Combined Sewer Overflow Program

2010 CSO REDUCTION PLAN AMENDMENT

Seattle Public Utilities

RESTORE OUR WATERS

TETRA TECH

May 2010

Seattle Public Utilities
2010 CSO REDUCTION PLAN AMENDMENT

April 2010

REVISED FINAL DRAFT

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Seattle Public Utilities
2010 CSO Reduction Plan Amendment

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EXECUTIVE SUMMARY

The City of Seattle owns and operates a combined sewer system that overflows during heavy rain events. These combined sewer overflows (CSOs) can contribute pollutants to surrounding water bodies, potentially impacting their quality and uses. Over the last 40 years, the City and the County through each agency's CSO reduction programs have successfully reduced CSO volume into surrounding receiving waters by approximately 20 billion gallons. However, there is still work to be done to control the remaining CSOs, and the final reduction in CSO volume is the most challenging. Over the next 10-15 years, the City will work in partnership with King County, the Washington State Department of Ecology (Ecology), and the Environmental Protection Agency (EPA) to address the remaining and most challenging CSOs. The City will also work collaboratively with the citizens of Seattle to create the optimal blend of capital and operational investments to control remaining CSOs. The City is confident that its investments in the CSO Program will provide long-term value and an environmental legacy for the citizens of Seattle.

2010 PLAN SETS AGGRESSIVE PATH FOR CSO PROGRAM

This *2010 CSO Reduction Plan Amendment* is an update to the City of Seattle's plan for reducing overflows from the combined sewer system into surrounding surface waters. It aims to identify projects or programs that will limit untreated overflows at each CSO outfall to an average of no more than one per year, a performance standard established in the City's CSO National Pollutant Discharge Elimination System (NPDES) permit. As a result, the City will capture 99% of combined sewer volume from the City's combined sewer system during storm events.

The City's focus through 2015 is to reduce CSOs at its most critical sites through a cost-effective blend of traditional and sustainable infrastructure. The path forward involves a four-prong approach: (1) optimize existing CSO infrastructure through low cost retrofits, (2) construct large CSO infrastructure projects to reduce overflows to Lake Washington, (3) construct natural "green" solutions to reduce CSOs throughout the City, and (4) develop a Long-Term Control Plan (LTCP) to control all remaining CSOs and achieve water quality goals. By the end of 2015, the City will have accomplished the following:

- Constructed CSO retrofits to optimize CSO control infrastructure in multiple uncontrolled CSO basins
- Completed the construction of the Windermere CSO Reduction Project
- Substantially completed the construction of the Genesee CSO Reduction Project
- Started construction on the Henderson and Central Waterfront CSO Reduction Projects (completion in 2018)
- Constructed green stormwater infrastructure (GSI) projects in the Ballard CSO basin to measure effectiveness of green solutions, followed by full-scale implementation of GSI in Ballard, North Union Bay, Interbay, Montlake, and Fremont/Wallingford CSO basins
- Completed the 2015 CSO Reduction Plan Amendment (aka LTCP), which will include evaluation of potential collaborative Seattle – King County CSO projects and identification of projects to reduce remaining CSOs

Table ES-1 summarizes the anticipated CSO reduction projects from 2010 to 2015.

TABLE ES-1.
2010-2015 CSO CONTROL PROJECTS

NPDES Basin No.	Project	Control Volume* (gallons)	Project Cost Range Low	Project Cost Range High	Projected Year of Completion
Basin Group: Windermere					
13	Off-Line Storage	1,900,000	$37,700,000	$51,000,000	2014
15	Retrofit	3,000	$3,000	$5,000	2010
Basin Group: Genesee					
40	GSI, Off-line Storage	177,000	$2,167,000	$8,668,000	2015
41	GSI, Off-line Storage	194,000	$2,525,000	$10,102,000	2015
43	GSI, Off-line Storage	180,000	$2,187,000	$8,732,000	2015
Basin Group: Henderson					
44	GSI, Off-Line Storage	2,173,000	$16,382,000	$65,529,000	2018
45	GSI, In-Line Storage	174,000	$983,000	$3,934,000	2018
46	GSI, Off-Line Storage	200,000	$2,400,000	$9,610,000	2018
47	GSI, Off-Line Storage	277,000	$2,544,000	$10,178,000	2018
49	GSI, Off-Line Storage	156,000	$1,806,000	$7,226,000	2018
171	GSI, Off-Line Storage	153,000	$1,685,000	$6,736,000	2018
Basin Group: Ballard					
150 / 151*	GSI	84,000	$530,000	$2,120,000	2015
152*	GSI	819,000	$5,103,000	$20,412,000	2015
60*	GSI	20,000	$30,000	$120,000	2015
Basin Group: N. Union Bay					
18*	GSI	71,000	$95,000	$380,000	2015
Basin Group: Interbay					
68*	GSI	45,000	$59,000	$238,000	2015
Basin Group: Central Waterfront					
69, 70, 71	Off-Line Storage	600,000	$7,343,000	$29,372,000	2018
Basin Group: West Seattle					
95	Retrofit	163,000	$250,000	$1,000,000	2015
Basin Group: Montlake					
140	GSI	12,000	$79,000	$316,000	2015
Basin Group: Fremont/Wallingford					
147*	GSI	79,000	$105,000	$418,000	2015
174*	GSI	126,000	$168,000	$672,000	2015
Basin Group: Longfellow/Delridge					
168	Retrofit	33,000	$2,250,000	$9,000,000	2015
169	Retrofit	285,000	$2,250,000	$9,000,000	2015
Total		**7,924,000**	**$88,644,000**	**$254,768,000**	

* First phase – See Table 5-5 for projects beyond 2015

Optimizing Use of Existing Infrastructure

The most cost-effective CSO reduction program will involve optimizing the use of the City's existing wastewater system. This strategy is consistent with the EPA's mandatory Nine Minimum Controls, which focus on best management practices to ensure that the existing system is fully utilized. The City's CSO Retrofit Program is designed to optimize the use of the existing system through advanced technologies such as real-time controls, as well as inexpensive structural modifications such as weir-height adjustments. Between 2010 and 2015, the City plans to invest up to $10 million in CSO retrofits to ensure that its existing system is fully optimized.

Prioritizing Lake Washington

Lake Washington is one of the region's greatest natural resources. As the largest freshwater lake in King County, it provides habitat for numerous aquatic species as well as recreational areas for the region's residents and visitors. Due to the importance of this water body, the City has placed the reduction of CSOs into Lake Washington as its highest priority through 2015. The Windermere, Genesee and Henderson Basins account for the majority of the uncontrolled CSO discharges into the Lake totaling an average of 24 million gallons annually. Successful completion of CSO reduction projects in the Windermere, Genesee, and Henderson basins will require significant investment in capital infrastructure. However, these three projects alone are expected to reduce the CSO volume to Lake Washington by approximately 14 million gallons per year, a reduction of approximately 60 percent of the current discharge from these basins.

The Windermere, Genesee, and Henderson basins and their location with respect to Lake Washington are shown in Figure ES-1.

Green Solutions Will Improve Neighborhoods and Water Quality

Reduction of CSOs will require a blend of traditional infrastructure projects and "green" solutions. Green technologies such as rain gardens, curb bulbs, cisterns, and green-roofs intercept stormwater runoff before it reaches the combined sewer system, thereby reducing the volume of overflow from the combined sewer system that might reach our receiving waters. In addition, green solutions often provide community and ecological benefits. The City is committed to implementing green solutions whenever they are feasible and cost-effective for reducing CSOs.

Residential Rain Garden

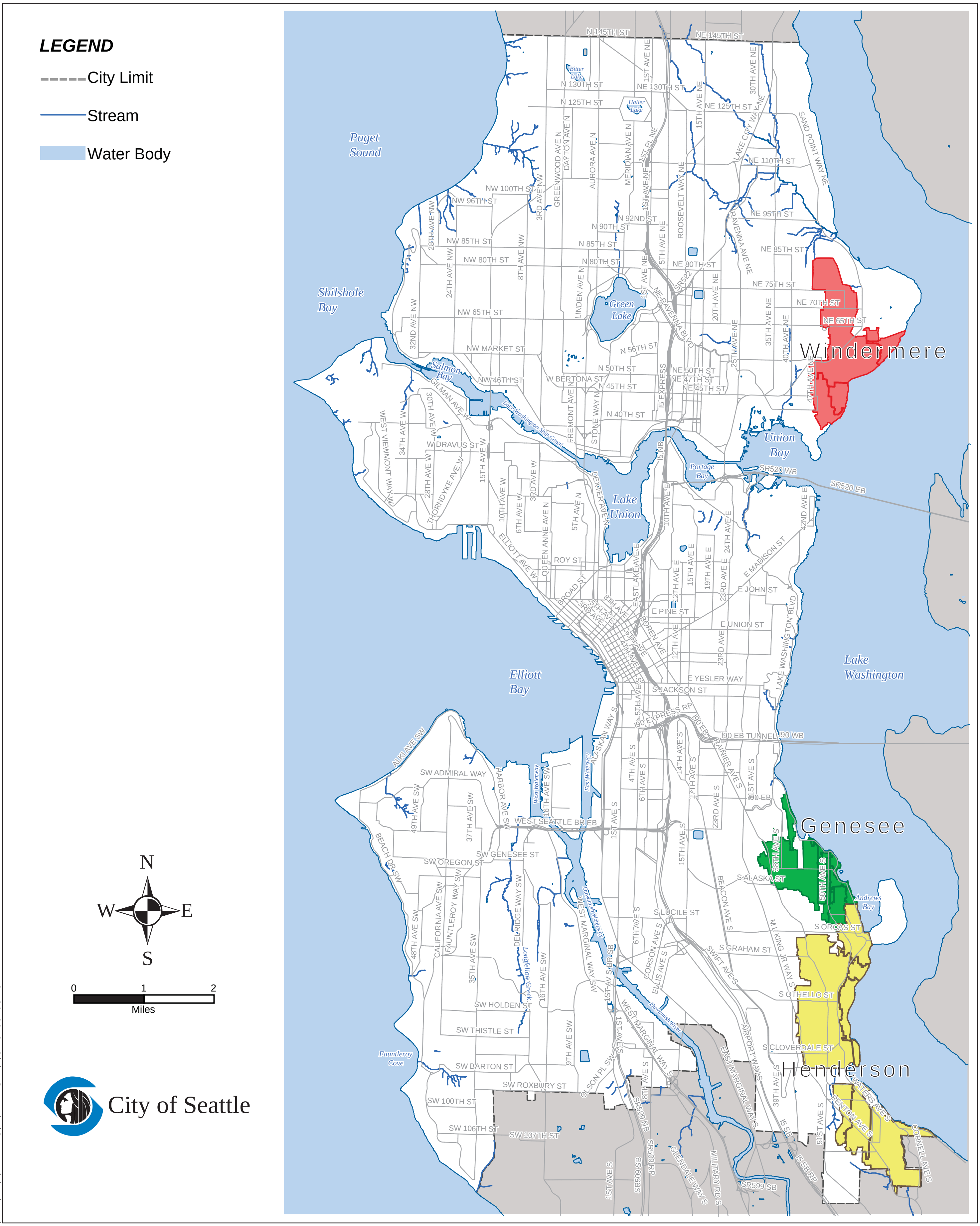

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Figure ES-1
LAKE WASHINGTON BASIN GROUPS— WINDERMERE, GENESEE AND HENDERSON

Bioretention Swale

Beginning in 2010, the City will construct green solutions in the Ballard basin and monitor their effectiveness at reducing CSOs. Upon completion, the City plans to implement full-scale green infrastructure projects in the Ballard, North Union Bay, Interbay, Montlake, and Fremont/Wallingford CSO basins. These project basins are listed in Table ES-1 and shown in Figure ES-2. From 2007 to 2009, these basins discharged a total of 76 million gallons of sewage into the Lake Washington Ship Canal, and Union Bay. Preliminary investigation indicates that green infrastructure alone can reduce the CSO volume from these basins by up to 80 percent.

The Ballard Roadside Rain Gardens project will involve construction of bioretention curb bulbs in partnership with the Seattle Department of Transportation. The City will also be implementing its Residential Rainwise Program, which will work in partnership with private property owners to install cisterns and residential rain gardens.

