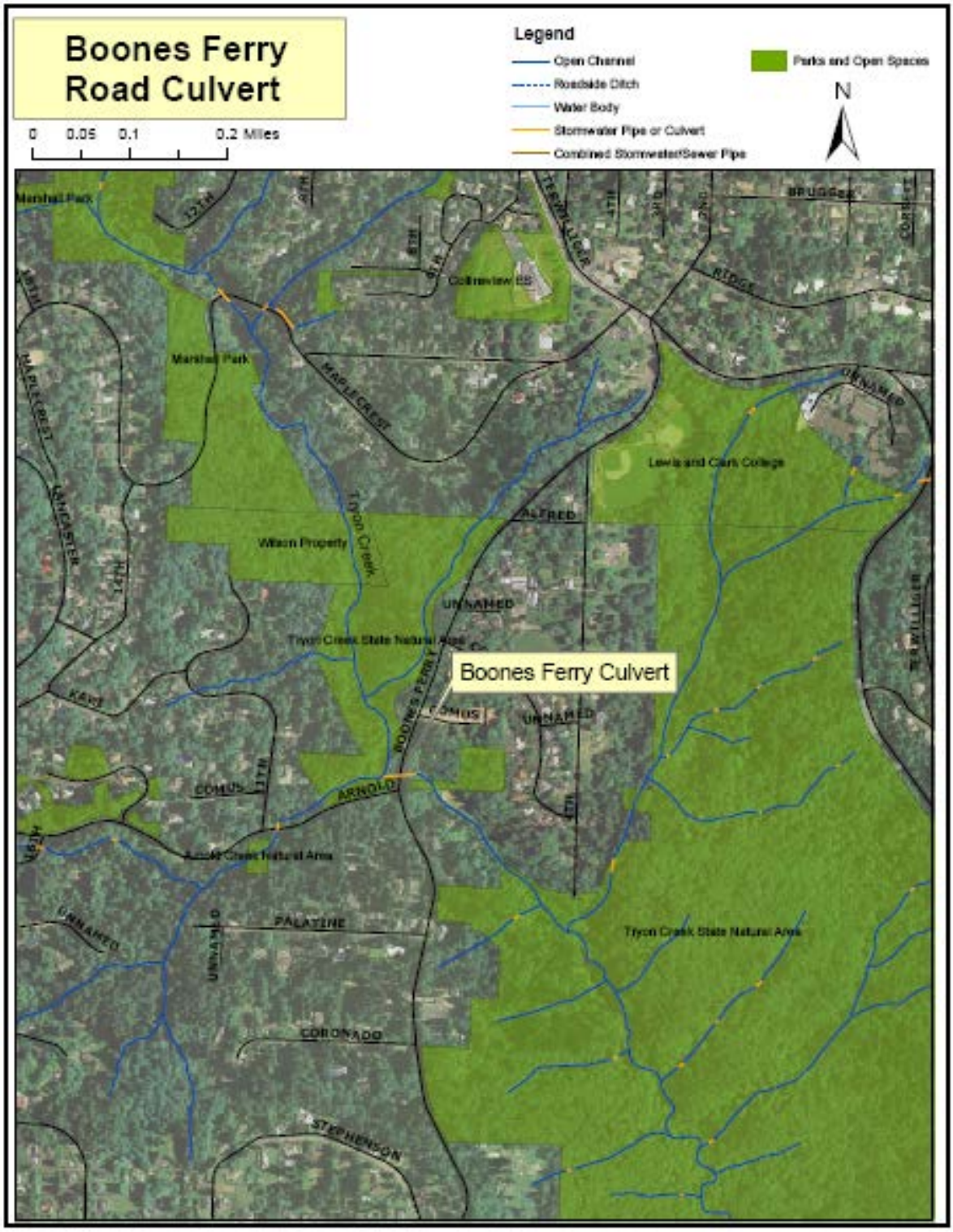


Figure 5-30: Boones Ferry Culvert Selected Alternative Site Plan

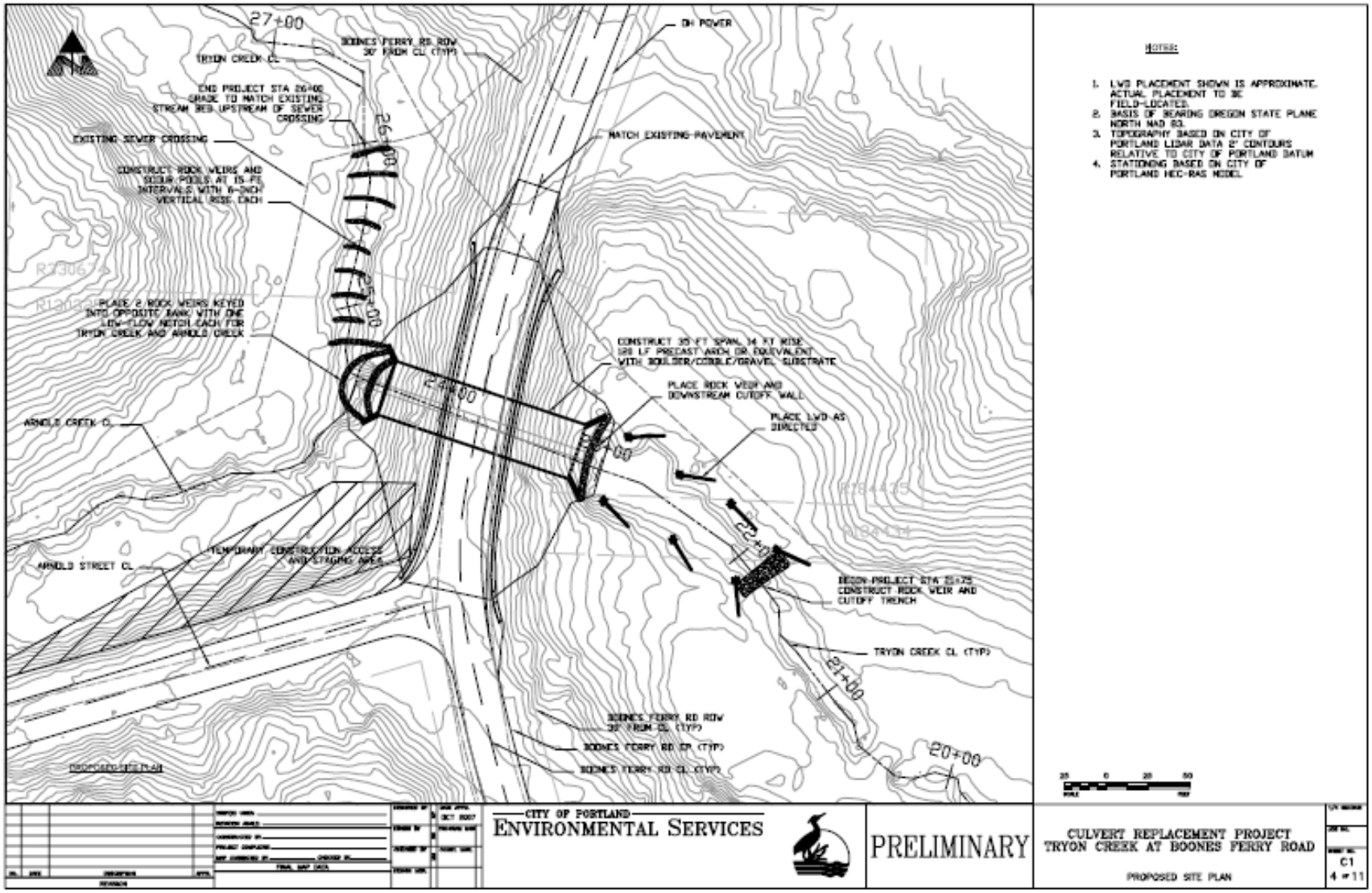
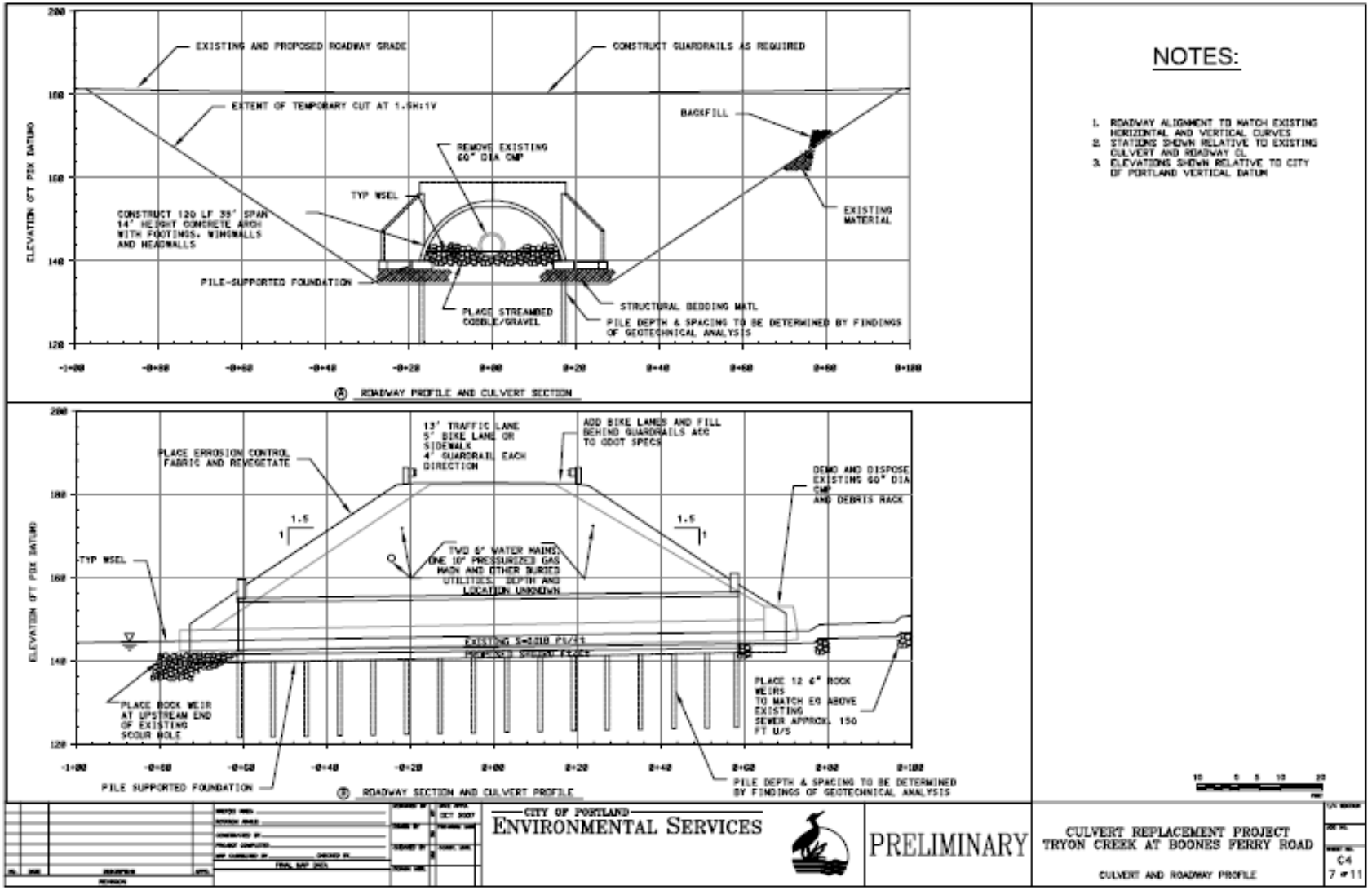


Figure 5-31: Boones Ferry Culvert Selected Alternative Profile



Sanitary Sewer Protection and Stream Enhancement Projects

Four sanitary sewer protection/rehabilitation and stream enhancement projects are recommended in the Pre-design (Figure 5-32). Projects include replacement of sewer manholes, stabilization and lining of a portion of the elevated sanitary sewer, protection of segments of the exposed sanitary sewer in Tryon Creek, and stream enhancement elements. These projects will ensure long-term sewer system reliability, protect water quality and public health and safety in Tryon Creek State Natural Area, and improve aquatic habitat for ESA-listed steelhead and other biological communities.