SIGNIFICANT INVESTMENT WILL YIELD SIGNIFICANT BENEFITS

Significant financial investment in CSO control is necessary for the City to achieve its environmental objectives of complying with regulatory requirements and improving water quality in the City's surrounding receiving waters. The investment of Seattle rate-payers will protect public health, improve water quality in Seattle's receiving waters, and create an environmental legacy that the residents of Seattle can take pride in.

The City's CSO control projects from 2010 to 2015 will cost the City approximately $162 million. Figure ES-3 shows the projected capital spending for the period.

The City is actively working to control the costs of the program by selecting the most cost-effective alternatives. In addition, the City is already pursuing federal funding to minimize the impact of this investment on City of Seattle ratepayers. However, rate increases will be necessary to support the level of investment in wastewater infrastructure that the City has planned.

As shown in Figure ES-4, the City projects that the cumulative amount of rate increases necessary to fund the CSO Program will increase the typical residential monthly drainage and wastewater bill by $4.62 in 2015. The City is confident that its investments in the CSO Program will provide long-term value for the current and future citizens of Seattle through its protection of water quality, habitat, and public health.

PREPARING FOR THE FUTURE

While the City will make significant investment between 2010 and 2015 to reduce CSOs by approximately 40 percent, there will be a subsequent phase of CSO reduction after 2015 to achieve regulatory requirements. The City is preparing for that next and final phase of CSO reduction by using the 2010 Plan Amendment as the foundation to prepare a comprehensive Long-Term Control Plan, which will identify all remaining CSO projects in basins such as Ballard, North Union Bay, Interbay, Fremont/Wallingford, Duwamish, West Seattle, Montlake, Leschi, Union Bay, East Waterway, and Lake Union/Portage Bay. The Long Term Control Plan will be submitted as the 2015 CSO Reduction Plan Amendment to Ecology.

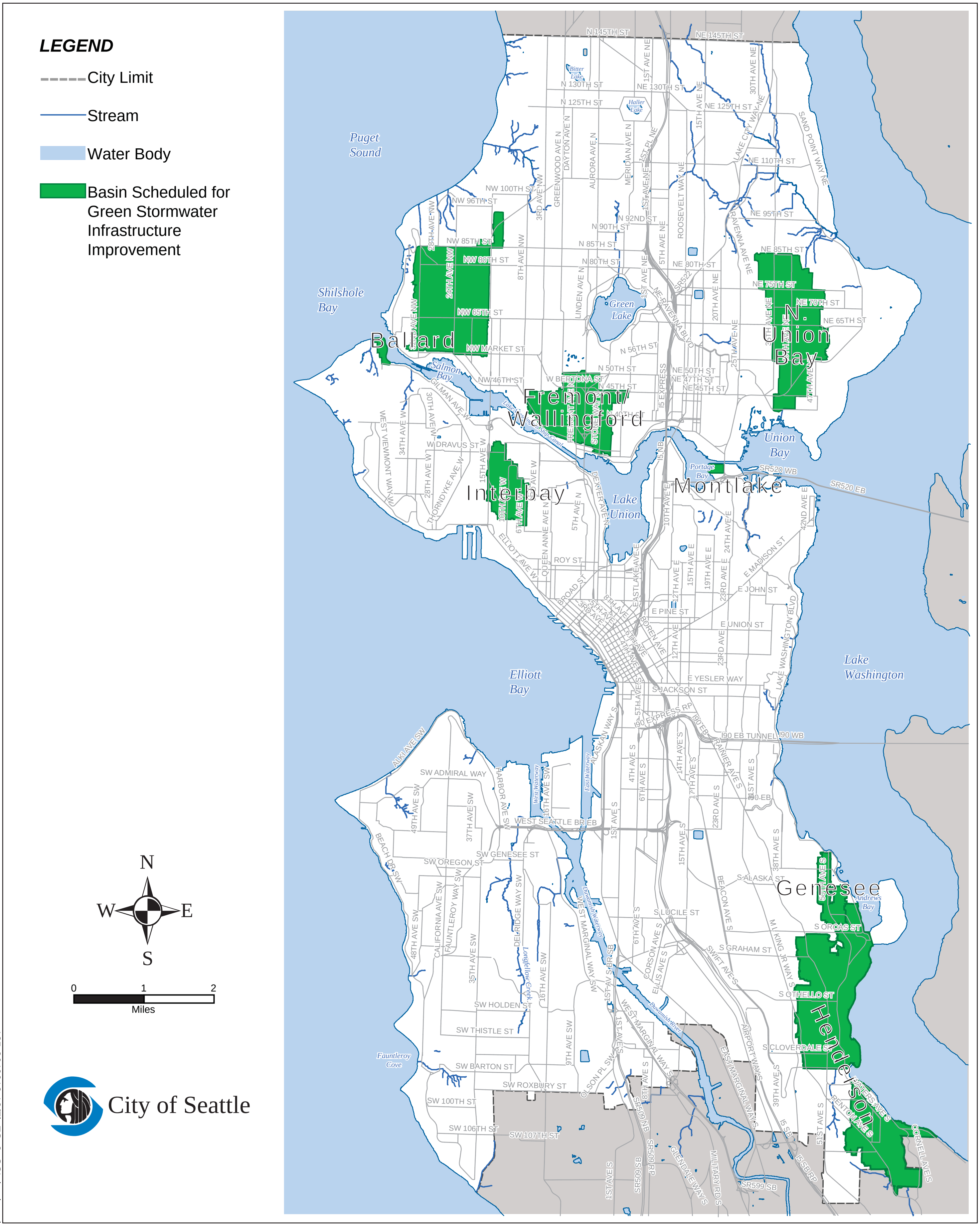

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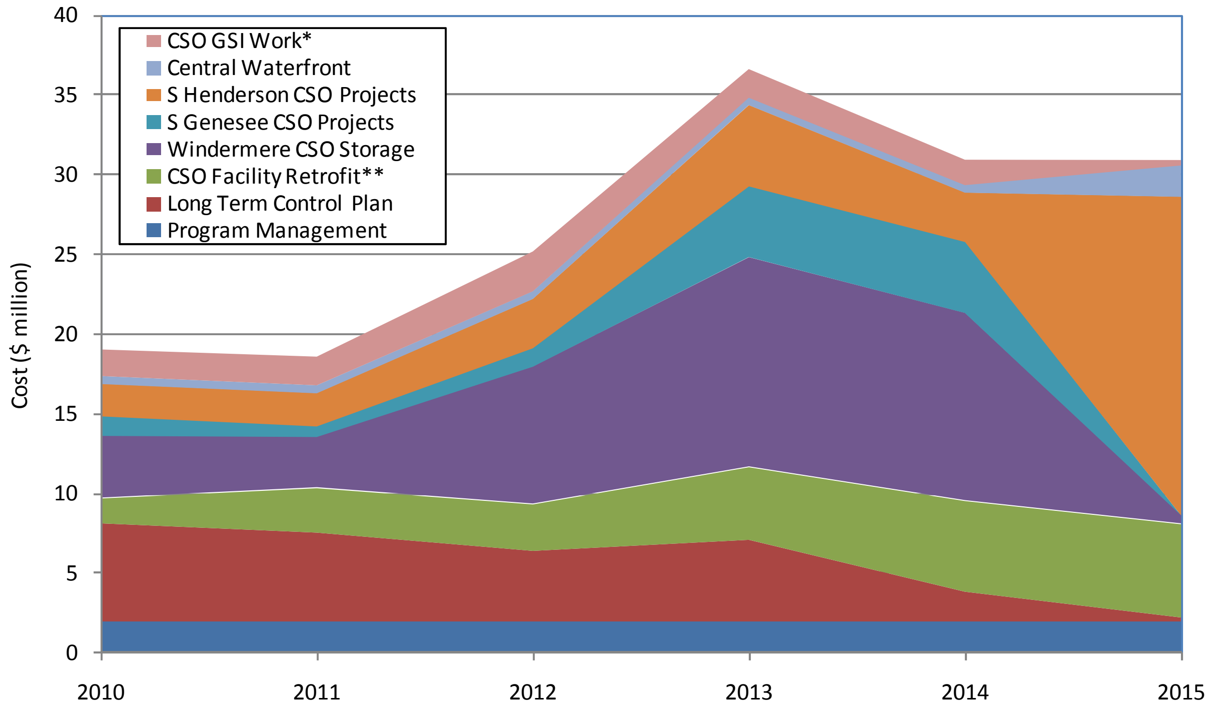
Figure ES-2
BASINS SCHEDULED FOR GREEN STORMWATER INFRASTRUCTURE IMPROVEMENTS



* Excludes Genesee & Henderson GSI

** Includes Longfellow/Delridge Large Retrofits

Figure ES-3. Estimated Annual Expenditures, 2010 – 2015

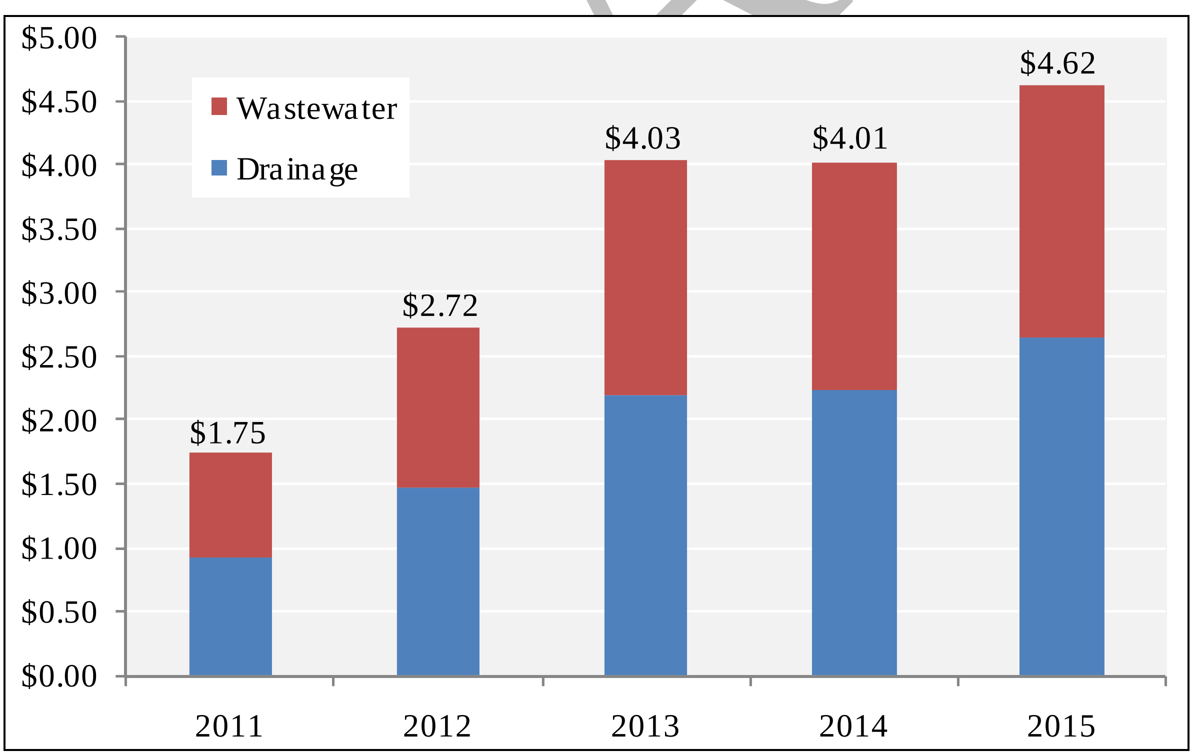


Figure ES-4. Projected Drainage & Wastewater Typical Monthly Household Bill Increases, 2011 – 2015

The 2015 CSO Reduction Plan Amendment will select a cost-effective blend of both traditional and green solutions for the remaining CSO basins. The Plan Amendment will explore opportunities to partner with King County on collaborative projects to control both agencies' CSOs. The solutions identified in the Plan Amendment will be approved by the Department of Ecology and the EPA, and they will be constructed in the years following 2015. Figure ES-5 shows the remaining CSO basins to be controlled after 2015.

PARTNERING WITH COMMUNITIES

Successful implementation of the CSO Program requires an active partnership with the communities, businesses, and individuals that make up the City. Inasmuch as the benefits of the CSO Program will be shared by the citizens of Seattle, the impacts of the program such as construction impacts and rate increases will also be felt by Seattle citizens. The residents and businesses of Seattle have an opportunity to shape the future of the City's CSO Program by participating in the program, whether through attending public meetings on CSO projects, constructing green solutions on their own properties, or participating in development of the 2015 CSO Reduction Plan Amendment. During this period, the City will actively seek public input on all the elements of the CSO Program, including the Windermere, Genesee, and Henderson projects, green solutions, and the Plan Amendment.