Projects located at reaches 1 and 4 are the most urgent because of potential leaking and because the sanitary sewer infrastructure is exposed in the active stream channel.

Each project is briefly described below.

Reach 1 Highway 43 to Iron Mountain Bridge

- Rehabilitate 11 undermined pipe columns/footings along the 30-inch elevated sanitary sewer pipe.
- Line up to 1,800 feet of the 30-inch elevated sanitary sewer pipe to address cracked and potentially leaking pipe joints.
- Rehabilitate two sanitary sewer manholes.
- Add complex channel forms and structure at critical points along the elevated and encased sewer to support natural channel-forming processes, improve aquatic habitat, aggrade the channel bed, and provide long-term sanitary sewer protection.
- Restore and revegetate all disturbed areas after construction.

Estimated Costs

Construction	$ 1,140,000
Design	$ 300,000
Contingency (overall) (30%)	$ 432,000
Total	$ 1,872,000

Reach 4 Obie's Bridge to High Bridge

- Relocate a segment of 30-inch sanitary sewer pipe out of the active stream channel. Currently, 30 feet of the sanitary sewer pipe is exposed in the active stream channel; a number of pipe joints are exposed.
- Stabilize and lay back streambanks to allow the stream channel to meander and increase floodplain.
- Add complex channel forms and structure to improve aquatic habitat.
- Enhance adjacent wetland and riparian area to enhance natural functions and habitat.
- Restore and revegetate all disturbed areas after construction.

Estimated Costs

Construction	$ 410,000
Design	$ 60,000
Contingency (overall) (30%)	$ 123,000
Total	$ 533,000

Reach 5 High Bridge to Boones Ferry Road

- Remove approximately 100 feet of streambank gabions and replace with large wood and other natural materials to protect adjacent sanitary sewer and improve habitat.
- Add complex channel forms and structures to improve aquatic habitat.
- Restore and revegetate all disturbed areas after construction.

Estimated Costs

Construction	$ 180,000
Design	$ 60,000
Contingency (overall) (30%)	$ 72,000
Total	$ 312,000

Reach 6 Boones Ferry Road to Marshall Park

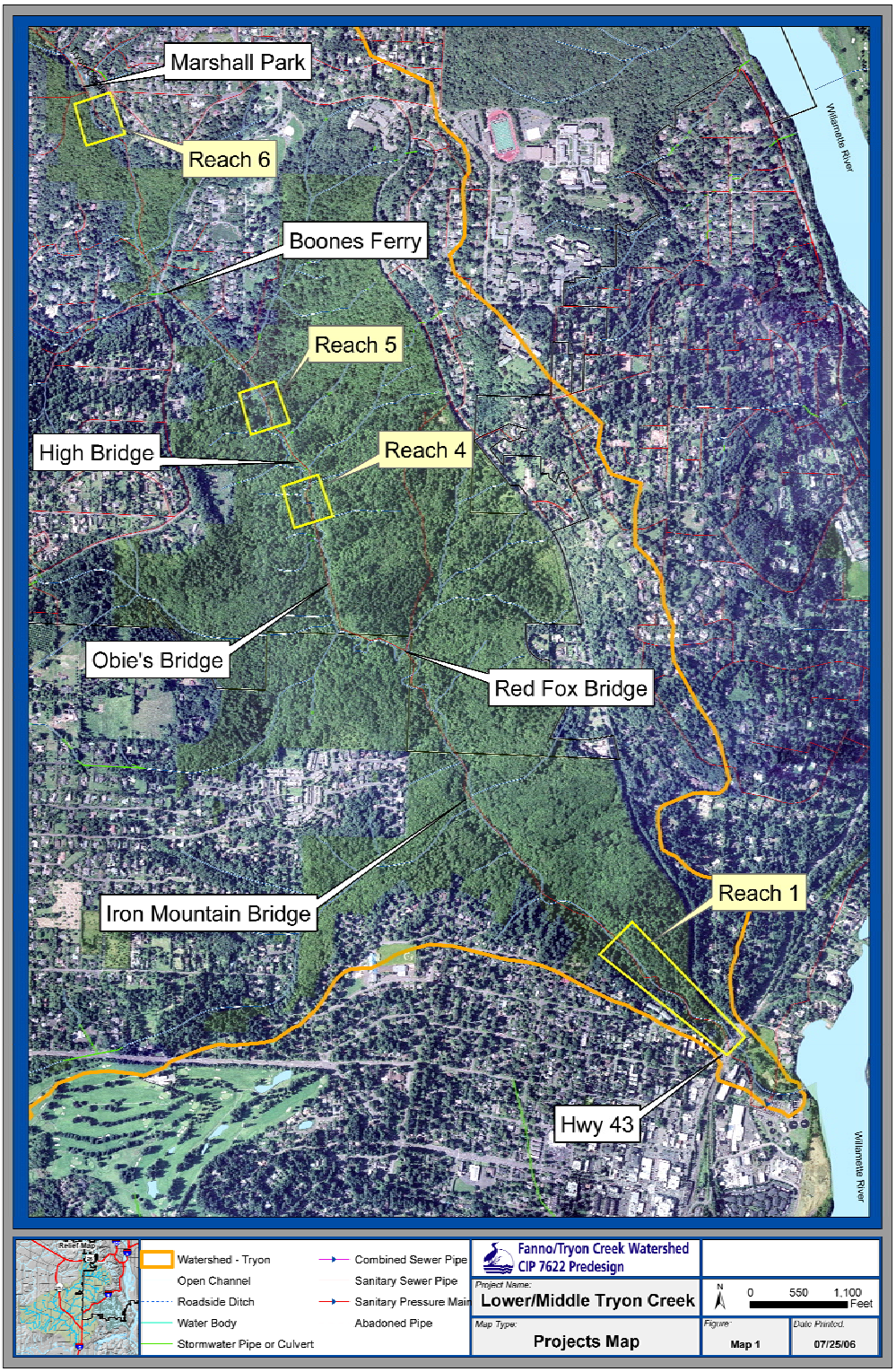
- Rehabilitate and protect two short segments of sanitary sewer pipe exposed in the active stream channel (approximately 10 feet total).
- Add complex channel forms and structures to improve aquatic habitat
- Enhance floodplain at pipe rehabilitation and protection locations where possible.
- Restore and revegetate all disturbed areas after construction.

Estimated Costs

Construction	$ 220,000
Design	$ 45,000
Contingency (overall) (30%)	$ 66,000
Total	$ 286,000

Cost estimates for infrastructure rehabilitation and replacement are based on BES Maintenance Engineering estimates. Where possible, costs for specific items (e.g., new manholes) were identified; other cost estimates are based on best professional judgment. Stream enhancement cost estimates are based on the approximate project length and previous BES stream enhancement and infrastructure repair projects.

Figure 5-32: Lower and Middle Tryon Sanitary Sewer and Stream Enhancement Sites



Other Stormwater Retrofits

Through on-call contracts with BES, consultants developed stormwater management pre-designs to retrofit seven sites in the Fanno Creek Watershed outside of the Beaverton Hillsdale Highway cluster (Figure 5-33).

Table 5-3 summarizes the sites, impervious area treated, and cost estimates. The average cost per square foot of impervious area managed for the seven sites is $1.50. At this average cost, about 100 percent of the impervious area at each site is managed.

Table 5-3: Stormwater Retrofits Summary

Site	Impervious Area Treated (square feet)	Percent Impervious Area Treated	Construction Cost	Cost/Square Foot
SW Multnomah at SW 45th	116,963	100%	$122,000.00	$1.04
SW Vermont at SW 45th	77,397	100%	$112,000.00	$1.45
Gabriel Park	54,315	100%	$155,000.00	$2.85
Portland Community College Sylvania (7 high-priority sites)	99,000	100%	$140,907.00	$1.42
St. John Fisher	174,980	99%	$296,000.00	$1.69
St. Luke Lutheran Church	31,809	100%	$21,483.00	$0.68
Gabriel Commons	103,934	100%	$144,446.00	$1.39
Total	**658,398**	**100%**	**$991,836.00**	**$1.50**

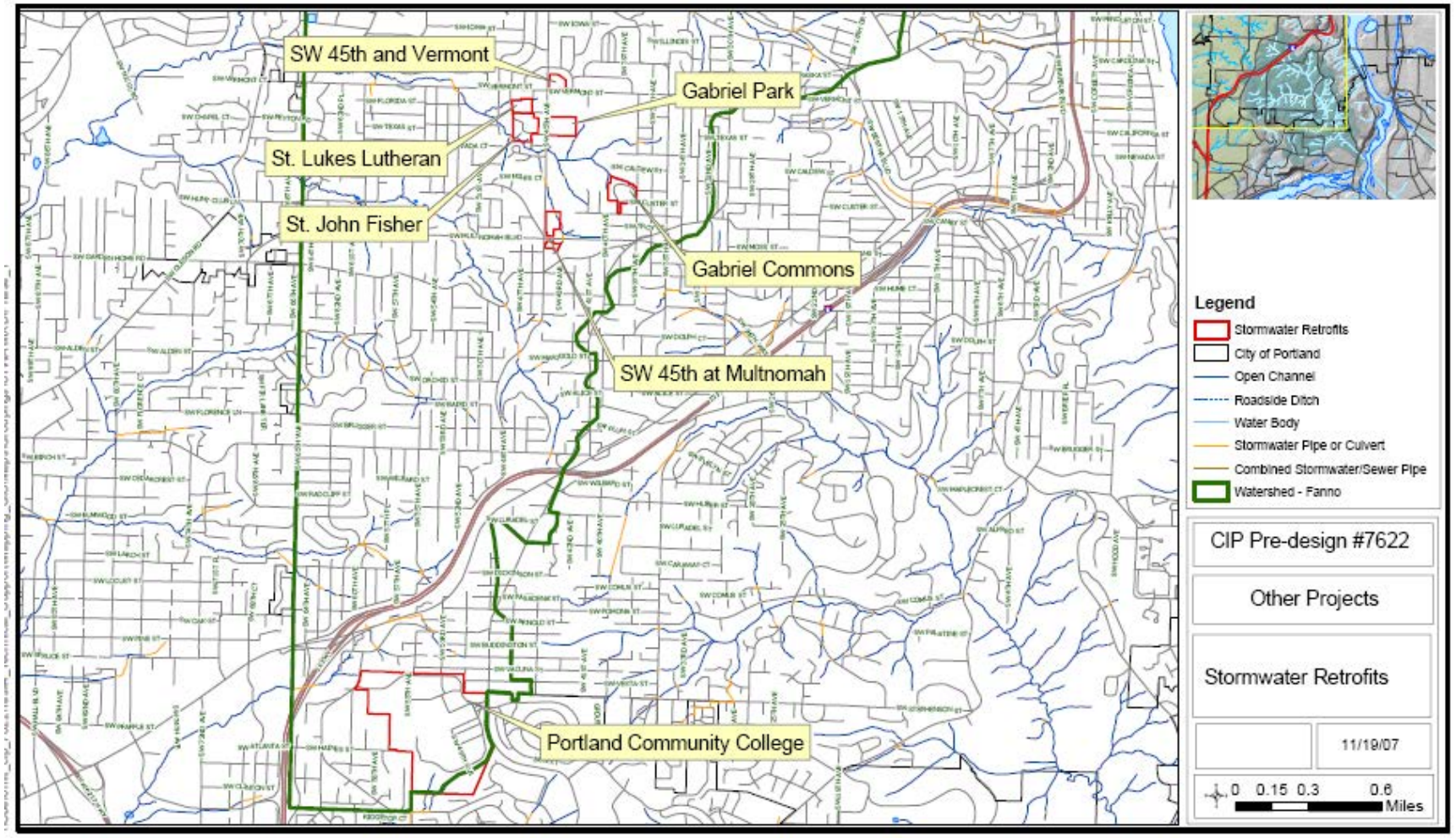
Estimated Costs

Construction	$ 991,836
Design (20%)	$ 198,367
Startup – 0&M (10%)	$ 99,183
Contingency (20%)	$ 198367
Total	$1,487,753

Many of these retrofit projects are located on private property. Policies are not yet in place to spend BES capital funds to design and construct stormwater facilities on private property. In addition, permission to construct any facilities of private property would need to be obtained. Given the near-term difficulty of implementing projects on private property, stormwater retrofits projects located on public property should be pursued first. These would include Gabriel Park and Portland Community College.

See Section 8.2.4 for more information on these projects.

Figure 5-33: Other Stormwater Retrofit Project Sites



Operations and Maintenance

The Pre-design identified 11 segments of sanitary sewer in need of replacement/rehabilitation. Nine segments were determined to be high priority. Cost estimates for these nine high-priority segments, developed by BES Maintenance Engineering, are provided below.
See Section 8.2.8 for more information on these projects.

SW 45th & Idaho

Construction (includes 25% contengency)	$	65,000
Design	$	7,000
Total	$	72,000

3000 Block of SW Fairmont Blvd.

Construction (includes 25% contengency)	$	151,000
Design	$	16,000
Total	$	167,000

4000 Block of SW Hillsdale Ave.

Construction (includes 25% contengency)	$	123,000
Design	$	13,000
Total	$	136,000

SW Council Crest & Beaverton

Construction (includes 25% contengency)	$	202,000
Design	$	22,000
Total	$	224,000

SW Hillsdale & Fairmount

Construction (includes 25% contengency)	$	123,000
Design	$	13,000
Total	$	136,000

SW Washougal & Chesapeake

Construction (includes 25% contengency)	$	202,000
Design	$	22,000
Total	$	224,000

SW Hillsboro & Council Crest

Construction (includes 25% contengency)	$	123,000

Design	$ 13,000
Total	$ 136,000

SW Multnomah & 22nd Ave.

Construction (includes 25% contengency)	$ 85,000
Design	$ 10,000
Total	$ 95,000

SW Multnomah & 30th Ave.

Construction (includes 25% contengency)	$ 280,000
Design	$ 30,000
Total	$ 310,000

Ditch-to-Swale

Over 35 percent of the roads in the Fanno and Tryon Creek watersheds are paved and not curbed, and most have ditches. These ditches, some of which are actively eroding, convey stormwater runoff from roadways directly to streams. Modeling and analysis shows that the transportation system is a significant source of pollutants.

The Pre-design (see Section 8.2.7) identified and prioritized roadside ditches for conversion to swales (Figure 5-34). Over 30,000 feet of high-priority ditches and 37,000 feet of medium-priority ditches were identified. Conversion of these roadside ditches to swales will slow and treat stormwater before it reaches streams.

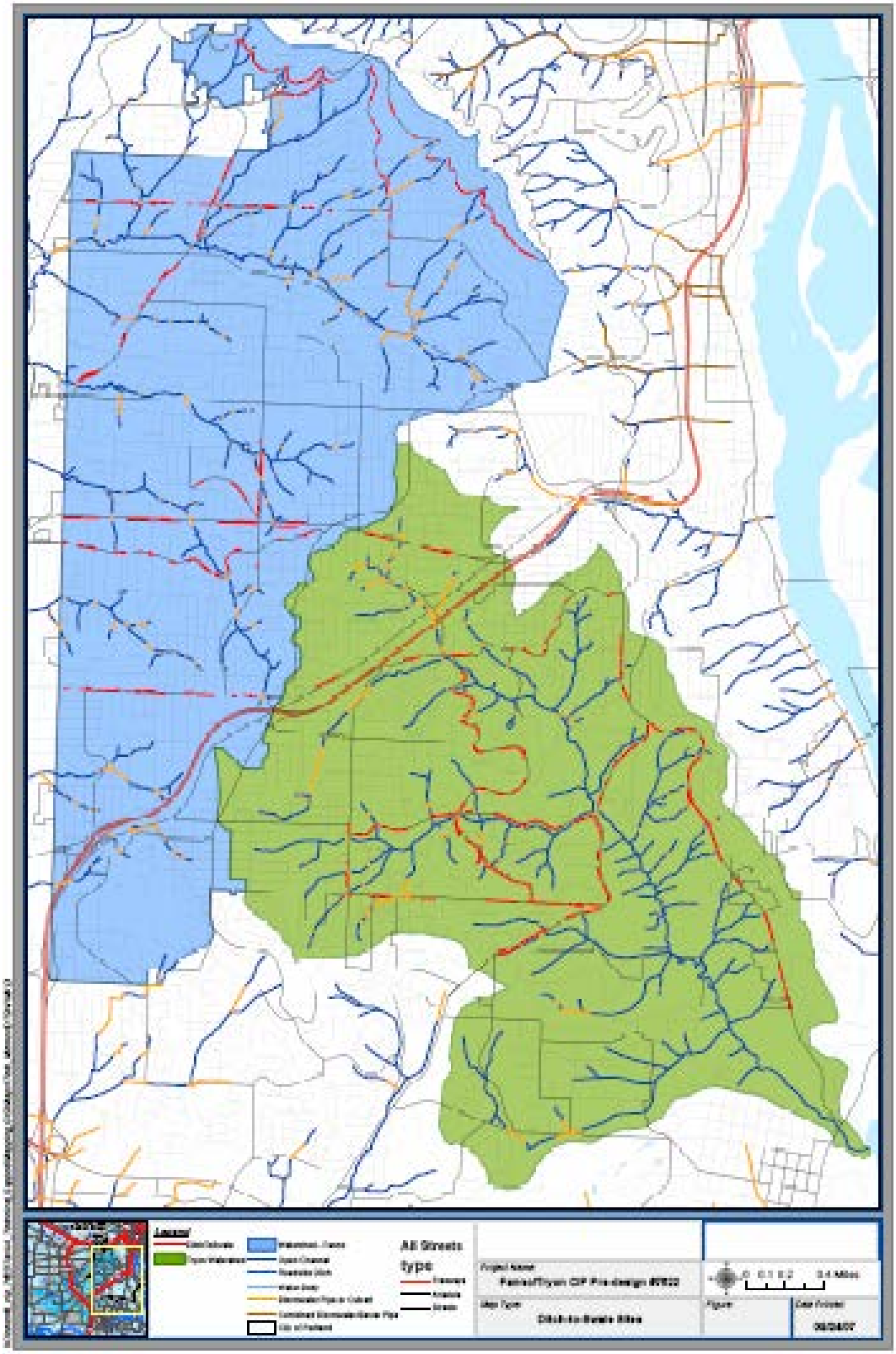
BES Maintenance Engineering has converted approximately 4,000 feet of roadside ditches to swales since 2001 to address recurring maintenance concerns. Ditch-to-swale conversions have taken two forms: a rock version and a vegetated version. Both versions include a perforated pipe under the swale. Since these projects are located in the public right-of-way and Maintenance Engineering designs already exist, these projects are well positioned to proceed to design and construction. However, interest arose during the Pre-design about potential pedestrian improvements that could be made as part of ditch-to-swale conversions. PDOT, BES, and community representatives have and continue to work on pedestrian-related issues as part of ditch-to-swale conversions. This issue could influence the design and implementation.

Estimated Costs

Conversion cost: $40 per foot (based on BES Maintenance Engineering estimates)

High-priority sites:	$1,204,000
Medium-priority sites:	$1,498,000
Total Cost Estimate:	$2,702,000

Figure 5-34: Ditch-to-Swale Sites



Land Acquisition

Land acquisition, through a willing seller program, is an important part of an overall strategy to meet watershed goals and objectives. Land acquisition can protect the natural watershed functions provided by headwater steams and riparian habitat, connect and expand existing natural areas, and improve access to BES sewer infrastructure.

The Pre-design report (see Section 8.2.5) identifies approximately 114 acres for acquisition (Figure 5-35). Table 5-4 summarizes sites and costs.