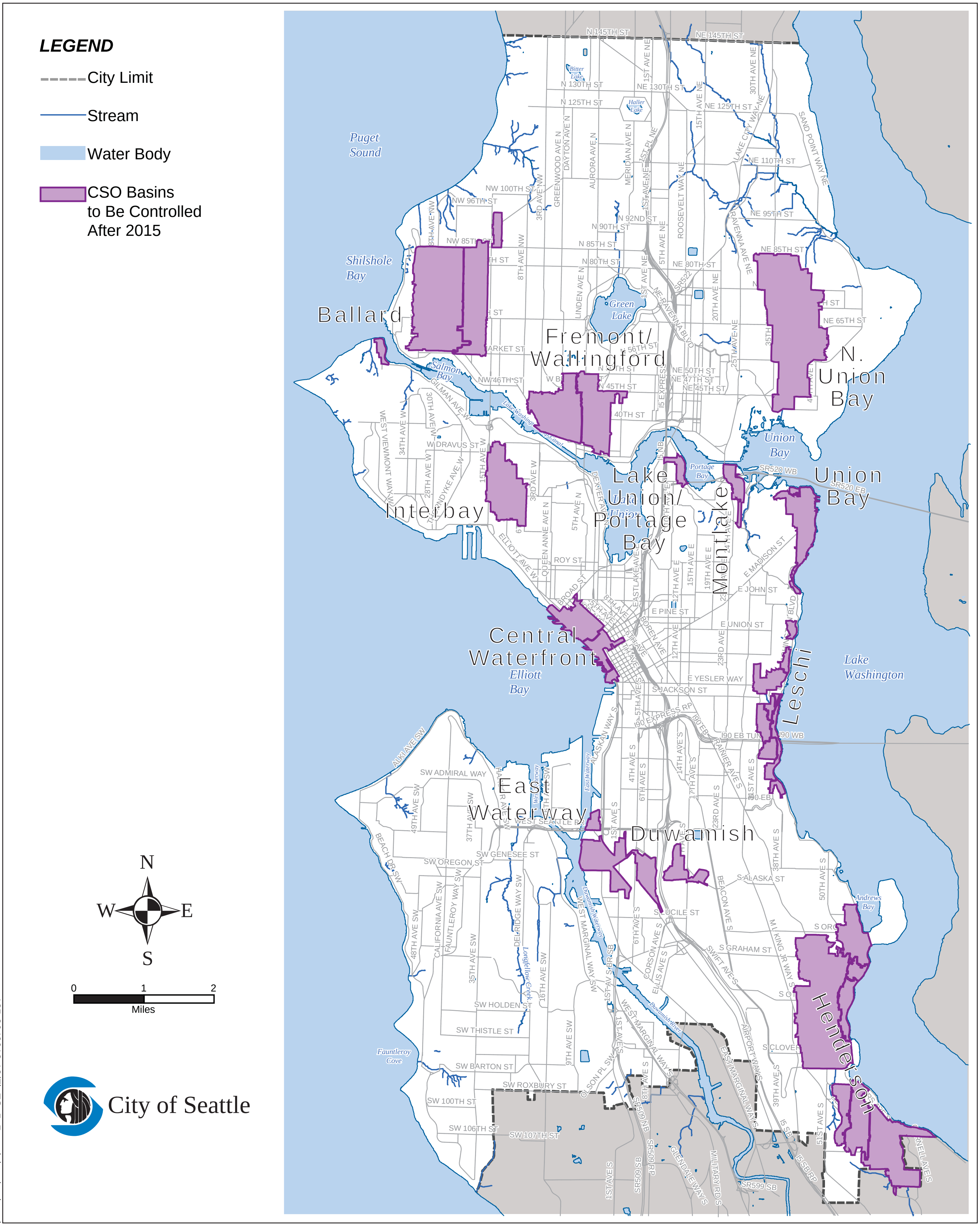


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Figure ES-5
CSO BASINS TO BE CONTROLLED AFTER 2015

CHAPTER 1.
GENERAL OVERVIEW

INTRODUCTION

The *2010 Combined Sewer Overflow (CSO) Reduction Plan Amendment* (2010 Plan Amendment) is an update to the City of Seattle's plan for reducing overflows from combined sewer systems into surrounding surface waters. Over the past 20 years, the City has reduced overflows from 24 of the City's 92 CSO outfalls, resulting in a significant reduction in the number of CSO events and overflow volumes. Many of these projects were identified in the City's 1988 CSO Reduction Plan and/or its subsequent amendments in 2001 and 2005. The 2010 Plan Amendment addresses the remainder of the City's combined sewer system. Its aim is to limit untreated overflows at each CSO outfall to an average of no more than one per year, a performance standard established in the City's National Pollutant Discharge Elimination System (NPDES) CSO permit.

BACKGROUND

Seattle Sewer System

Early sewer systems in Seattle and many older cities were designed to carry combined flows of sanitary sewage and stormwater runoff. During wet weather, when the volume of sewage and stormwater entering the combined sewers exceeds the system capacity, the system was designed to overflow at designated outfalls. The overflows carry pollutants, primarily in the form of untreated sewage, into water bodies.

Beginning in the 1950s, additions to the sewer system were designed as separated systems, with separate networks of pipes for sewage and stormwater. Since the 1960s, the City has undertaken a number of efforts to partially separate previously combined systems; in partially separated systems, stormwater from streets and parking lots runs into separate storm drains, but stormwater from other sources, mostly building roofs, still enters a combined system.

Today, Seattle's wastewater collection system is a combination of combined, partially separated and separated areas. About two-thirds of Seattle is served by a combined or partially separated sewer system (971 miles of sewer). Separated systems serve the other one-third (455 miles of sewer). The City conveys most of its wastewater to King County sewers for conveyance to treatment facilities.

Previous CSO Reduction Planning Efforts

Seattle has completed several planning efforts since the 1980s to identify CSO reduction projects. Some of the projects involved maintenance or modification of existing sewer facilities. Others involved construction of diversion structures to direct flows away from CSO outfalls or storage facilities to store excess wastewater until flows decrease enough for the stored wastewater to be returned to the conveyance system. The major CSO reduction planning efforts were as follows:

- 1980 Facility Plan—The 1980 *Final Facility Plan* (*201 Facilities Planning)* addressed CSO reduction in high priority areas based on human contact potential and environmental protection—Longfellow Creek, Lake Washington and Puget Sound beaches. Storage facilities were recommended for controlling CSOs from 50 outfalls, with an estimated cost of $13.2 million (1978 dollars).

- 1988 CSO Reduction Plan—The 1988 *CSO Reduction Plan* addressed CSO reduction in Portage Bay, Lake Union, the Ship Canal, Elliott Bay and the Duwamish River. The plan recommended storage facilities for 30 uncontrolled outfalls. Estimated cost of the recommended improvements was $60 million (1988 dollars).
- 2001 CSO Reduction Plan Amendment—The 2001 *CSO Reduction Plan Amendment* reevaluated previously studied areas of the City and expanded the evaluation to include other areas (see Figure 1-1). Estimated cost of the recommended improvements was $58 million (2001 dollars).
- CSO Reduction Plan Amendment 2005 Update—The 2005 Update was prepared to evaluate the effectiveness of BMP (best management practice) projects from the 2001 Amendment that had been completed, and to revise cost estimates and schedules for remaining 2001 projects.

2010 Plan Amendment Goals

The primary goal of the 2010 Plan Amendment is to make progress toward controlling CSOs to an average of no more than one untreated discharge per year, while meeting the following objectives:

- Minimize public health and environmental impacts of CSOs cost-effectively.
- Coordinate the CSO program with other City and King County programs.
- Partner with neighborhood communities to identify concerns regarding project impacts.
- Build upon previous CSO control efforts.
- Confirm the validity of previous CSO control recommendations.
- Identify new CSO reduction projects that conform to City standards for cost and benefits.
- Provide interim direction until system-wide flow monitoring, flow modeling, and a Long-Term Control Plan (2015 CSO Plan) are complete.

2010 Plan Amendment Approach

Recommendations in this Plan Amendment were developed by evaluating a range of potential CSO reduction measures to determine the most cost-effective and environmentally beneficial options for each basin with a permitted CSO outfall (referred to as NPDES basins), as follows:

- Review the performance of previous CSO reduction projects to determine their effectiveness, their cost-effectiveness, and the appropriateness of the technologies used for future projects.
- Rank NPDES basins by priority, based on potential impacts on public health and the environment.
- Based on flow monitoring records, identify which NPDES basins are "controlled" (meeting the requirement of no more than an average of one untreated overflow per year) and those that are "not controlled" (exceeding the one-overflow-per-year requirement).
- For basins that are not controlled, estimate the reduction in annual CSO volume required to meet the limit of an average of one untreated overflow per outfall per year.
- Identify all feasible CSO control measures and estimate the unit cost for each (life cycle cost per gallon of CSO volume reduced).
- Recommend alternative control measures for each basin that is not controlled.

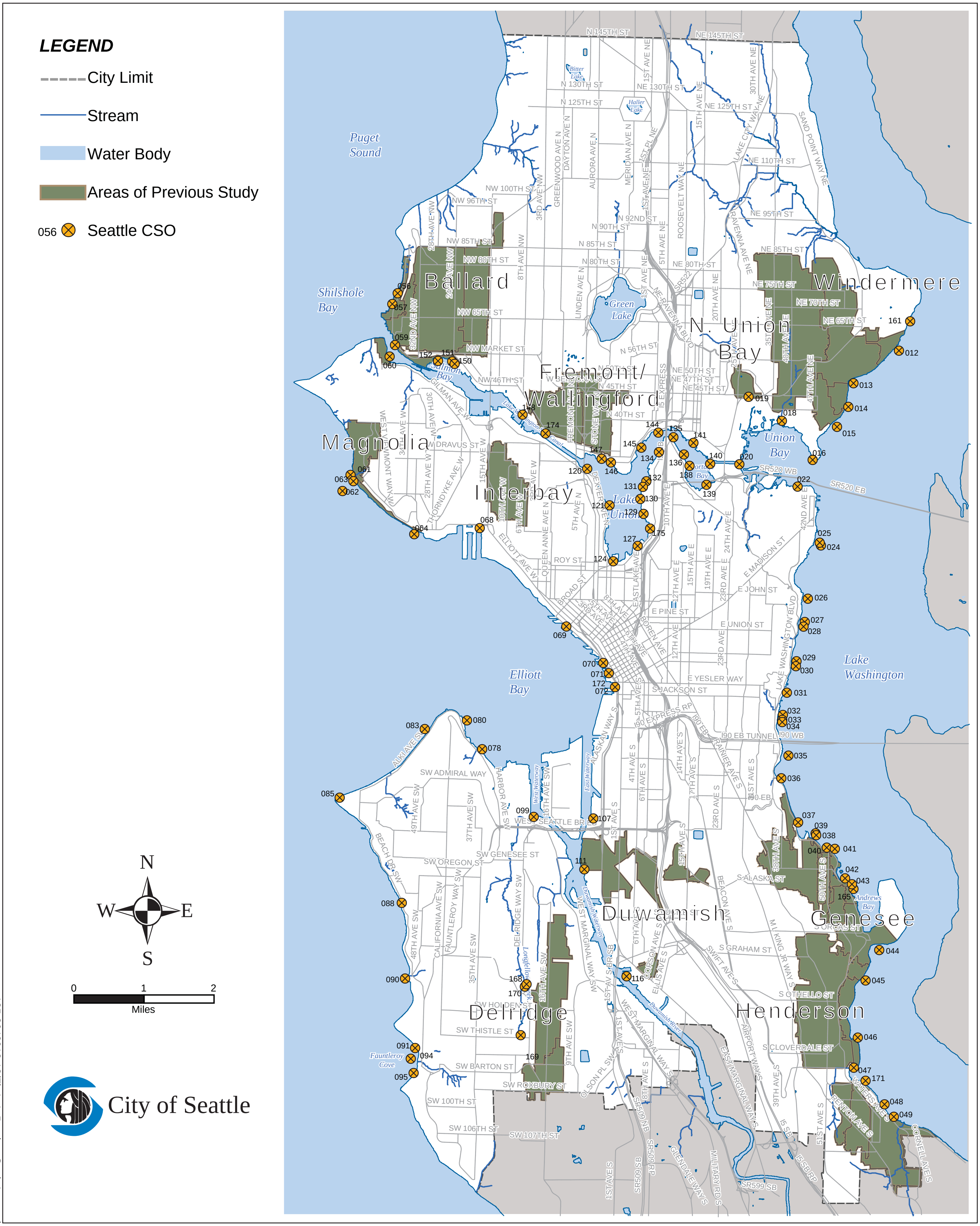

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Figure 1-1
AREAS OF PREVIOUS STUDY FOR CSO REDUCTION

CHAPTER 2.
AGENCY COORDINATION AND PUBLIC INVOLVEMENT

Implementation of the CSO Program will require significant coordination with other agencies and continuous input and feedback from the citizens of Seattle. This chapter provides an overview of the agency coordination and public involvement that SPU conducted to help prepare this 2010 Plan Amendment. This chapter also provides details on the public involvement that SPU will perform in the next five years (2011-2015) as it implements its next set of CSO projects and prepares the 2015 Long-Term Control Plan.