The Metro land acquisition bond measure recently passed by voters presents a unique and time-limited opportunity to leverage BES funds with Metro and other City bureaus to support land acquisition to protect critical natural areas.

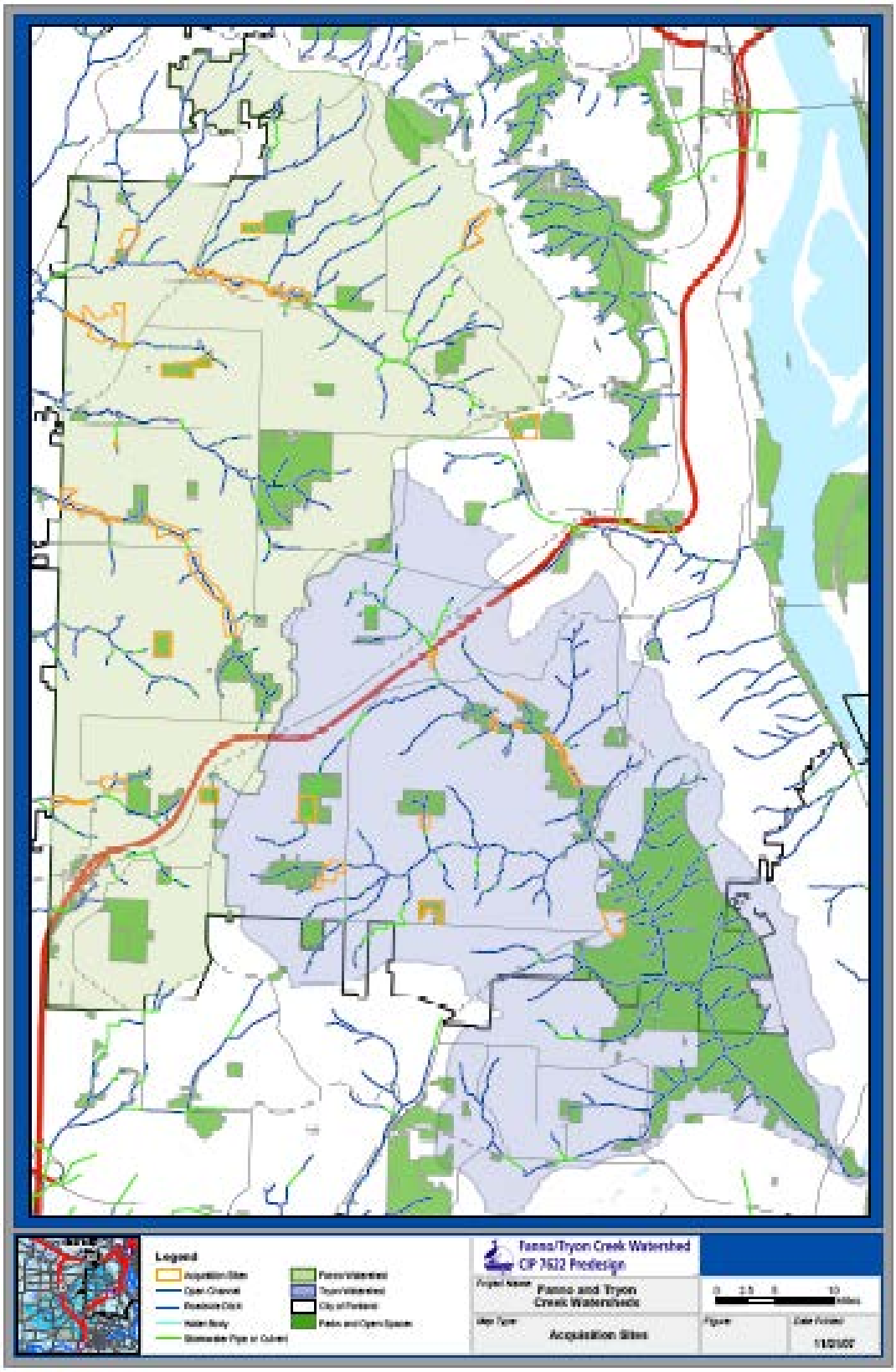
Table 5-4: Land Acquisition Cost Estimates

Acquisition Area (Acres)	# of Taxlots	Tax Lot Total Area (Acres)	Total "Tax" Land Value (2005)	Estimated "Market" Land Value[1]	Estimated Acquisition Cost[2]
113.8	282	207.9	$32,068,900	$40,085,402	$23,547,567

[1] Calculated as follows: Total "tax" land value (2005) multiplied by 1.25

[2] Calculated as follows: Acquisition priority area (acres) divided by the total tax lot area (acres) multiplied by the land market value.

Figure 5-35: Land Acquisition Sites



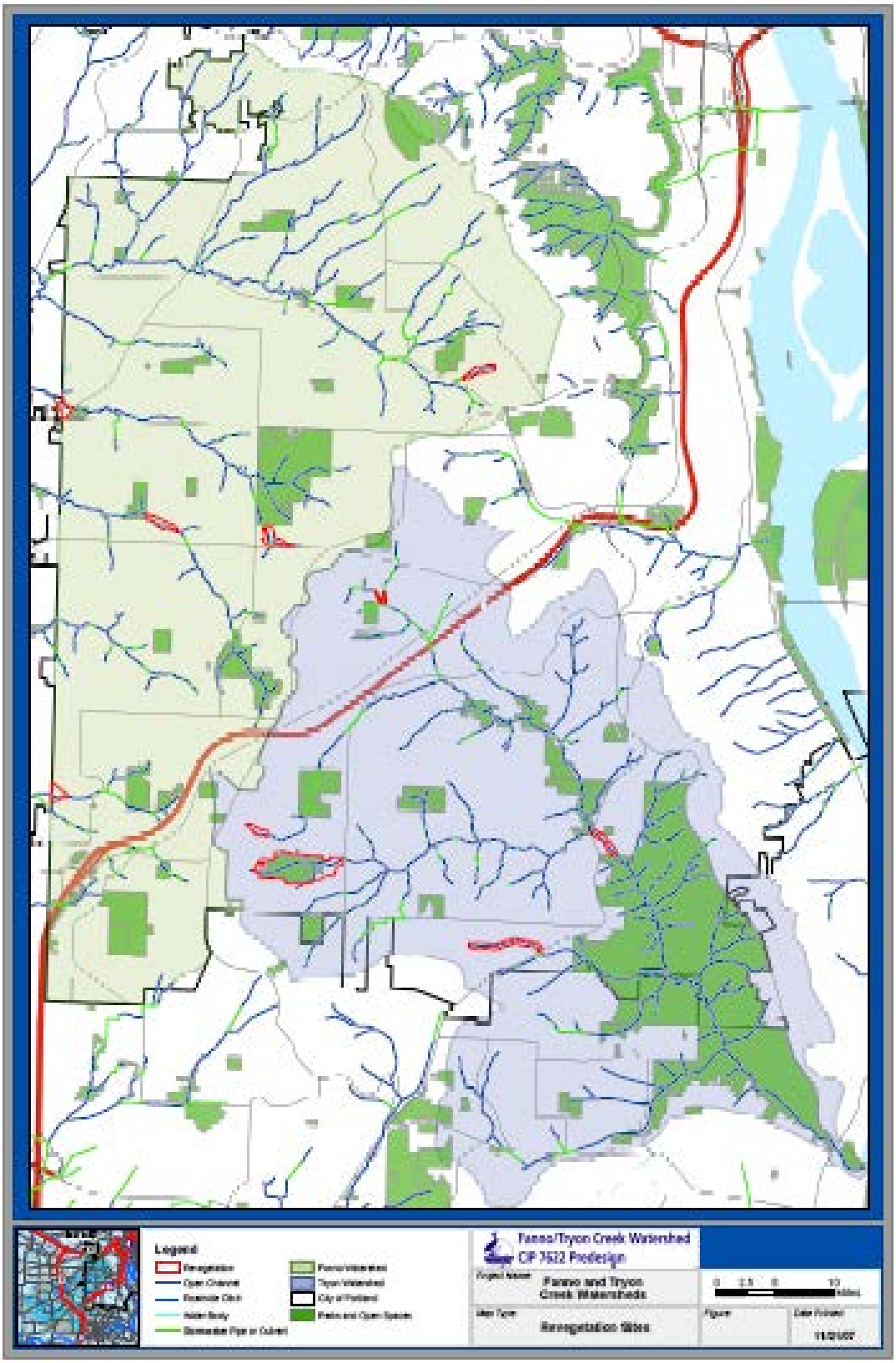
Revegetation

Revegetation is an important component of BES's strategy to meet regulatory obligations under the NPDES MS4 permit. Revegetation shades streams, helping them to keep cool and to maintain adequate levels of dissolved oxygen for aquatic species.

The Pre-design (see Section 8.2.6) recommends three high-priority sites (8.8 acres) and seven medium-priority sites (52.5 acres) (Figure 5-36). BES Revegetation Program staff developed cost estimates for revegetation projects. The cost estimates for each project include the initial project cost and 5 years of site establishment.

Cost Estimate: $643,321

Figure 5-36: Revegetation Sites



6.0 Evaluation of Benefits

Purpose

The purpose of the evaluation is to compare the relative benefits provided by each of the *Fanno Tryon Water Quality and TMDL CIP Pre-design #7622* (Pre-design) projects.

Alternatives were analyzed and evaluated throughout the Pre-design process at various levels, as appropriate for required project completion.

For the geographic clusters, alternatives were evaluated at both the project element and project pre-design level. For example, 38 culverts in the Beaverton Hillsdale Highway cluster were evaluated in detail. From this initial list, four culverts were selected, based on developed criteria, for specific project pre-designs. During engineering pre-design of each individual culvert, alternatives were evaluated to select the recommended design option.

A similar approach was used for programmatic elements. Design and implementation alternatives were analyzed for each programmatic element. Individual project sites were then evaluated and prioritized for implementation.

Project Goals and Indicators

For the evaluation, a set of Pre-design goals and indicators was compiled, using the watershed goals, objectives, key watershed attributes, indicators, and implementation measures established by the *Fanno Tryon Creek Watershed Management Plan* (FTCWMP). Results of the technical memorandums were also incorporated. The indicators are measurable attributes of projects. Table 6-1 shows the watershed goals, project indicators, and associated metrics. All goals are weighted equally.

Scoring Guidance

Based on the goals and indicators, the Pre-design project team developed scoring guidance (Table 6-2) to evaluate the pre-design projects and programmatic elements. Projects are scored from 1-10 for each goal category and then summed for an overall project score.

The scoring guidance was developed to help evaluate the project metrics in relation to the goals and to enable scoring of the multi-objective projects across different goals (e.g., comparison of stormwater retrofits with culvert repair/replacement). The scoring guidance lists key project indicators and metrics for each project category and each goal.

Table 6-1: Goals and Project Indicators

GOAL	PROJECT INDICATOR	METRICS
Hydrology		
	Impervious area managed for flow control	Acres
	Acres of natural area protected (fee purchase/conservation easement)	Acres
	Floodplain reconnected	Acres
	Stream daylighted	Ft
	Stream length added (e.g., increasing sinuosity)	Ft
Water Quality		
	Impervious area treated/managed	Acres
	Total suspended solids (TSS) removed	Lbs
	Riparian revegetation	Ft
	Bacteria loading reduced	
	Stream bank stabilized	Ft
	Sanitary pipe protected	Ft
Habitat		
	Stream enhancement	Ft
	Floodplain reconnected	Acres
	Riparian revegetation	Ft
	Revegetation	Acres
	Impervious area treated/managed	Acres
	TSS removed	Lbs
	Acres of natural area protected (fee purchase/conservation easement)	Acres
	Fish passage: Linear feet of stream made accessible during all seasons	Ft
Biological Communities		
	Improves distribution of native fish communities	Low, Medium, High
	Directly or indirectly (e.g., water quality facility) improves aquatic habitat	Low, Medium, High
Infrastructure		
	Fish passage: Linear feet of stream made accessible during all seasons	Ft
	Level of urgency (protect public health and safety)	Low, Medium, High
	Ditch enhanced	Ft
	Sanitary pipe protected (public health and safety)	Ft
	Reduced long-term maintenance costs	Low, Medium, High

Table 6-2: Scoring Guidance

Goal	Score	Scoring Guidance								
		Stormwater Retrofits	Water Quality Facilities	Ditch-to-Swale	Stream Enhancement	Sanitary Sewer Infrastructure Protection and Enhancement	Stormwater Outfall Rehabilitation and Replacement	Culvert Repair and/or Replacement	Revegetation	Land Acquisition
Hydrology	8-10	IA Treated 80-100% +Peak Flow Reduced +Volume Reduction	IA Treated 80-100% +Peak Flow Reduced +Volume Reduction	IA Treated 80-100% +Peak Flow Reduced +Volume Reduction	Floodplain reconnection (score based on magnitude)					Natural areas protected
	5-7	50-70% (+) Area Managed (-)	50-70% (+) Area Managed (-)	50-70% (+) Area Managed (-)	Stream daylighitng, floodplain reconnection (score based on magnitude)					
	2-4	20-40%	20-40%	20-40%		Rehabilitates or replaces sanitary sewer (I&I, SSO reduction)		Culvert Repair and/or Replacement (flood management)	Revegetation	
	0-1	0-10%	0-10%	0-10%	Stream bank stabilization		Streambank stabilization			
Water Quality	8-10	TSS Reduced 70% +TMDL +MS4 +Other Pollutants	TSS Reduced 70% +TMDL +MS4 +Other Pollutants	TSS Reduced 70% +TMDL +MS4 +Other Pollutants						Natural areas protected
	5-7	50-70% (+) Area Managed (-)	50-70% (+) Area Managed (-)	50-70% (+) Area Managed (-)		Protects exposed sanitary sewer pipe				
	2-4	20-40%	20-40%	20-40%	Streambank Stabilization			Reduces exisitng erosion/scour problems	Riparian revegetation	
	0-1	0-10%	0-10%	0-10%	Riparian Vegetation	Rehabilitates or replaces sanitary sewer (I&I, SSO reduction)	Streambank stabilization (prevents scour, erosion)	Streambank stabilization, culvert re-position/design (prevents scour, erosion)		
Habitat	8-10				Stream daylighting					Natural areas protected
	5-7	Creates New Habitat Managing stormwater runoff provides indirect benefit	Creates New Habitat Managing stormwater runoff provides indirect benefit		Stream enhancement, floodplain reconnection			Provides local habitat improvements and/or connection		
	2-4			Managing stormwater runoff provides indirect benefit			revegetation		Revegetation	
	0-1				Stream bank stabilization		Streambank stabilization			
Biological Communities	8-10							Improves fish passage (T&E Species)		Natural areas protected
	5-7	Reduces Identified Limiting Pollutants	Reduces Identified Limiting Pollutants	Reduces Identified Limiting Pollutants	Stream Enhancement and Daylighting where known presence of T and E species in system			Improves fish passage (Resident species)		
	2-4	Managing stormwater runoff provides indirect benefit (presence of T and E species score higher)	Managing stormwater runoff provides indirect benefit (presence of T and E species score higher)	Managing stormwater runoff provides indirect benefit (presence of T and E species score higher)	Stream Enhancement and Daylighting				Revegetation (habitat connectivity)	
	0-1					Protects exposed sanitary sewer pipe (indirect benefit)	Streambank stabilization	Streambank stabilization		
Infrastructure	8-10					High level of urgency	High level of urgency	High level of urgency; Improves fish passage		
	5-7					Medium level of urgency	Medium level of urgency	Medium level of urgency		
	2-4	Enhances **public** stormwater infrastructure	Enhances **public** stormwater infrastructure	Enhances **public** stormwater infrastructure,		Low level of urgency	Low level of urgency	Low level of urgency		
	0-1	Enhances **public** stormwater infrastructure	Enhances **public** stormwater infrastructure	Enhances **public** stormwater infrastructure	Stream daylighitng (flow storage, reduction of peak flows and impact on storm system, natural system cheaper to maintain over long run					Improves access to public sewer infrastructure

Scored Projects

Six Pre-design project team members scored the pre-design projects and programmatic elements, using the scoring matrix and guidance described above. Table 6-3 lists projects organized by cluster. The average score (1-10 point range) each project received for each goal category is provided. Total scores, rank within cluster, and overall rank are also listed for each project.

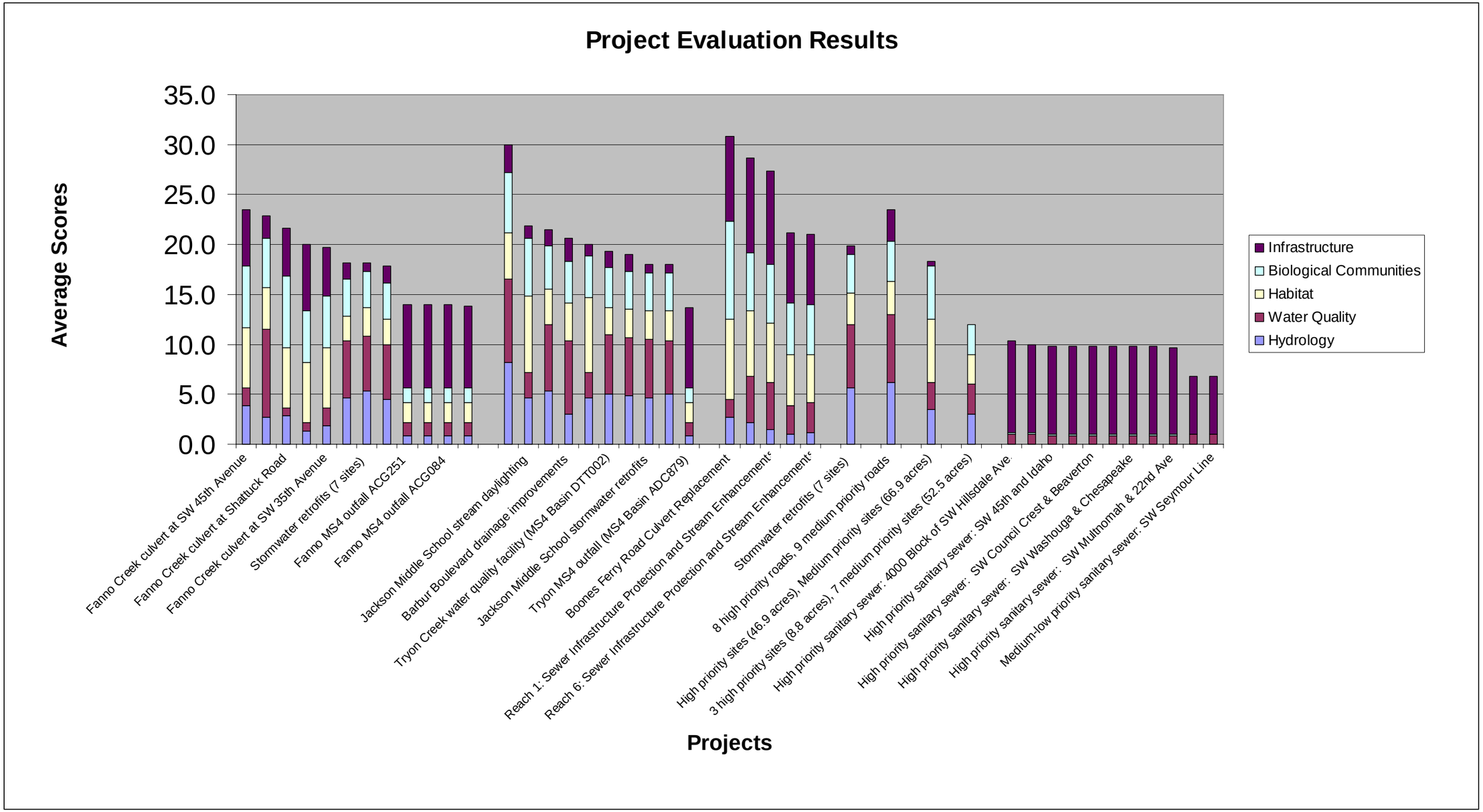
Figure 6-1 displays projects and scores graphically. Each project score is represented by one bar on the chart. Each bar depicts the total project score, subdivided into goals.