2010 PLAN AMENDMENT AGENCY COORDINATION AND PUBLIC INVOLVEMENT

SPU made an effort to coordinate with other agencies, provide information to the public, and involve the public in the preparation of this 2010 Plan Amendment. The goals of the City's efforts were twofold:

- Inform citizens and agencies about the planning process so they understood its purpose, goals and schedule
- Provide multiple opportunities for public participation and input at key points in the process so this input could be considered during the selection of priorities and preferred approaches.

The approaches used for agency coordination, public information, and public involvement complied with the EPA guidelines for public participation and were consistent with SPU's commitment to involve citizens in significant planning processes.

The Public Information and Public Involvement Plan for the 2010 Plan Amendment are presented in Appendix A.

Coordination with King County

Because Seattle discharges its wastewater to King County for conveyance and treatment, and because both systems can affect one another hydraulically, SPU staff met with King County's CSO Program staff during the development of the 2010 Plan Amendment. The meetings included the following topics:

- Description of SPU's approach for the Amendment
- Progress reports on Amendment development
- Status reports of two rounds of public workshops
- Discussion of basin control status, control volumes and priority locations
- SPU's decision-making process using cost curves to screen alternative strategies

Public Information Materials

SPU used the following approaches to present information on the planning process to the public:

- Fact sheets developed over the course of the project (included in Appendix A):
  - An initial fact sheet providing context and background information about the nature and extent of CSO control issues in Seattle and opportunities for public involvement.

  - A second fact sheet describing the alternatives the City considered.
  - A third fact sheet summarizing the results of the planning process, including the priority projects and approaches that were selected to be in the Plan Amendment.
- A dedicated webpage created at SPU's website to announce workshops, provide access to fact sheets, workshop agendas and technical materials as well as summaries of public input from workshops.
- Over 2000 electronic invitations from SPU to key stakeholders, including community organizations, district councils and community leaders, with consultant follow-up to encourage participation.

Workshops

The planning process featured two rounds of public workshops for stakeholders and interested citizens to provide input on key issues. During the first round of workshops, SPU presented the basin prioritization process. Workshop materials included a technical memorandum on CSO basin ranking and a map of Seattle's CSO locations. During the second round of workshops, SPU presented alternative approaches for controlling CSOs in high-priority basins. Following each round of workshops, a summary of public input was posted on SPU's CSO webpage. The summaries are also included in Appendix A:

Briefings for SPU's Creeks, Drainage and Wastewater Advisory Committee

SPU staff provided information on the 2010 Plan Amendment to the Advisory Committee on two occasions. The first presentation included an overview of the 2010 Plan Amendment development process and information on upcoming public workshops. The second presentation included a briefing on CSO control alternatives and the proposed decision-making process.

FUTURE PUBLIC INVOLVEMENT ON CSO PROGRAM

Over the next five years, SPU will embark on an aggressive program of constructing three large CSO projects in the Windermere, Genesee, and Henderson neighborhoods, implementing green solutions in multiple City neighborhoods, and preparing a Long-Term Control Plan (LTCP) by 2015. SPU will work collaboratively with the citizens of Seattle to ensure that the public is fully informed on the purpose, benefits, and scope of the projects as well their potential impacts. SPU's goal is to partner with Seattle's communities in implementing projects that will provide lasting value and improvements to water quality. This section describes SPU's overall approach to public involvement on CSO projects and the LTCP.

Public Involvement on CSO Projects

Between 2011 and 2015, SPU will begin construction on three major CSO projects in the Windermere, Genesee, and Henderson neighborhoods and construct green solutions in a number of Seattle neighborhoods. SPU is committed to implementing a public involvement process for each of these projects to provide the public with opportunities to participate in the project siting, design and environmental assessment decision process. The specific public engagement elements of each project may vary based on the unique neighborhood characteristics within each neighborhood. Elements of public involvement for the projects may include:

- Consultation with key community groups
- Public meetings on alternatives

- Project-specific environmental review process (includes public comment period and optional public hearings)
- Briefings and presentations to affected groups, businesses, or residents
- Interactive websites

SPU is committed to engaging Seattle citizens in areas affected by the projects to achieve its goal of providing a transparent and accessible public involvement process for CSO control project siting and design in these basins.

Public Involvement on 2015 CSO Reduction Plan Amendment (aka Long-Term Control Plan)

The 2015 CSO Reduction Plan Amendment will identify CSO projects to construct in the remaining CSO basins throughout the City. The Plan Amendment is scheduled for completion in 2015. The Plan Amendment will likely identify both smaller neighborhood specific projects as well as larger joint King County-City of Seattle projects that may span across multiple City neighborhoods. Given the scope of the Plan Amendment and its potential to impact many neighborhoods in the City, SPU is preparing a public involvement process that will enable public engagement on a citywide scale as well as a neighborhood-specific scale. SPU's intent is to adequately inform the public throughout the Plan Amendment development and provide multiple opportunities for Seattle citizens to participate in the planning and decision process for neighborhood and citywide projects. Elements of public involvement for the 2015 CSO Reduction Plan Amendment will include:

- Creation of a City-wide Sounding Board to provide input and feedback on the Plan Amendment
- Neighborhood consultations and meetings
- Programmatic environmental review process (includes public comment periods and public hearings)
- Briefings and presentations to affected groups, businesses, or residents
- Interactive websites
- Special events

SPU is confident that partnering with the citizens of Seattle on the development of the LTCP will result in the selection of projects that achieve the City's CSO reduction goals, minimize impacts, and provide maximum benefits to the City's residents and businesses.

CHAPTER 3.
HISTORICAL CSO REDUCTION EFFORTS

Seattle has been constructing CSO control facilities since 1968, first by partially separating combined sewer areas by re-routing roadway drainage. This was followed by construction in the 1980s of approximately 35 storage facilities with over 8.1 million gallons (MG) of capacity to provide additional storage during storm events. More recently, emphasis has been placed on constructing retrofit projects to enhance system operating efficiency. Figure 3-1 shows the long-term decline in CSO volume in response to both the City and King County CSO reduction programs and projects.

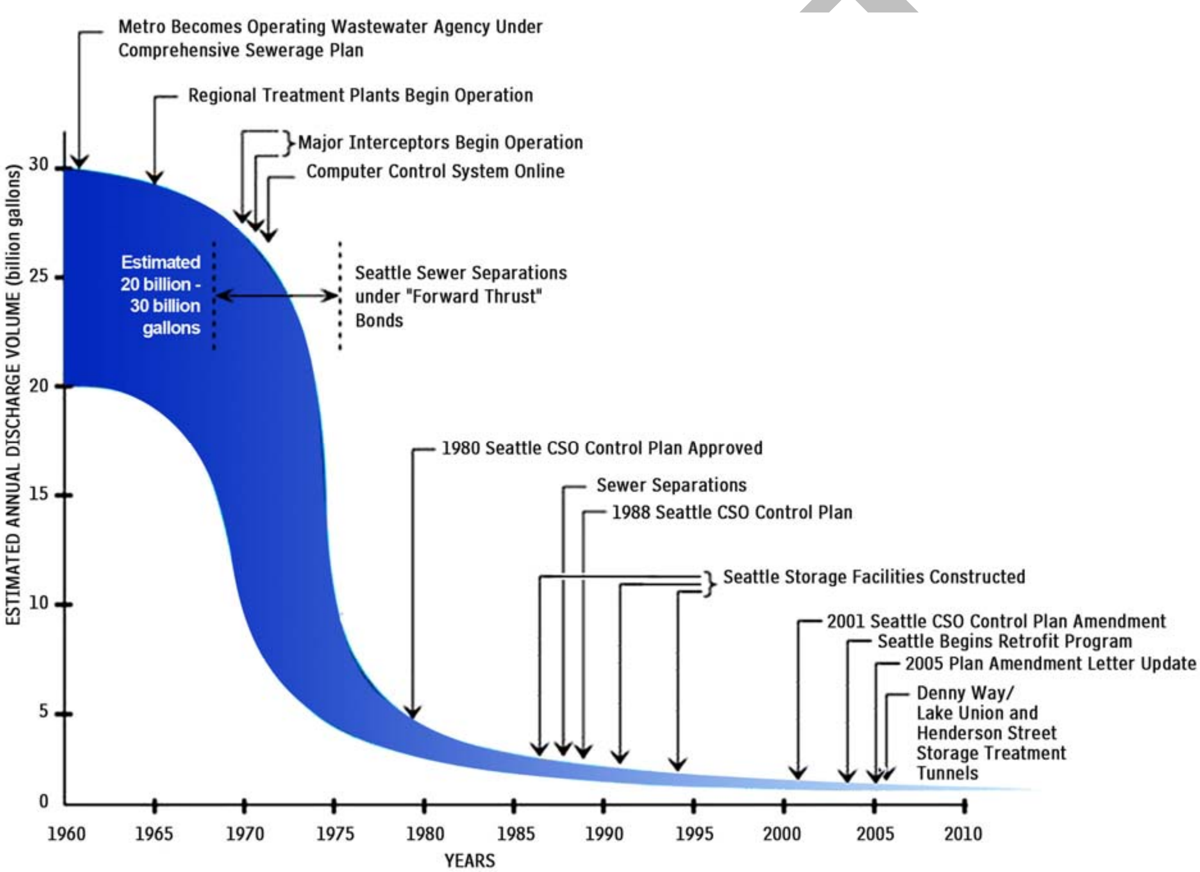


Figure 3-1. History of CSO Reduction in Seattle Combined Sewer System

The City's CSO storage facilities range from 16-inch diameter pipe to 100-foot-diameter, 35-foot-deep concrete storage tanks. Containment capacities range from a few hundred gallons to 1.6 MG. The CSO storage tanks/pipes were, for the most part, designed to store excess runoff from a 1-year, 24-hour design storm (i.e., a storm event that statistically should be exceeded only once per year). The two largest tanks, located along Longfellow Creek in the Delridge neighborhood, were designed for a 10-year, 24-hour storm. Experience and extensive flow monitoring data have shown that most of the constructed facilities have substantially reduced the number and volume of overflows. However, in many cases additional system improvements are required to achieve the design objective (average of one CSO event per year).

COSTS FOR CSO REDUCTION

From 1968 through 1976, costs related to CSO reduction were incurred as partial separation projects were completed under the Forward Thrust program. Both partial separation and storage facilities were constructed during the 1980s. From 1997 through 2005, CSO reduction costs were incurred for the Denny Way/Lake Union project (in conjunction with King County) and retrofits of existing facilities. Table 3-1 summarizes past City expenditures for CSO control and reduction projects for each year since 1968. In total, the City has expended over $524 million (2009 dollars) on CSO control and reduction efforts, including about $385 million (73 percent) for partial separation projects, $134 million (26 percent) for storage projects, and $5 million (1 percent) for retrofits.

EXISTING CSO FACILITIES

Table 3-2 lists the facilities constructed from 1985 through 2004 by basin and by construction contract.

SYSTEM RETROFITS

The City actively pursues system improvements intended to optimize use of the City’s existing infrastructure. Table 3-3 lists retrofit projects implemented since 2000, when SPU began citywide flow monitoring. In 2006, the City developed a formalized, ongoing CSO Retrofit Program as a permanent part of the City’s CSO Program. The Retrofit Program is designed to be an ongoing tool to improve the efficiency of the combined sewer system and assist in reducing the frequency and volume of CSOs. Potential projects are identified that are relatively low-cost and easy to implement. Examples include adjustment of overflow weirs, and improvements to hydraulics at control structures. Projects are identified annually for implementation. Currently the Retrofit Program is funded at $1 million to $2 million annually.

HISTORY OF CSO DISCHARGES

The City has been monitoring overflows at all permitted CSO outfalls since 2000. The data includes overflow event time, frequency, duration and volume. These data, along with rainfall information, are reported to Ecology both monthly and annually. The reports include data for each specific overflow location, as well as summaries for each receiving water body and the City as a whole. The quality of CSO monitoring data has gradually improved over time, as site hydraulic constraints are better understood and more rigorous quality assurance/quality control (QA/QC) procedures have been implemented.

In August 2007, SPU made significant improvements to the permanent CSO monitoring program. Specifically, all flow monitoring equipment and rain gauges were replaced with more advanced instrumentation, and rigorous data quality assurance and quality control procedures were put in practice. As a result, the quality of the overflow data has improved significantly.

Seattle CSO discharges were originally determined from hydrologic/hydraulic modeling estimates published in the 1980 *Final Facilities Plan* and the 1988 *CSO Reduction Plan* prior to construction of the CSO control/reduction facilities. No earlier data exist to demonstrate the effectiveness of the partial separation program of the 1960s (Forward Thrust).

Based on the original estimates and data reported to Ecology, overflow volume has declined from an estimated 400 MG per year in the 1980s to less than 100 MG per year based on 2008-09 data. Similarly, overflow frequency has declined from an estimated 2,800 events per year in the 1980s to approximately 200 events per year, based on 2008-09 data. This frequency reduction of over 90 percent is substantial, but does not achieve the NPDES permit requirement of an average of one event per outfall per year. This 2010 Amendment identifies projects and programs that will help the City achieve the permit requirement.

TABLE 3-1.
HISTORICAL CSO CONTROL PROJECT COST

Year	Annual Project Costs[a] ($)			
	Total	Storage	Separation	Retrofits
1968	21,652,606	0	$21,652,606	0
1969	13,149,678	0	13,149,678	0
1970	78,314,168	0	78,314,168	0
1971	94,992,081	0	94,992,081	0
1972	47,595,385	0	47,595,385	0
1973	39,605,084	0	39,605,084	0
1974	33,059,814	0	33,059,814	0
1975	29,568,023	0	29,568,023	0
1976	7,405,370	0	7,405,370	0
1977	0	0	0	0
1978	0	0	0	0
1979	0	0	0	0
1980	99,334	99,334	0	0
1981	1,436,393	1,436,393	0	0
1982	3,210,610	3,210,610	0	0
1983	6,600,244	6,587,043	13,200	0
1984	3,444,565	3,410,119	34,446	0
1985	6,167,759	5,859,371	308,388	0
1986	7,402,795	2,813,062	4,589,733	0
1987	21,446,429	10,508,750	10,937,679	0
1988	20,623,207	16,911,030	3,712,177	0
1989	7,503,393	7,503,393	0	0
1990	3,343,868	3,343,868	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	6,741,593	6,741,593	0	0
1994	9,376,689	9,376,689	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	16,666,166	16,666,166	0	0
1998	2,963,985	2,963,985	0	0
1999	2,396,641	2,396,641	0	0
2000	3,328,171	3,328,171	0	0
2001	5,243,965	5,243,965	0	0
2002	3,926,878	3,555,265	0	371,613
2003	7,710,528	6,616,026	0	1,094,502
2004	5,475,491	4,640,006	0	835,485
2005	3,472,281	2,430,500	0	1,041,781
2006	2,973,852	2,549,350	0	424,502
2007	2,629,442	1,954,000	0	675,442
2008	4,752,921	4,094,000	0	658,921
Total	**$524,279,409**	**$134,239,330**	**$384,937,833**	**$5,102,246**

a. Based on October 2009 Engineering News Record Construction Cost Index for Seattle (= 8644.84)

TABLE 3-2.
CONSTRUCTED CSO REDUCTION FACILITIES SUMMARY INFORMATION

NPDES No.	Major Facility Elements	Year
Windermere		
13	Flow control structure with weir; offline storage Downstream flow control chamber with Hydrobrake; inline storage	1988
14	Downstream manholes with overflow weirs (2) and Hydrobrake; inline storage	
15	Downstream manholes with overflow weir and Hydrobrake; inline storage Normal flow (through Hydrobrake) and overflow flow to downstream CSO control facility (CSO 19, NPDES 15A) Two control structures to divert flow into detention; offline storage; downstream outflow-overflow chamber with Hydrobrake and weir.	
North Union Bay		
18	Upstream flow control manhole with overflow weir, inline storage, downstream manhole with Hydrobrake Upstream inflow control chamber (with OF weir to storm OF control chamber), storm overflow control chamber (with OF weir to pump station discharge), offline storage, and downstream manhole with Hydrobrake	1989
Montlake		
20	Two overflow weirs associated with lift station. The first weir diverts flow to offline storage. Flows overflowing second weir directed to outfall	1988
140	Hydrobrake with offline storage. Stored flows are pumped back to gravity system.	1994
Union Bay		
23, 24, 25	Two separate outfalls. Flow control structure with overflow weir and inline storage. Overflow weir at inlet to wet well.	1987
Leschi		
29 30 32	Hydrobrake with inline storage Hydrobrake with inline storage Hydrobrake with inline storage	1986
33, 34 35 36	Hydrobrakes (2) with offline storage Hydrobrake with offline storage Hydrobrake with inline storage	1987
North Genesee		
38	Hydrobrake with inline storage	1987
Genesee		
40 42 43	Hydrobrake with inline storage Hydrobrake with inline storage Hydrobrake with inline storage	1986

TABLE 3-2 (continued).
CONSTRUCTED CSO REDUCTION FACILITIES SUMMARY INFORMATION

NPDES No.	Major Facility Elements	Year
Henderson		
44 45	Hydrobrake with offline storage Hydrobrake directs flow to Lift Station No. 10	1985
47, 171	Two orifice/weir manholes regulate flow to lift station. Excess flows diverted to inline storage. Hydrobrake regulates flow from storage. Control facility has two separate outfalls. Hydrobrake with inline storage Weir control structure with inline storage Weir diverts excess flow to storm drain (both basins)	1985
49	Hydrobrake with offline storage	1985
Magnolia		
62, 63	Hydrobrake with inline storage Two inline flow control structures with downstream Hydrobrake. Two overflow outfalls from this CSO control facility	1987
Interbay		
68	Flow control structure with Hydrobrake and weir; offline storage; overflow manhole with weir Flow control structure with Hydrobrake and overflow weir; inline storage	1990
Central Waterfront		
70	Diversion structure with orifice and flap valve. Overflow structure with flexible check valve	1993
West Waterway		
99	Flow control structure with Hydrobrake; overflow structure with 2 weirs; offline storage; low flow diversion from storm drain to lift station	1993
Duwamish		
111	Five overflow structures with weirs; low flow diversion from storm drain to County's Duwamish Pump Station Hydrobrake with inline storage	1994
Lake Union/Portage Bay		
130, 132, 135, 175	Five new connections to reroute flow to King County's Denny Way / Lake Union CSO Control Facility and City's share of Facility cost: • Roy Street and Eighth Avenue North • Republican Street and Eighth Avenue North • Roy Street and Dexter Avenue North • Valley Street and Westlake Avenue North • Valley Street, east of Fairview Avenue North	1997 - 2004
138	Hydrobrake with offline storage	1994

TABLE 3-2 (continued).
CONSTRUCTED CSO REDUCTION FACILITIES SUMMARY INFORMATION

NPDES No.	Major Facility Elements	Year
Delridge		
168	Hydrobrake with offline storage tank	1984
169	Hydrobrake with offline storage tank	1984
170	Overflow weir in manhole; Hydrobrake; offline storage	1983

TABLE 3-3.
RETROFIT PROJECTS PERFORMED FOR CSO CONTROL

NPDES Basin	Project Description	Construction Date
Windermere		
13	Replacement of 2 flap gates /Weir Modifications	2003
14	Weir / Structural Revisions; reline mainline pipe	2003
15	Replace Hydrobrake	2003
	Install new maintenance hole & drop connection	2007
Leschi		
26	Raise overflow weir height	2008
28	Raise overflow weir height	2008
29	Modify existing Hydrobrakes (Basins A, B)	2008
30	Install motor-operated slide gate / replace Hydrobrake	2008
32	Modify existing Hydrobrake (Basins A, B)	2008
34	Raise overflow weir height	2008
35	Install motor-operated slide gate / replace Hydrobrake	2008
North Genesee		
38	Weir modifications / replace Hydrobrake	2005
Genesee		
39	Abandon & plug outfall	2006
40	Modify existing Hydrobrake	2009
	Install sharp-crested weir at raised elevation	2009
41	Raise overflow weir height	2006
42	Modify existing Hydrobrake	2009
	Install sharp-crested weir at raised elevation	2009
	Converted from inline to offline storage	2009
165	Raise overflow weir height	2008

TABLE 3-3 (continued).
RETROFIT PROJECTS PERFORMED FOR CSO CONTROL

NPDES Basin	Project Description	Construction Date
Henderson		
44	Installed access road to control structure	2006
	Modify existing Hydrobrake	2008
45	Modify existing Hydrobrake	2008
47/171	Modify existing Hydrobrakes (Basins A, B)	2009
	Install sharp-crested weir at raised elevation	2009
49	Raise overflow weir height	2008
	Modify existing Hydrobrake	2008
Magnolia		
62, 63	Repair incoming line to Hydrobrake; abandon one outfall	2003
Central Waterfront		
69	Permanently seal lower overflow weir	2004/2005
70	Permanently seal lower overflow weir	2004/2005
71	Permanently seal lower overflow weir	2004/2005
72	Permanently seal lower overflow weir	2004/2005
Duwamish		
111	Rehabilitated Five overflow structures with weirs (Basins A, B, C, D, G)	1994
	Weir / Structural Revisions and flap gate replacement (Basin D)	2004
Lake Union/West		
125	Outfall plugged & eliminated	1997
126	Outfall plugged & eliminated	1997
Lake Union/Portage Bay		
130	Rehabilitated overflow weir in manhole	1997
132	Rehabilitated overflow weir in manhole	1997
135	Rehabilitated overflow weir in manhole	1997
175	Rehabilitated overflow weir in manhole	1997
Ballard		
150	Raise overflow weir height	2008
Delridge		
168	Modify existing Hydrobrake	2008
169	Modify existing Hydrobrake	2008

CHAPTER 4.
DETERMINATION OF CSO BASIN STATUS

Some City CSO locations discharge more frequently or in greater volumes than others do, or into areas with potentially greater impact on public health or the environment. The City places a higher priority on reducing overflows sooner at such CSO locations. The EPA's CSO Control Policy contains the following principle:

> *EPA expects a permittee's long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas. Sensitive areas, as determined by the NPDES authority in coordination with State and Federal agencies, as appropriate, include designated Outstanding National Resource Water, National Marine Sanctuaries, waters with threatened and endangered species and their habitat, waters with primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds.*

In addition, some of the City's CSO basins are already considered "controlled," since they meet the state requirement of discharging less than once per year. In contrast, the remaining CSO basins are considered "uncontrolled," since they currently discharge more than once per year.

This chapter prioritizes the City's CSO basins based on potential impacts on public health and the environment and identifies which CSO basins are considered controlled and which are uncontrolled. For basins deemed uncontrolled, this chapter establishes a "control volume," or volume of CSO that must be addressed (e.g., removed, stored, treated, or transferred) to reduce the frequency of the overflow down to the state requirement of less than once per year on average.

STUDY AREAS

The study area for this Plan Amendment includes all areas tributary to the outfall locations stipulated in the NPDES Permit. The Permit lists 92 outfall locations; however, since 2005 two outfalls have been abandoned or taken out of service.

Environmental Setting

A general description of the Seattle sewer service area can be found in the environmental impact statement prepared in support of the 2001 *CSO Reduction Plan Amendment*. Appendix B presents a State Environmental Policy Act checklist prepared as a companion document to this Plan Amendment.

Seattle covers an area of 83 square miles, 15 miles in the north-south direction and 3 to 7.5 miles in the east-west direction. Water is a dominant feature of the geography of the City, which is bounded by Puget Sound on the west and Lake Washington on the east. Other major bodies of water in the City are Green Lake; the Duwamish River; and the passageway between Puget Sound and Lake Washington, which consists of Salmon Bay, the Lake Washington Ship Canal and locks, Lake Union, Portage Bay, and Union Bay. Water-oriented activities include swimming, diving, boating, fishing, shell fishing, beach walking and picnicking.