Table 6-3: Project Evaluation Results

Cluster or Element	Projects	Watershed Goals					Total Score	Group Rank	Overall Rank
		Hydrology	Water Quality	Habitat	Biological Communities	Infrastructure			
		Average Benefit Scores							
Beaverton Hillsdale Highway Cluster	Fanno Creek culvert at SW 45th Avenue	3.8	1.8	6.0	6.2	5.7	23.5	1	5
	Beaverton Hillsdale Highway drainage improvements	2.7	8.8	4.2	5.0	2.2	22.8	2	7
	Fanno Creek culvert at Shattuck Road	2.8	0.8	6.0	7.2	4.8	21.7	3	9
	Fanno Creek culvert at SW 39th Avenue	1.3	0.8	6.0	5.2	6.7	20.0	4	14
	Fanno Creek culvert at SW 35th Avenue	1.8	1.8	6.0	5.2	4.8	19.7	5	17
	Fanno Creek water quality facility (MS4 basin ACM139)	4.7	5.7	2.5	3.7	1.7	18.2	6	22
	Stormwater retrofits (7 sites)	5.3	5.5	2.8	3.7	0.8	18.2	7	21
	Fanno Creek water quality facility (MS4 basin ACG084)	4.5	5.5	2.5	3.7	1.7	17.8	8	25
	Fanno MS4 outfall ACG251	0.8	1.3	2.0	1.5	8.3	14.0	9	26
	Fanno MS4 outfall DTF026/ANJ549	0.8	1.3	2.0	1.5	8.3	14.0	10	27
	Fanno MS4 outfall ACG084	0.8	1.3	2.0	1.5	8.3	14.0	11	28
	Fanno MS4 outfall ACM514	0.8	1.3	2.0	1.5	8.2	13.8	12	29
Upper Tryon Creek Cluster	I-5 at SW 26th water quality facility	8.2	8.3	4.7	6.0	2.8	30.0	1	2
	Jackson Middle School stream daylighting	4.7	2.5	7.7	5.8	1.2	21.8	2	8
	Tryon Creek water quality facility (MS4 Basin ADC879)	5.3	6.7	3.5	4.3	1.7	21.5	3	10
	Barbur Boulevard drainage improvements	3.0	7.3	3.8	4.2	2.3	20.7	4	13
	Spring Garden Park stream daylighting	4.7	2.5	7.5	4.2	1.2	20.0	5	15
	Tryon Creek water quality facility (MS4 Basin DTT002)	5.0	6.0	2.7	4.0	1.7	19.3	6	18
	Stormwater retrofits (Multnomah Village)	4.8	5.8	2.8	3.8	1.7	19.0	7	19
	Jackson Middle School stormwater retrofits	4.7	5.8	2.8	3.8	0.8	18.0	8	24
	Stormwater retrofits (7 sites)	5.0	5.3	3.0	3.8	0.8	18.0	9	23
	Tryon MS4 outfall (MS4 Basin ADC879)	0.8	1.3	2.0	1.5	8.0	13.7	10	30
Lower and Middle Tryon Creek Cluster	Boones Ferry Road culvert replacement	2.7	1.8	8.0	9.8	8.5	30.8	1	1
	Reach 4: Sewer infrastructure protection and stream enhancements	2.2	4.7	6.5	5.8	9.5	28.7	2	3
	Reach 1: Sewer infrastructure protection and stream enhancements	1.5	4.7	6.0	5.8	9.3	27.3	3	4
	Reach 5: Stream bank gabion removal and enhancement	1.0	2.8	5.2	5.2	7.0	21.2	4	11
	Reach 6: Sewer infrastructure protection and stream enhancements	1.2	3.0	4.8	5.0	7.0	21.0	5	12

Cluster or Element	Projects	Watershed Goals					Total Score	Group Rank	Overall Rank
		Hydrology	Water Quality	Habitat	Biological Communities	Infrastructure			
		Average Benefit Scores							
Other Stormwater Retrofits	Stormwater retrofits (7 sites)	5.7	6.3	3.2	3.8	0.8	19.8	1	16
Ditch-to-Swale	8-high priority roads, 9-medium priority roads	6.2	6.8	3.3	4.0	3.2	23.5	1	6
Land Acquisition	High-priority sites (46.9 acres), medium-priority sites (66.9 acres)	3.5	2.7	6.3	5.3	0.5	18.3	1	20
Revegetation	3 high-priority sites (8.8 acres), 7 medium-priority sites (52.5 acres)	3.0	3.0	3.0	3.0	0.0	12.0	1	31
Operations and Maintenance	High-priority sanitary sewer: 4000 block of SW Hillsdale Ave.	0.0	1.0	0.0	0.2	9.2	10.3	1	32
	High-priority sanitary sewer: SW Multnomah & 30th Ave.	0.0	1.0	0.0	0.2	8.8	10.0	2	33
	High-priority sanitary sewer: SW 45th and Idaho	0.0	0.8	0.0	0.2	8.8	9.8	3	34
	High-priority sanitary sewer: 3000 block of SW Fairmont Blvd.	0.0	0.8	0.0	0.2	8.8	9.8	4	35
	High-priority sanitary sewer: SW Council Crest & Beaverton	0.0	0.8	0.0	0.2	8.8	9.8	5	36
	High-priority sanitary sewer: SW Hillsdale & Fairmount	0.0	0.8	0.0	0.2	8.8	9.8	6	37
	High-priority sanitary sewer: SW Washouga & Chesapeake	0.0	0.8	0.0	0.2	8.8	9.8	7	38
	High-priority sanitary sewer: SW Hillsboro & Council Crest	0.0	0.8	0.0	0.2	8.8	9.8	8	39
	High-priority sanitary sewer: SW Multnomah & 22nd Ave.	0.0	0.8	0.0	0.2	8.7	9.7	9	40
	Medium/low-priority sanitary sewer: Cambridge Gravity Line	0.0	1.0	0.0	0.0	5.8	6.8	10	41
	Medium/low-priority sanitary sewer: SW Seymour Line	0.0	1.0	0.0	0.0	5.8	6.8	11	42

Figure 6-1: Project Evaluation Results



Project Considerations

Evaluation scores are based on project performance in relation to the five Pre-design goals. The scores do not, however, reflect other factors that should be considered when developing the final prioritized list of recommended projects. These factors include:

- Issues that affect implementation, such as need for BES policy guidance before CIP funds can be spent on private property.
- Community expectations.
- The level of urgency of individual projects.
- Time-limited opportunities, such as the availability of Metro bond funds to support land acquisition.
- Opportunities to expand partnerships with other City bureaus and public agencies.
- Projects that substantially fulfill other City or bureau objectives.

These considerations are described in more detail for specific projects in Chapter 7.0.

7.0 Recommendations and Implementation Plan

Purpose

This chapter provides a ranked list of recommended *Fanno Tryon Water Quality and TMDL CIP Pre-design #7622* (Pre-design) projects, based on the benefit scores described in Chapter 6.0 and an implementation schedule (Table 7-1). Projects are grouped by clusters/elements and listed according to rank. The estimated cost is provided for each project. Project implementation has four phases. Project costs are allocated into these phases, based on rank.

A more detailed discussion of the implementation plan follows Table 7-1. It is organized by phase and identifies implementation considerations for each project. These considerations could influence the project schedule, cost, and ease of implementation. Project implementation and scheduling will also depend on Bureau of Environmental Services (BES) CIP program procedures and criteria.

Implementation Plan

The implementation plan organizes projects into four phases, based on evaluation scores. Highest-ranked projects are in the early phases; lower-ranked projects are in later phases. It is expected that some projects, such as a water quality facility, will be completed within a single phase. Programmatic projects that require a sustained level of effort, such as land acquisition and conversion of roadside ditches to swales, are organized through several phases. Stormwater retrofits are also organized into several phases. Pilot projects would be implemented in early phases, laying the groundwork for a sustained level of effort over several phases.

The implementation plan reflects the project ranking and implementation considerations and provides a long-term framework for a consistent level of investment to improve the health of the Fanno and Tryon Creek watersheds.

Table 7-1 Ranked Pre-design Projects

Cluster or Element	Projects	Cluster Rank	Overall Rank	Project Cost	Implementation Plan			
					Phase 1	Phase 2	Phase 3	Phase 4
Beaverton Hillsdale Highway Cluster	Fanno Creek culvert at SW 45th Avenue	1	5	$1,370,749	$1,370,749			
	Beaverton Hillsdale Highway drainage improvements	2	7	$1,104,000	$1,104,000			
	Fanno Creek culvert at Shattuck Road	3	9	$987,118		$987,118		
	Fanno Creek culvert at SW 39th Avenue	4	14	$12,024		$12,024		
	Fanno Creek culvert at SW 35th Avenue	5	17	$907,823		$907,823		
	Fanno Creek water quality facility (MS4 basin ACM139)	6	22	$34,650		$34,650		
	Stormwater retrofits (7 sites)	7	21	$2,878,819	$300,000	$500,000	$800,000	$1,278,819
	Fanno Creek water quality facility (MS4 basin ACG084)	8	25	$430,745			$430,745	
	Fanno MS4 outfall ACG251	9	26	$304,003			$304,003	
	Fanno MS4 outfall DTF026/ANJ549	10	27	$361,736			$361,736	
	Fanno MS4 outfall ACG084 (see WQ facility ACG084 above)	11	28	Ref.		Ref.		
	Fanno MS4 outfall ACM514	12	29	$118,187			$118,187	
Upper Tryon Creek Cluster	I-5 at SW 26th water quality facility	1	2	$1,318,214	$1,318,214			
	Jackson Middle School stream daylighting	2	8	$759,941	$759,941			
	Tryon Creek water quality facility (MS4 Basin ADC879)	3	10	$202,800		$202,800		
	Barbur Boulevard drainage improvements	4	13	$690,000		$690,000		
	Spring Garden Park stream daylighting	5	15	$ 104,730		$ 104,730		
	Tryon Creek water quality facility (MS4 Basin DTT002)	6	18	$202,800		$202,800		
	Stormwater retrofits (Multnomah Village)	7	19	$552,037	$230,000	$322,037		
	Jackson Middle School stormwater retrofits	8	24	$798,453			$798,453	
	Stormwater retrofits (7 sites)	9	23	$5,118,081	$300,000	$500,000	$800,000	$3,518,081
	Tryon MS4 outfall (MS4 Basin ADC879)	10	30	$32,760			$32,760	
Lower and Middle Tryon Creek Cluster	Boones Ferry Road culvert replacement	1	1	$ 2,418,621	$ 2,418,621			
	Reach 4: Sewer infrastructure protection and stream enhancements	2	3	$533,000	$533,000			
	Reach 1: Sewer infrastructure protection and stream enhancements	3	4	$1,872,000	$1,872,000			
	Reach 5: Streambank gabion removal and enhancement	4	11	$312,000		$312,000		
	Reach 6: Sewer infrastructure protection and stream enhancements	5	12	$286,000		$286,000		

Cluster or Element	Projects	Cluster Rank	Overall Rank	Project Cost	Implementation Plan			
					Phase 1	Phase 2	Phase 3	Phase 4
Other Stormwater Retrofits	Stormwater retrofits (7 sites)	1	16	$1,487,753	$500,000	$500,000	$487,753	
Ditch-to-Swale	8 high-priority roads, 9 medium-priority roads	1	6	$2,702,000	$305,000	$300,000	$300,000	$1,597,000
Land Acquisition	High-priority sites (46.9 acres), medium-priority sites (66.9 acres)	1	20	$23,547,567	$385,000	$500,000	$500,000	$22,162,567
Revegetation	3-high priority sites (8.8 acres), 7-medium priority sites (52.5 acres)	1	31	$643,321		$300,000	$343,321	
Operations and Maintenance	High-priority sanitary sewer: 4000 block of SW Hillsdale Ave.	1	32	$136,000			$136,000	
	High-priority sanitary sewer: SW Multnomah & 30th Ave.	2	33	$310,000			$310,000	
	High-priority sanitary sewer: SW 45th and Idaho	3	34	$72,000			$72,000	
	High-priority sanitary sewer: 3000 Block of SW Fairmont Blvd.	4	35	$167,000			$167,000	
	High-priority sanitary sewer: SW Council Crest & Beaverton	5	36	$224,000			$224,000	
	High-priority sanitary sewer: SW Hillsdale & Fairmount	6	37	$136,000			$136,000	
	High-priority sanitary sewer: SW Washouga & Chesapeake	7	38	$224,000			$224,000	
	High-priority sanitary sewer: SW Hillsboro & Council Crest	8	39	$136,000			$136,000	
	High-priority sanitary sewer: SW Multnomah & 22nd Ave.	9	40	$95,000			$95,000	
	Medium/low-priority sanitary sewer: Cambridge Gravity Line	10	41	$70,000			$70,000	
	Medium/low-priority sanitary sewer: SW Seymour Line	11	42	$217,000			$217,000	
			Total	$53,879,932	$11,396,525	$6,661,982	$7,063,958	$28,556,467

Phase 1

The highest-ranked projects in each cluster/element are proposed for implementation in Phase 1.