Revised NPDES Basin Delineation

To facilitate analysis of the contributing areas upstream of each of the 90 NPDES outfalls, NPDES basins were delineated in a process identifying the core area associated with each outfall. The delineation process was an iterative activity, with revisions as appropriate to reflect the most current sewer network and topographical information in the City's GIS system. Where appropriate, as-built information or site inspections were used to clarify sewer connectivity or routing. The basins are shown in Figure 4-1.

PRIORITIZATION OF BASINS

In accordance with NPDES permit requirements (Section S5.B), a process developed by the EPA was used to prioritize the CSO basins with respect to the need for CSO control. The EPA's 1995 *Combined Sewer Overflows Guidance for Screening and Ranking* uses a set of seven criteria with associated rating points to establish a score for each CSO location. Additional scoring requirements are specified based on the most recent CSO performance history. This guidance was used to:

- Rank individual outfalls needing prompt attention
- Better allocate limited resources
- Prioritize any necessary modification.

The EPA prioritization process was applied to Seattle's CSO basins, as described in Appendix C. The basins were then grouped into categories of priority, as shown in Figure 4-2.

Fourteen Priority A basins are shown with the highest CSO impact in the most sensitive areas (highest EPA points). As shown in Figure 4-2, the highest priority CSO basins are those that discharge into Lake Washington, specifically in the Windermere, Genesee, and Henderson basins. NPDES basins 168 and 169, which discharge into Longfellow Creek, were also in the highest priority category. Finally, NPDES basin 147 in the Wallingford neighborhood, which discharges into Lake Union, received a high priority scoring primarily due its high frequency and volume of overflows.

Twenty-two Priority B basins represent the next highest CSO condition. Many of these sites also discharge into Lake Washington from the Leschi basin. CSO basins discharging into Union Bay, the Duwamish, Salmon Bay, Portage Bay, and the Lake Washington Ship Canal are also included in this second highest priority grouping.

The 31 Priority C basins and 11 Priority D basins were given lower EPA point totals, primarily due to the lower class of receiving water body, and only a small fraction experiencing actual CSO events in 2008 and 2009.

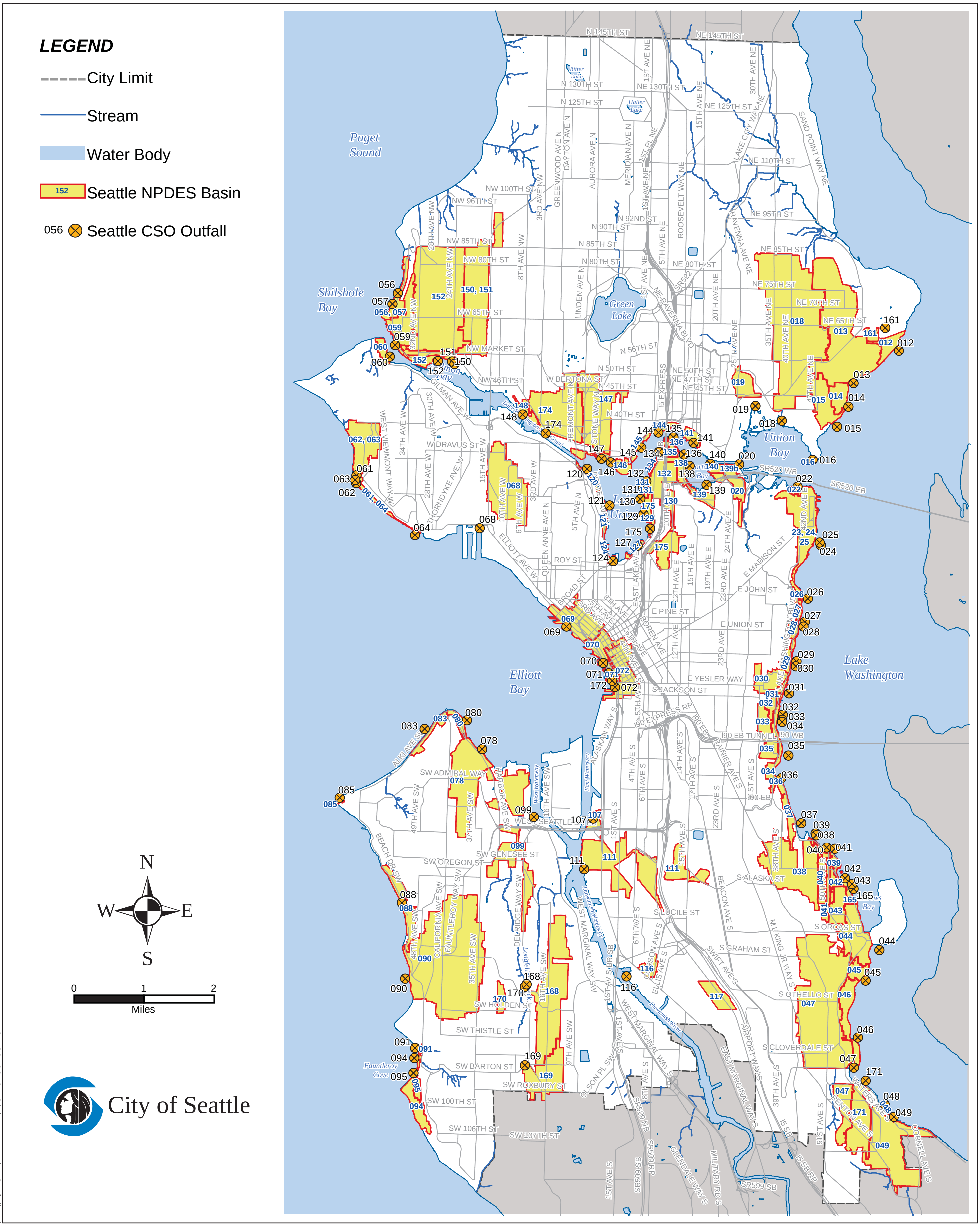
Eleven Priority E basins did not experience CSOs in 2008/2009. This group also has the lowest point values, and can generally be assumed to be within the City's permit requirement.

REVISED CSO BASELINES

A specific requirement of the NPDES Permit (Section S8.B) is a determination of revised CSO Baselines. Baselines are defined in WAC 173-245-020 as *"the annual CSO volume and frequency that is estimated to occur based upon the existing sewer system and the historical rainfall record."* The Baselines were updated in April 2010 and submitted to Ecology in fulfillment of the Permit requirement. Baselines are included in Appendix D.

ESTIMATING CSO CONTROL VOLUME

For each basin deemed to be "Not Controlled," analyses were undertaken to estimate the CSO control volume, which is the volume of overflow that would need to be eliminated for the basin to be regarded as "Controlled." Eliminating this volume, through a variety of CSO reduction techniques, is the goal of CSO reduction strategies detailed in Chapter 5.



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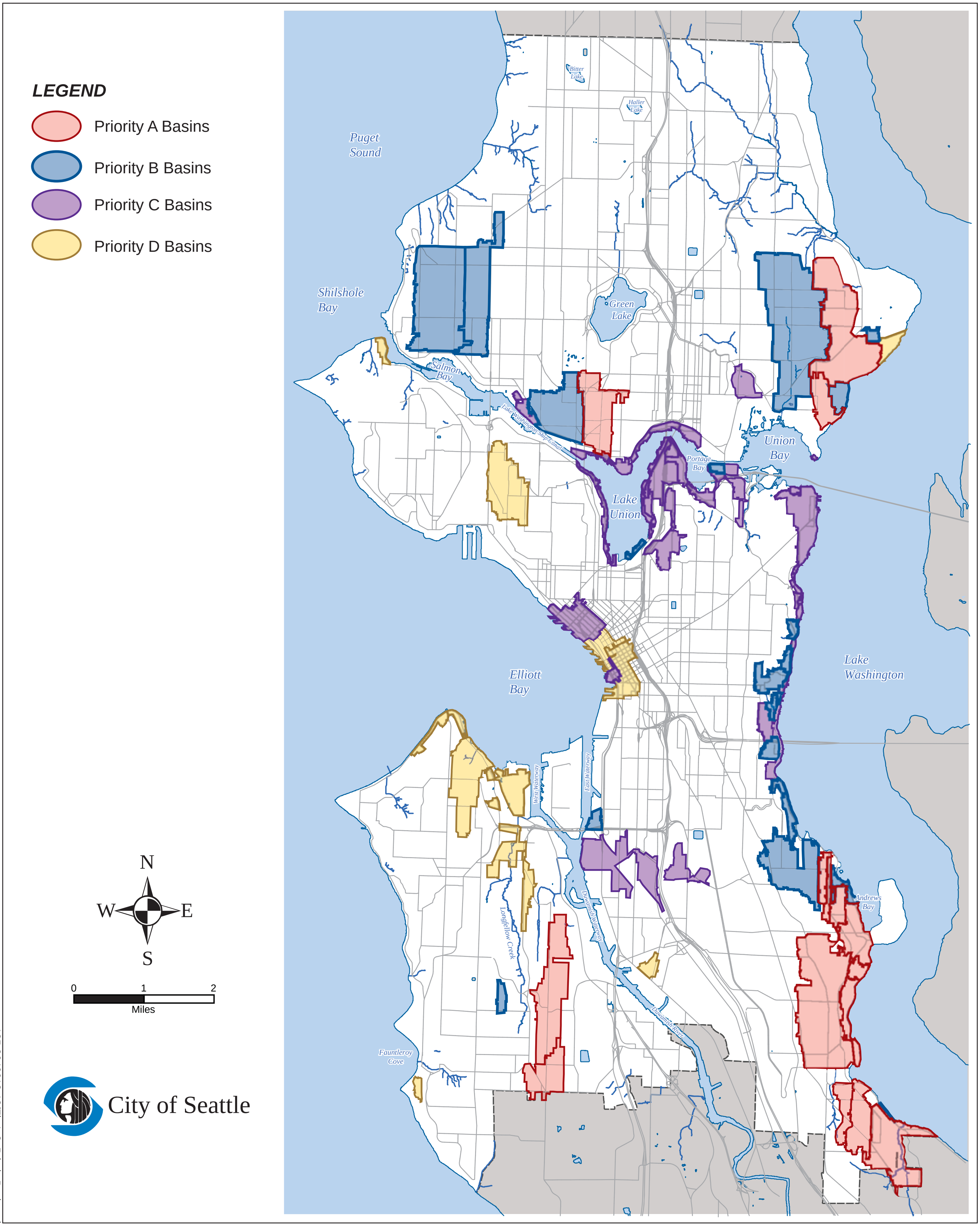
Seattle Public Utilities
2010 CSO REDUCTION PLAN AMENDMENT

Figure 4-1
CITY OF SEATTLE NPDES BASINS AND CSO OUTFALLS



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Seattle Public Utilities
2010 CSO REDUCTION PLAN AMENDMENT

Figure 4-2
PRIORITIZATION OF CSO BASINS

Several approaches of varying complexity were available for estimating CSO control volumes. The approach used for each basin was chosen based on the stage of completion and method of analysis being performed by the various consultants employed by SPU to assess basins in various areas of the City. Some methods were based on direct use of overflow data reported to Ecology, and others were based on computer modeling. Table 4-1 describes the various estimating approaches. Figure 4-3 graphically shows the correlation of each method with its associated level of accuracy.

TABLE 4-1.
SUMMARY OF CSO CONTROL VOLUME ESTIMATING APPROACHES

Annual Overflow Data Approach	
Underlying Principle	Control volume may be estimated from direct monitoring of overflows.
Description	Review the City's permanent CSO monitoring data to establish long-term range of overflow volumes.
Required Information	Accurate, reliable flow monitoring data indicating frequency and volume of overflows for the subject basin.
Use and Accuracy	With the improved quality of flow data obtained in 2008/2009, this approach was used to determine the control volume for the majority of the CSO basins. This approach is considered appropriate for planning purposes.
Long-Term Model Simulation Approach	
Underlying Principle	Computer models can use detailed system information and historical flow records to estimate overflow frequency and volume over long periods and a wide range of conditions. Long-term simulation allows evaluation of overflow performance for a wider range of conditions than available from the permanent metering program. It therefore provides a higher level of confidence that the selected control volume is not a statistical anomaly.
Description	Develop a hydrologic/hydraulic model of one basin or several connected basins using available system information. Conduct flow monitoring to provide data for calibration of the model. Use the calibrated model to simulate a range of historical flow events for validation and further refinement based on comparison of model results to recorded data. Use the final refined model to simulate flows for approximately 30 years of rainfall data recorded by the City's rain gauge network. Identify the 31st largest overflow volume and use it as the basin's CSO control volume.
Required Information	City GIS records provide hydraulic loading data (Census data, roof or pavement area, etc.) and sewer network physical characteristics. Sewer system as-built information enables error correction and confirmation of attributes at key hydraulic structures. Rainfall data have been recorded at 17 locations across the City, with most gauges having a data record back to 1978. Models are calibrated using data from short-term flow metering and rainfall information from a suitable rain gauge. Further refinement is made by validation against historical overflow records. As part of the refinement process, a field survey program is underway to verify physical parameters at a number of key structures.
Use and Accuracy	Long-term model simulations are considered the highest level of accuracy for determining control volumes for CSO basins. Long-term simulations were used to determine the control volumes for the Windermere, Genesee, Henderson, and Central Waterfront CSO basins.

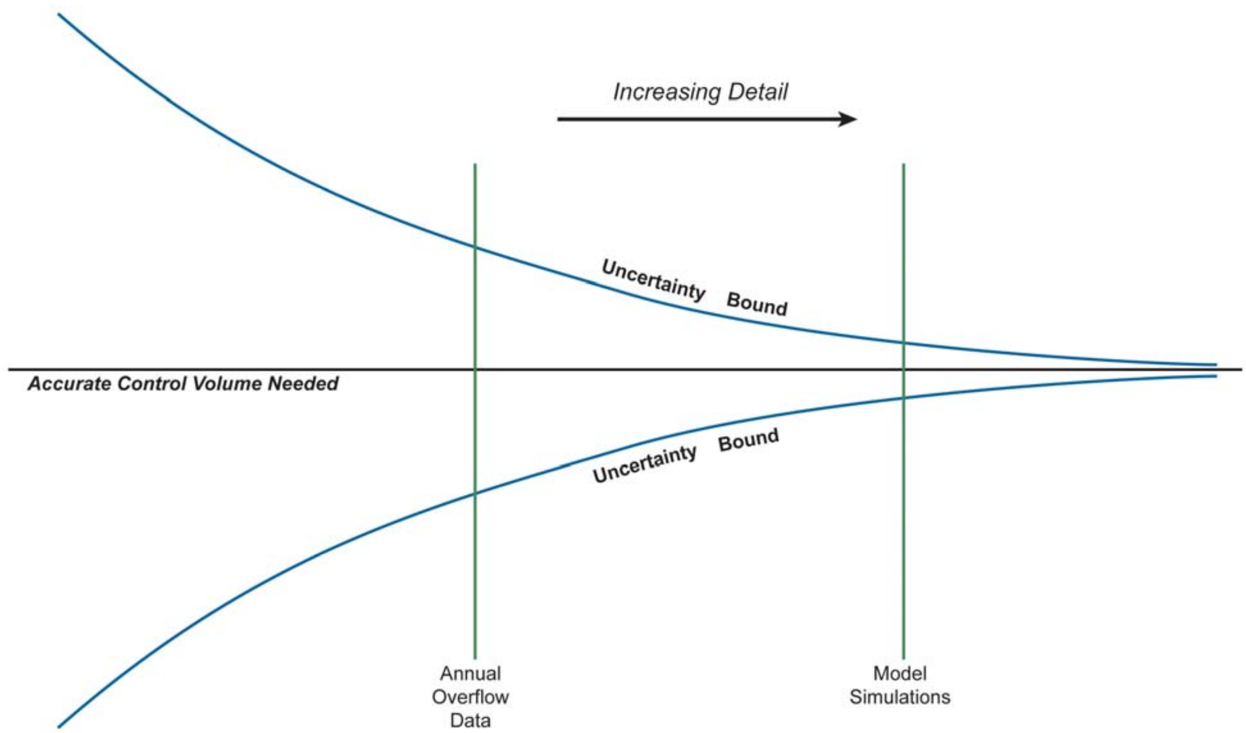


Figure 4-3. Control Volume Estimating Approaches

BASIN CONTROL STATUS AND VOLUME

Table 4-2 identifies the control status and CSO control volume, where appropriate, for all NPDES basins in the City (grouped by CSO area). For most basins, the Annual Overflow Data approach was used to determine control status because calibrated models were not available to perform long-term model simulations. High and low estimates of CSO control volume were developed for these basins to account for uncertainties in the data. The average of the high and low estimates was used as the design basis control volume for these basins.

The design basis control volumes for the Windermere, Genesee, Henderson and Central Waterfront CSO basin were derived through Long-Term Model Simulations. Because of the high level of accuracy of the model simulations, low and high CSO volume estimates are not included. Basins designated as "Controlled" are shaded in the table. Thirty-nine NPDES basins discharging to 38 outfalls were determined to be "Not Controlled."

TABLE 4-2.
ESTIMATED CONTROL VOLUMES

Basin	Control Volume (1000 gallons) Low	Control Volume (1000 gallons) High	Control Volume (1000 gallons) Design Basis[a]	Basin Status Controlled?
Windermere				
12	—	—	—	Yes
13			1,900[b]	No
14	—	—	—	Yes
15	—	—	3 [b]	No
16	—	—	—	Yes
161	—	—	—	Yes
North Union Bay				
18	142	284	213	No
19	—	—	—	Yes
Montlake				
20	58	117	88	No
139	—	—	—	Yes
140	7	15	12	No
Union Bay				
22	—	—	—	Yes
24	—	—	—	Yes
25	468	935	701	No
Leschi				
26	—	—	—	Yes
27	—	—	—	Yes
28	117	234	175	No
29	248	497	372	No
30	53	107	80	No
31	235	469	352	No
32	59	119	89	No
33	—	—	—	Yes
34	21	43	32	No
35	8	15	11	No
36	77	153	115	No

a. Design basis is average of Low and High control volume estimates, unless otherwise noted.
b. Design basis volume determined by long-term model simulation.

TABLE 4-2 (continued).
ESTIMATED CONTROL VOLUMES

Basin	Control Volume (1000 gallons) Low	High	Design Basis[a]	Basin Status Controlled?
North Genesee				
37	—	—	—	Yes
38	—	—	—	Yes
39 (Abandoned)				
Genesee				
40	—	—	177[b]	No
41	—	—	194[b]	No
42	—	—	—	Yes
43	—	—	180[b]	No
165	—	—	—	Yes
Henderson				
44	—	—	2,173[b]	No
45	—	—	174[b]	No
46	—	—	200[b]	No
47	—	—	277[b]	No
48	—	—	—	Yes
49	—	—	156[b]	No
171	—	—	153[b]	No
Ballard				
56	—	—	—	Yes
57	—	—	—	Yes
59	—	—	—	Yes
60 (Salmon Bay)	123	247	185	No
150/151	200	448	324	No
152	1,000	2,000	1,500	No
Magnolia				
61	—	—	—	Yes
62	—	—	—	Yes
63 (Abandoned)				
64	—	—	—	Yes

a. Design basis is average of Low and High control volume estimates, unless otherwise noted.
b. Design basis volume determined by long-term model simulation.

TABLE 4-2 (continued).
ESTIMATED CONTROL VOLUMES

Basin	Control Volume (1000 gallons) Low	High	Design Basis[a]	Basin Status Controlled?
Interbay				
68	59	119	89	No
Fremont/Wallingford				
147	3,409	4,582	3,996	No
148	—	—	—	Yes
174	1,481	2,743	2,112	No
Central Waterfront				
69, 70, 71	—	—	600[b]	No /Combined Project
72	—	—	—	Yes
West Seattle				
78	—	—	—	Yes
80	—	—	—	Yes
83	—	—	—	Yes
85	—	—	—	Yes
88	—	—	—	Yes
90	—	—	—	Yes
91	—	—	—	Yes
94	—	—	—	Yes
95	108	217	163	No
West Waterway				
99	—	—	—	Yes
East Waterway				
107	626	1,251	938	No
Duwamish				
111	1,374	2,749	2,062	No
116	—	—	—	Yes

a. Design basis is average of Low and High control volume estimates, unless otherwise noted.
b. Design basis volume determined by long-term model simulation.

**TABLE 4-2 (continued).
ESTIMATED CONTROL VOLUMES**

Basin	Control Volume (1000 gallons) Low	High	Design Basis[a]	Basin Status Controlled?
Lake Union/West				
120	—	—	—	Yes
121	—	—	—	Yes
124	—	—	—	Yes
127	—	—	—	Yes
Lake Union/Portage Bay				
129	—	—	—	Yes
130	—	—	—	Yes
131	—	—	—	Yes
132	—	—	—	Yes
134	—	—	—	Yes
135	—	—	—	Yes
136	—	—	—	Yes
138	261	522	391	No
175	—	—	—	Yes
Lake Union/North				
141	—	—	—	Yes
144	—	—	—	Yes
145	—	—	—	Yes
146	—	—	—	Yes
Delridge				
168	22	44	33	No
169	190	380	285	No
170	—	—	—	Yes

a. Design basis is average of Low and High control volume estimates, unless otherwise stated
b. Design basis volume determined by long-term model simulation.

CHAPTER 5.
CSO CONTROL ALTERNATIVES

In order to meet the requirement of an average of one untreated discharge per year per CSO location, the City must implement one or more CSO reduction alternatives. This chapter describes potential CSO control/reduction alternatives and presents the process used to evaluate and select appropriate alternatives for each NPDES basin.

REQUIREMENTS AND APPROACH

Nine Minimum Controls

Ecology requires that all ongoing CSO programs include the "nine minimum controls" defined by the EPA. The nine minimum controls ensure that maximum use is being made of existing infrastructure, management emphasis, and regulatory programs prior to major investment in new capital projects. They are intended to enhance combined sewer system performance through focused maintenance and relatively low cost improvements. The nine minimum controls have been integrated into SPU's regular operation and maintenance procedures. They include enhanced or more frequent maintenance and retrofit of flow-control devices such as Hydrobrakes and weirs. They are typically low-cost, easy to implement and less disruptive than other CSO reduction approaches. The nine minimum controls should be considered as common to all alternatives considered.

Department of Ecology CSO Reduction Alternatives

The CSO reduction alternatives presented in this chapter are consistent with the minimum required alternatives set forth as follows in Washington Administrative Code (WAC) Chapter 173-245-040:

- *"(i) Use of best management practices, sewer use ordinances, pretreatment programs, and sewer maintenance programs to reduce pollutants, reduce infiltration, and delay and reduce inflow; and*
- *(ii) In-line and off-line storage with at least primary treatment and disinfection at the secondary sewage treatment facility that is served by the combined sewer; or*
- *(iii) Increased sewer capacity to the secondary sewage treatment facility that shall provide at least primary treatment and disinfection; or*
- *(iv) At-site treatment equal to at least primary treatment, and adequately offshore submerged discharge. At-site treatment may include a disinfection requirement at CSO sites that are near or impact water supply intakes, potentially harvestable shellfish areas, and primary contact recreation areas; or*
- *(v) Storm sewer/sanitary sewer separation."*

In the foregoing items primary treatment is defined as any process that removes at least 50 percent of the total suspended solids from the waste stream, and discharges less than 0.3 ml/l/hr of settleable solids. In addition to the minimum number of alternatives required, this Plan Amendment explored a number of other potential alternatives that are also described in the following sections.

EXISTING PROGRAMS

Retrofit Program

The City initiated the CSO Retrofit Program in 2002 and will continue investing up to $2 million annually in the program through 2015. The goal of the program is to implement affordable measures that will reduce the frequency and/or volume of CSO discharges by optimizing system performance. Key objectives for retrofit projects are to maximize collection system storage and flow to the County's wastewater treatment plants, while minimizing adverse upstream and downstream impacts.

In 2009, a Weir Height Adjustment Plan was developed as a requirement of the City's amended Compliance Order from the US EPA (Item No. 26, December 3, 2009). The Plan will maximize in-line storage by raising overflow weir elevations, where appropriate and feasible, to minimize the number and volume of CSOs in the City's system. Implementation of the Weir Raising Plan is the Retrofit Program's highest priority and will be completed by late 2011.