Beaverton Hillsdale Highway Cluster

Fanno Creek Culvert at SW 45th Avenue

The Portland Office of Transportation (PDOT) owns this culvert. Issues that could affect cost and/or schedule include:

- Transportation requirements: SW 45th is designated in Portland's Transportation System Plan as a local service street and a city walkway, requiring a future cross-section of a 32-foot-wide street, two 14-foot sidewalk corridors (0.5-foot curb, 6-foot planter/swale, 6-foot sidewalk, 1.5-foot frontage zone), and two 4-foot buffers for guardrails. Total right-of-way needed is 68 feet. (Existing right-of-way is 70 feet.)

- Easement acquisition: The right-of-way along SW 45th Avenue in this location is 70 feet wide. The new street cross-section (designed to meet PDOT requirements) will use this entire width, so additional permanent easements are required for wing-walls as well as maintenance of grade control structures up and downstream. Temporary construction easements are required for access.

- Utilities: A sanitary sewer line runs underneath the culvert; the clearance between the top of the sewer line and the bottom of the culvert is 2.25 feet. The cover between the top of the culvert to the road is 3.5 feet. The location of utilities in the road crossing and crossing the creek could constrain the design, make construction more complicated, or create a need for additional stream work to protect utilities at or near the surface.

- Environmental assessments and geotechnical investigations: Results could influence design and could affect costs and/or schedule.

- The anticipated in-water work window along Fanno Creek is June 1 through September 30.

- Traffic control will be a significant concern at this location because of traffic volumes on this street and lack of convenient detours.

- City, state, and local permits will be required.

Beaverton Hillsdale Highway Drainage Improvements

This funding request will support the design and construction of stormwater retrofits located primarily within the existing street fight-of-way for the Beaverton Hillsdale Highway. The City is responsible for maintenance of this section of highway, and the stormwater facilities are part of the City's NPDES municipal separate storm sewer system (MS4).

The choice of City-approved stormwater technologies that could be installed into the existing drainage system is extremely limited. The actual performance of these facilities and the ability to install them as a retrofit may be limited. Some sites may have geotechnical and/or environmental concerns that could be identified during design and construction and could affect project costs and/or schedule.

Stormwater Retrofits (7 sites)

This funding request will support pilot stormwater retrofit projects. Many of these retrofit projects are located on private property. Policies are not yet in place to spend BES capital funds to design and construct stormwater facilities on private property. Therefore, projects located on public property (e.g., Oregon Department of Transportation [ODOT], TriMet) would be pursued first. As supporting policies are developed and opportunities arise, projects located on private property may be pursued.

All stormwater retrofit projects will require agreements with property owners. Some stormwater retrofit sites may have geotechnical (soils/infiltration) and/or environmental concerns that could be identified during design and construction. These could affect project costs and/or schedules.

Upper Tryon Creek Cluster

I-5 at SW 26th Water Quality Facility

This project is located on ODOT right-of-way. ODOT has been involved in and reviewed all pre-designs. A draft memorandum of understanding between ODOT and BES that describes roles and responsibilities has been developed. This would need to be finalized and approved by both agencies as part of the project.

A preliminary environmental assessment revealed Pyrene onsite. The site will require disposal at a non-hazardous landfill. Environmental records research revealed a gas spill located 300 feet upgradient of the site, an active Oregon Department of Environmental Quality (DEQ) LUST site. Remediation activities are still occurring. Further environmental and geotechnical investigations and coordination with DEQ will be required. BES Maintenance Engineering had an onsite storm line TV'd for approximately 520 feet. Results indicate that there are hairline cracks, leaking joints, and flowing inflow and infiltration along the entire length. These issues could affect the design, costs, and/or schedule.

Jackson Middle School Stream Daylighting

This project is located at Jackson Middle School; the tennis courts are owned by the Portland Bureau of Parks & Recreation. Portland Public Schools (PPS) and Parks representatives have been involved in and reviewed all pre-designs. Both parties have agreed to allow the tennis court relocation.

A geotechnical survey of the project areas has been completed; no critical environmental issues have been identified. The project will require state, federal, and City permits. It is expected that permit can be acquired with relative ease and should not adversely affect the implementation schedule.

Stormwater Retrofits (Multnomah Village)

This funding request will support the design and construction of stormwater management facilities located in the public right-of-way or on public property. These projects should be relatively easy to implement; pre-designs have been presented to the Multnomah Village Business Association and have been reviewed by staff from the Bureau of Maintenance and PDOT.

Stormwater Retrofits (7 sites)

This funding request will support pilot stormwater retrofit projects. Many of these retrofit projects are located on private property. Policies are not yet in place to spend BES capital funds to design and construct stormwater facilities on private property. Therefore, projects located on public property (e.g., ODOT, TriMet) would be pursued first. As supporting policies are developed and opportunities arise, projects located on private property may be pursued.

All stormwater retrofit projects will require agreements with property owners. Some stormwater retrofit sites may have geotechnical (soils/infiltration) and/or that could be identified during design and construction. These could affect project costs and/or schedules.

Lower and Middle Tryon Creek Cluster

Boones Ferry Road Culvert Replacement

Replacement of the Boones Ferry culvert, currently a complete fish passage barrier, would extend fish passage upstream approximately 3,000 feet to Marshall Cascades, thought to be a natural passage barrier. Downstream of Boones Ferry Road near the Willamette River, Tryon Creek flows through the Highway 43 culvert, a partial fish passage barrier. ODOT will retrofit the Highway 43 culvert in summer 2008 to improve fish passage. That project, along with replacement of the Boones Ferry Road culvert, would enable fish passage on Tryon Creek from its confluence with the Willamette River upstream to the Marshall Cascades.

Issues that could affect the design, costs, and/or schedule include:

- Community groups have expressed an interest in the bridge alternative, which was also considered in the Pre-design. The bridge would provide space for a trail connection below Boones Ferry Road. This option should be considered further in the design phase and would influence costs.

- Environmental assessment and geotechnical investigations will be required to determine the load-bearing capabilities of the soil.

- PDOT street requirements, such as lane widths, sidewalks, and bike lanes, need to be determined.

- Detailed survey of topography, utilities, and other features for design will be needed.

- Construction access easements will be required.

- Federal, state, and City permits will be required.

- The in-water work window for Tryon Creek is July 15 through September 30.

Reach 4: Sewer Infrastructure Protection and Stream Enhancements

This request will support the design and construction of urgently needed repairs to the sanitary sewer. A portion of the 30-inch sanitary sewer trunk line is exposed in the active stream channel; the project is located in Tryon Creek State Natural Area. This project should proceed to design and construction as soon as possible.

City, state, and federal permits will be required. Construction easements will be needed for some project elements. Detailed flow modeling will be needed to support the design. The in-water work window for Tryon Creek is July 15 through September 30. These factors could influence the project costs and/or schedule.

Reach 1: Sewer Infrastructure Protection and Stream Enhancements

This request will support the design and construction of urgently needed repairs to the sanitary sewer located in Tryon Creek State Natural Area. Support structures for the elevated sanitary sewer are located in the active channel, and many of them are undermined. A number of sanitary sewer manholes are in need of rehabilitation/replacement. This project should proceed to design and construction as soon as possible.

City, state, and federal permits will be required. Construction easements will be needed for some project elements. Detailed flow modeling will be needed to support the design. The in-water work window for Tryon Creek is July 15 through September 30. These factors could influence the project costs and/or schedule.

Other Stormwater Retrofits

This funding request will support pilot stormwater retrofit projects. Many of these retrofit projects are located on private property. Policies are not yet in place to spend BES capital funds to design and construct stormwater facilities on private property. Therefore, projects located on public property (e.g., Portland Parks, Portland Community College) would be pursued first. As supporting policies are developed and opportunities arise, projects located on private property may be pursued.

All stormwater retrofit projects will require agreements with property owners. Some stormwater retrofit sites may have geotechnical (soils/infiltration) and/or environmental concerns that could be identified during design and construction. These could affect project costs and/or schedules.

Ditch-to-Swale

This funding request will support the initiation of a program to systemically convert high-priority City-maintained roadside ditches to swales. All projects are located in the public right-of-way. As part of the Pre-design, community interests arose about potential pedestrian improvements that could be made as part of ditch-to-swale conversions. PDOT, BES, and community representatives have and continue to work on pedestrian-related issues as part of ditch-to-swale conversions. These issues could influence the design, costs, and schedule.

Land Acquisition

This funding request will support the initiation of a willing seller land acquisition program. CIP funds will be leveraged with the City's local cost share (approximately $15 million) and regional funds (approximately $160 million) from Metro's bond measure, which must be spent by March 2012.

Phase 2

Beaverton Hillsdale Highway Cluster

Fanno Creek Culvert at Shattuck Road

Issues that could affect the design, cost and/or schedule include:

- Transportation requirements: SW Shattuck Road is designated in Portland's Transportation System Plan (TSP) as a neighborhood collector, community transit street, city bikeway, city walkway, and major emergency transit street. Future TSP project 90059 would provide bike lanes and sidewalks along this portion of Shattuck; that project is currently listed for years 6 to 10 in the TSP. The future cross-section is two 11-foot travel lanes, two 6-foot bike lanes, two 14-foot sidewalk corridors (0.5-foot curb, 6-foot planter/swale, 6-foot sidewalk, 1.5-foot frontage zone), and two 4-foot buffers for guardrails. Total right-of-way needed is 68 feet. (Existing right-of-way is 50 feet.)

- Easement acquisition: There is only 50 feet of right-of-way along this portion of Shattuck. Since 70 feet of right-of-way is needed to accommodate the design, an additional 20 feet of right-of-way for the new street width must be purchased. For this project, easements are required for temporary construction access and permanent access to the culvert and any grade control structures installed.

- Utilities: There are several relevant utility conflicts. An 18-inch storm pipe outfalls directly into the culvert and will have to be rerouted or reconnected to the new culvert. An 18-inch sanitary pipe is located within the right-of-way 4 feet below the bottom of the culvert, limiting the ability to lower the culvert.

- Environmental assessments and geotechnical investigations will be needed.

- The anticipated in-water work window along Fanno Creek is June 1 through September 30.

- Traffic control: Traffic control along Shattuck will be a significant concern during planning and construction. Recent road work in this neighborhood and lack of adequate alternate routes will make public involvement regarding the road closure critical.

- City, state, and local permits will be required.

Fanno Creek Culvert at SW 39th Avenue

Issues that could affect the design, cost and/or schedule include:

- Transportation requirements: SW 39th Drive is designated in the Transportation System Plan as a local service street. The existing pavement width is 32 feet, with curbs but no sidewalks. The future cross section is 32-foot-wide street, two 12-foot sidewalk corridors (0.5-foot curb, 6-foot planter/swale, 5-foot sidewalk, 0.5-foot frontage zone), and two 4-foot buffers for guardrails. Total right-of-way needed is 66 feet (Existing right-of-way is 50 feet.)

- Easement acquisition: The right-of-way is 50 feet wide at this location. PDOT will need to purchase an additional 16 feet of right-of-way to accommodate the required roadway width. The culvert is 122 feet long and extends beyond the right-of-way. The outlet is located in property owned by Portland Parks and Metro. The inlet is located on a private residential lot and is covered by an existing easement. Additional easements for the culvert may need to be purchased for maintenance access.

- Utilities: No conflicts were identified in the Pre-design.

- Environmental assessments and geotechnical investigations will be needed.

- The anticipated in-water work window along Fanno Creek is June 1 through September 30.

- Traffic control will be required.

- City, state, and local permits will be required.

Fanno Creek Culvert at SW 35th Avenue

Issues that could affect the design, cost and/or schedule include:

- Transportation requirements: The road crossing this culvert is a private driveway. The current pavement width is nearly 20 feet. This current width will be restored after construction. This driveway is the only access point for a large apartment complex and a few homes. This will necessitate staging to provide access during construction, possibly installing the culvert in sections.

- Easement acquisition: The culvert is completely located on BES property. The stream upstream and downstream is mostly located in the right-of-way along Beaverton Hillsdale Highway. Easements may be needed for small areas of stream if grade controls are installed. Research will be necessary to confirm property ownership and the location of any easements.

- Utilities: An 8-inch sanitary sewer line exists just above the crown of the culvert, limiting flexibility in culvert placement. A 15-inch storm sewer line outfalls directly into the culvert; this will be connected to the new structure. A concrete wall downstream of the culvert is catching debris, and the creek is flowing through the debris and under the wall. Along the bank upstream of the culvert is a concrete block of unknown utility; if it no longer has a function, it should be removed.

- Environmental assessments and geotechnical investigations will be needed.

- The anticipated in-water work window along Fanno Creek is June 1 through September 30.

- City, state, and local permits will be required.

Fanno Creek Water Quality Facility and Outfall Repair (MS4 basin ACM139)

This funding request will support the design and construction of this water quality facility. This project is located in the right-of-way and BES property.

Environmental and geotechnical investigations will be needed. City, state, and local permits will be required.

Stormwater Retrofits (7 sites)

This funding request will continue to support design and construction of stormwater retrofit projects. See the description in Phase 1 for more information.

Upper Tryon Creek Cluster

Tryon Creek Water Quality Facility (MS4 Basin ADC879)

This funding request will support the design and construction of this water quality facility. This project is located on private property and in the ODOT right-of-way along Interstate 5.

Facility designs were not developed as part of the Pre-design. Detailed modeling, environmental investigations, and geotechnical assessments will be required. Land ownership, facility size, and the exact location of the facility have not been determined. Based on those determinations, agreements with property owners and land acquisition and/or easements may be needed; those costs were not included in the cost estimate. City and state permits may also be required.

Barbur Boulevard Drainage Improvements

This funding request will support the design and construction of stormwater retrofits located primarily within the existing street right-of-way for Barbur Boulevard.

Three issues may effect implementation and performance. First, while these projects would be located in the public right-of-way, Barbur Boulevard is a state-owned and maintained highway. The design and installation of any facilities would need to be closely coordinated with ODOT. Second, the choice of City-approved stormwater technologies that could be installed into the existing drainage system is extremely limited. The actual performance of these facilities and the ability to install them as a may be limited. Third, some sites may have geotechnical and/or environmental concerns that could be identified during design and construction and could affect implementation.

Spring Garden Park Stream Daylighting

This project will support the design and construction of this stream daylighting project located on Portland Parks property.

Environmental assessment and geotechnical analysis needs to be conducted. A non-park use permit and a street opening permit will probably be required from the City. An easement over the drainage flow path will be needed. The design and construction must be coordinated with Portland Parks. These items could moderately affect implementation.

Tryon Creek Water Quality Facility (MS4 Basin DTT002)

This funding request will support the design and construction of this water quality facility. This project is located primarily in the ODOT right-of-way along Interstate 5 and partially on private property.

Facility designs were not developed as part of the Pre-design. Detailed modeling, environmental investigations, and geotechnical assessments will be required. Land ownership, facility size, and the exact location of the facility have not been determined. Based on those determinations, agreements with property owners and land acquisition and/or easements may be needed; those costs were not included in the cost estimate. City and state permits may also be required.

Stormwater Retrofits (Multnomah Village)
This funding request will continue to support the design and construction of stormwater retrofits in the public right-of-way and on public property. See the description in Phase 1 for more information.

Stormwater retrofits (7 sites)
This funding request will continue to support the design and construction of stormwater retrofits in upper Tryon Creek. See the description in Phase 1 for more information.

Lower and Middle Tryon Creek Cluster

Reach 5: Streambank Gabion Removal and Enhancement
This request will support the design and construction of the removal and replacement of stream bank gabions with large wood and other natural materials. This project is located in Tryon Creek State Natural Area.

City, state, and federal permits will be required. Construction easements will be needed for some project elements. Detailed flow modeling will be needed to support the design. The in-water work window for Tryon Creek is July 15 through September 30. These factors can influence the project costs and/or schedule.

Reach 6: Sewer Infrastructure Protection and Stream Enhancements
This request will support the design and construction of measures to protect two exposed segments of sanitary sewer. The project is located on Tryon Creek on private property upstream of Boones Ferry Road.

Access to the site is difficult. Construction easements will be needed for some project elements. Detailed flow modeling will be needed to support the design. City, state, and federal permits will be required. The in-water work window for Tryon Creek is July 15 through September 30. These factors may influence the project costs and/or schedule.

Other Stormwater Retrofits

This funding request will continue to support design and construction of stormwater retrofit projects. See the description in Phase 1 for more information.

Ditch-to-Swale

This funding request will continue to support the conversion of roadside ditches to swales. See the description in Phase 1 for more information.

Land Acquisition

This funding request will continue to support a willing seller acquisition program. See the description in Phase 1 for more information.

Revegetation

This funding request will support revegetation on high-priority sites. These sites are on private property. BES Revegetation Program staff will establish agreements with property owners for initial plantings and 5 years of project maintenance.

Phase 3

Beaverton Hillsdale Highway Cluster

Stormwater Retrofits (7 sites)

This funding request will continue to support design and construction of stormwater retrofit projects. See the description in Phase 1 for more information.

Fanno Creek Water Quality Facility (MS4 Basin ACG084)

This funding request will support the design and construction of this water quality facility located on Portland General Electric property.

Environmental and geotechnical investigations will be needed. Ownership of the onsite stormwater pipe needs to be determined. Property and easements must be acquired. Access to the site for construction and maintenance will be challenging. Additional easements and access road construction may be needed. City, state, and local permits will be needed. These items could affect implementation.

Fanno MS4 Outfall ACG251

This funding request will support the replacement of this storm pipe and stream bank repairs. The pipe is located on private property.

The entire pipe should be TV'd to determine pipe condition along the entire length and determine if lining is appropriate. Initial environmental and geotechnical investigations are needed. Ownership of the storm pipe needs to be determined; it appears to be a private pipe. Property and easements must be acquired. Access to the site for both construction and maintenance will be difficult. Additional easements and access road construction may be needed. These issues could affect implementation.

Fanno MS4 Outfall DTF026/ANJ549

This funding request will support the lining of this piped outfall and stream bank repairs. This pipe is located on private property.

The entire pipe should be TV'd to determine pipe condition along the entire length and determine if lining is appropriate. Initial environmental and geotechnical investigations are

needed. Ownership of the storm pipe needs to be determined; it appears to be a private pipe. Property and easements must be acquired. Access to the site for both construction and maintenance will be difficult. Additional easements and access road construction may be needed. These issues could affect implementation.

Fanno MS4 Outfall ACM514

This funding request will support the repair of this piped outfall and stream bank revegetation. The project is located in the right-of-way.

The entire pipe should be TV'd to determine if the entire pipe needs replacement. If the adjacent property owners are interested, opportunities to extend revegetation should be pursued. No other issues that could affect implementation were identified.

Upper Tryon Creek Cluster

Jackson Middle School Stormwater Retrofits

This funding request will support the design and construction of stormwater retrofits at Jackson Middle School. Pre-designs have been reviewed by Portland Public Schools representatives. The project will require City permits. It is expected that these permits can be acquired with relative ease and should not adversely affect the implementation schedule.

Stormwater Retrofits (7 sites)

This funding request will continue to support the design and construction of stormwater retrofits in upper Tryon Creek. See the description in Phase 1 for more information.

Tryon MS4 Outfall (MS4 Basin ADC879)

This funding request will support the rehabilitation of this stormwater outfall. The outfall appears to be located in the right-of-way. Additional investigations of pipe condition by BES Maintenance Engineering will be needed.

Other Stormwater Retrofits

This funding request will continue to support design and construction of stormwater retrofit projects. See the description in Phase 1 for more information.

Ditch-to-Swale

This funding request will continue to support the conversion of roadside ditches to swales. See the description in Phase 1 for more information.

Land Acquisition

This funding request will continue to support a willing seller acquisition program. See the description in Phase 1 for more information.