A second significant effort within the CSO Retrofit Program is completion of approximately 60 retrofit projects, many of which have been identified by the CSO LTCP Monitoring Program. The types of projects that are being considered in this set of retrofits include:

- Outfall consolidation, abandonment, or reclassification
- Improved operations and maintenance practices
- Elimination of excessive infiltration & inflow
- Overflow structure upgrades, such as
  - Removal of Hydrobrake and replacement with a actively controlled sluice gate or other mechanism to maximize flow the system downstream
  - Improve hydraulic controls to better utilize existing storage
  - Eliminate diversion of flow into a combined sewer basin
  - Modifications to facility to improve access for operation and maintenance
  - Weir modification for improved measurement of CSO frequency and volume

These projects will be designed and constructed on a prioritized basis through 2015.

Residential Rainwise

SPU is developing a program called Residential Rainwise to encourage residential customers to take steps to reduce the volume of stormwater that must be managed in public conveyance systems. An extensive program web site (http://www.rainwise.seattle.gov) provides assistance for residents who wish to participate (Figure 5-1). The program will include elements to improve the water quality of the removed stormwater to reduce impacts on the receiving water.

Figure 5-1. Residential Rainwise Website

Residential Rainwise will encourage voluntary, incentive-style, small scale, parcel-based alternatives such as the following:

- Roof drain disconnects—Removing rooftop drainage that is currently conveyed directly to the combined sewer and conveying it to a drainage facility for conveyance, retention, detention or beneficial use.
- Residential rain gardens—Bioretention on private property where the creation of planting areas is used to retain water from roof drains for subsequent release through infiltration or weirs.
- Cisterns/rain barrels—Storage of rainwater in above- or below-grade vessels for alternate uses, principally irrigation of vegetation.

- Permeable Pavement—Replacement of low-traffic areas with pervious structural components that allow rainfall to enter the groundwater rather than run off the pavement.
- Green Roofs – Areas of living vegetation installed on top of buildings to provide flow control via attenuation, soil storage, and losses to interception, evaporation and transpiration.
- Impervious surface removal—Reduction in the impermeable surface area draining to the combined sewer system, where the functional need for pavement is minimal.
- Tree Planting—A long-term return of available areas to its original forest cover providing detention/retention of rainfall in the forest canopy.
- Compost amended soils—A key part of both rain gardens and tree planting, in which impermeable soils are loosened and become storage volumes for detention of precipitation.

The Residential Rainwise Program was initially envisioned to be an education and technical assistance program. The information established through this CSO planning effort suggests the Program should be significantly expanded. Using the incentive-based approach, the first four of the tools described above have been incorporated into the cost analyses for this Plan Amendment. The effectiveness of the other elements is more difficult to quantify, and they have been grouped as emerging alternatives. As additional experience with the other elements is obtained as the program matures, these can be more accurately analyzed and their impacts on major projects determined.

GENERAL CONTROL STRATEGIES AND ALTERNATIVES

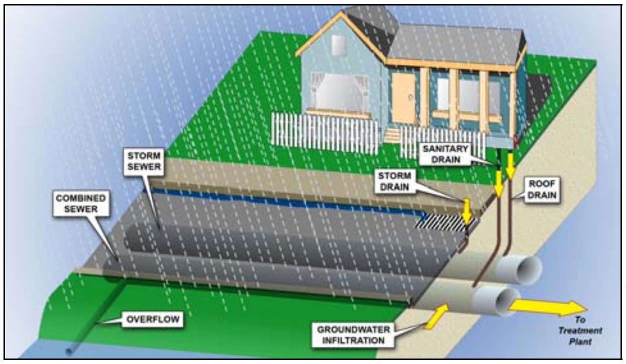
CSO reduction alternatives can be grouped into four general strategies:

- **Source Control**—Source control consists of actions that slow, detain or retain precipitation on public or private property, thus reducing the amount of flow or the timing of the flows into the system. Source control alternatives described as green stormwater infrastructure have applicability in small areas or neighborhoods. These alternatives are voluntary (or incentive-based) actions by property owners to reduce flows from their properties. Green Stormwater Infrastructure (GSI), also called Low-Impact Development or Demand Management, can be effective in the right setting in controlling stormwater pollution and protecting developing watersheds and urbanized communities. Table 5-1 describes source control alternatives evaluated for this Plan Amendment.
- **Conveyance Control**—Divert flows in a different direction where capacity is available or increase the size of conveyance facilities. These controls are generally on public property. Table 5-2 describes conveyance control alternatives evaluated for this Plan Amendment.
- **Storage**—Provide a storage volume at some point in the system to reduce the peak flow that the conveyance system must handle, and release the flow at a later time when conveyance or treatment capacity is available. While many of the source control solutions include some element of storage (cisterns or rain gardens), storage in this context is confined to large, constructed volumes. Table 5-3 describes storage alternatives evaluated for this Plan Amendment.
- **Wet-Weather Treatment**—Construct an intermittent treatment facility (probably mechanical) that can be activated for storms and provide improved water quality in the overflow discharge. Table 5-4 describes wet-weather treatment alternatives evaluated for this Plan Amendment.

TABLE 5-1.
SOURCE CONTROL ALTERNATIVES FOR CSO REDUCTION

<table>
<tr><th>Name and Description</th><th>Benefits</th><th>Constraints</th></tr>
<tr><td>

Green Infrastructure, Roof Drain Disconnects—Eliminate direct connection of roof drainage systems from the combined sewer system by redirecting the drainage to a separate stormwater conveyance system or to permeable soils.



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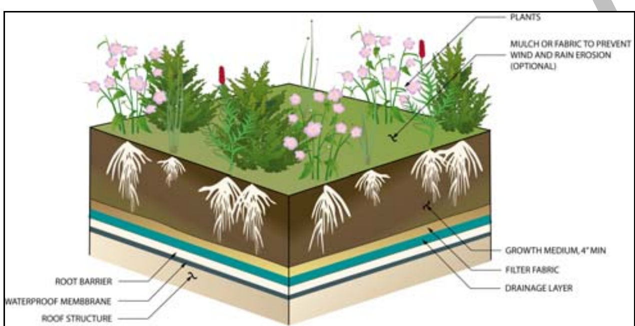
- Reduces peak flow to the combined sewer
- May provide opportunity to eliminate flows through infiltration or in combination with other infiltration alternatives

</td><td>

- Potential increase in untreated flow to receiving water
- Applicable to partially separated areas only
- Large number of properties required to have a significant impact on CSOs
- Discharge to unsuitable soils or steep slopes can cause flooding, slope instability and other problems.
- Limited applicability to commercial parcels.

</td></tr>
<tr><td>

Green Infrastructure, Commercial/Institutional Green Roof Retrofit— Retrofit existing rooftops by adding an impermeable liner and a layer of soil and vegetation to filter, absorb, and retain or detain precipitation and attenuate flows to the combined sewer.



</td><td>

- Attenuates and reduces flow to combined sewer
- Removes pollutants
- Improves air quality
- Reduces heat island effect
- Reduces energy use
- Extends roof life

</td><td>

- Structural limitations related to building materials and roof slopes.
- Increased structural costs
- Increased roof repair costs

</td></tr>
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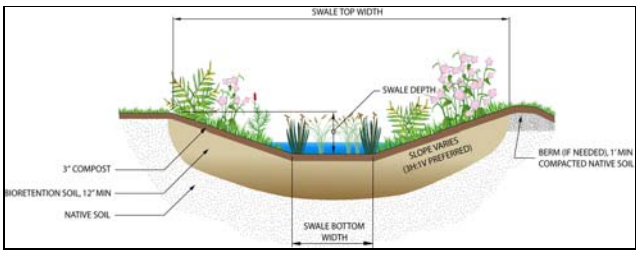
Green Infrastructure, Right-of-Way Bioretention Swale – Construct a large, interconnected vegetated swale and shallow ditch in the public right-of-way to hold some stormwater in an amended soil section below ground and some as standing water above ground. This alternative includes full right-of-way reconfiguration and is only applicable on streets without curb, gutter, and sidewalk.



</td><td>

- Attenuates peak flows to combined sewer
- Removes pollutants
- Can reduce runoff
- Reduces heat island effect
- Sequesters carbon
- Provides green space
- Improves street and sidewalk
- Improves drainage conveyance

</td><td>

- Site specific limitations
- Cost to maintain swale plants to avoid safety concern or eyesore

</td></tr>
</table>

TABLE 5-1 (continued).
SOURCE CONTROL ALTERNATIVES FOR CSO REDUCTION

Name and Description	Benefits	Constraints
Green Infrastructure, Roadside Rain Garden— Similar to bioretention swale, but smaller in scale (typically 100 to 300 square feet). Provides retention/infiltration rather than conveyance. Can be used at curb bulbs, planting strip areas, or central rotary (roundabout) locations. 	• Attenuates peak flows to the combined sewer • Removes pollutants • Can reduce total runoff if combined with infiltration • Reduces heat island effect • Sequesters carbon • Provides green space	• Site specific limitations • Cost to maintain swale plants to avoid safety concern or eyesore • Not suitable for use on steep slopes or in landslide-prone critical areas.
Green Infrastructure, Residential Rain Garden—Equivalent to the right-of-way rain garden, but voluntarily constructed by homeowners. Residential rain gardens handle residential roof drainage in areas where roof drain disconnects are not feasible due to the absence of a stormwater drainage system.	• Reduces peak flows to combined system • Removes pollutants • Improves air quality • Reduces heat island effect • Sequesters carbon	• Site specific limitations • Potential for lack of maintenance • Possible leakage through foundation
Green Infrastructure, Residential Cistern—Cisterns are tanks used to capture stormwater from rooftops and other non-pollution generating impervious surfaces for use in landscape irrigation.	• Attenuates peak flows into the combined system • Potential reduced demand on potable water systems	• Requires active homeowner operation and maintenance (screen cleaning, outlet valve setting) • Cisterns should be fitted with an overflow device that discharges to an appropriate location and does not negatively impact the property. • Due to the low cost of water in Seattle, the benefits to water supply are modest in comparison to benefits to CSO control.

**TABLE 5-1 (continued).
SOURCE CONTROL ALTERNATIVES FOR CSO REDUCTION**

Name and Description	Benefits	Constraints
Green Infrastructure, Alley Permeable Paving Retrofit—A number of pervious wearing surfaces are commercially available. These materials enhance on-site infiltration of stormwater in larger paved areas where the underlying native soils have a high permeability rate and are not on steep slopes or landslide-prone critical areas.	• Attenuates peak flows into the combined sewer system • Removes pollutants • Recharges local groundwater • Reduces heat island effects • Promotes street tree survival (irrigation and ventilation of roots)	• Site specific limitations
Sewer Separation—Remove stormwater running off streets and parking lots from the combined sewer system and route it to a separate stormwater conveyance system.	• Separates sanitary sewage from combined sewage for treatment • Provides high degree of pollutant removal • Low operation and maintenance requirements • Provides uniform flow to treatment plant • Can be coupled with road improvements • Uses existing system • More control of systems within the right-of-way • With complete separation: there are fewer outfalls to manage and monitor (NPDES permit no longer needed; no post construction monitoring, nor frequency, duration or volume reporting required).	• Disruptive construction in urban areas • High initial capital costs • Does not eliminate contamination associated with urban stormwater runoff • Separate stormwater discharges to surface waters may require separate treatment • Not cost-effective if condition of existing combined sewer system is deteriorated • Scheduling/ implementation may be complex

**TABLE 5-2.
CONVEYANCE CONTROL ALTERNATIVES FOR CSO REDUCTION**

Name and Description	Benefits	Constraints
Infiltration-Inflow (I/I) Reduction—Replace or line defective pipes, pipe joints and manholes of the combined sewer system to remove system defects that allow excessive amounts of I/I to enter the system. Usually, significant lengths of sewers and house laterals are involved for effective rehabilitation.	• Keeps stormwater out of system • May reduce construction impacts if trenchless methods applicable • No operation and maintenance costs	• City owns sewer mains only • May require work on private property to rehabilitate laterals • Requires studies to assess infiltration points • I/I reduction may cause problems in another location
Increased Conveyance Capacity—Methods for increasing sewer capacity include conveyance system controls that can affect CSO flows after runoff has entered the system. Excess system flows from a basin with limited flow capacity can be transferred via a new line connecting with the downstream King County conveyance system having available capacity. The potential impact on downstream system elements must be considered, since it could require new or larger King County facilities.	• Economy of scale for any subsequent downstream control facility • Consolidation can lessen exceedance risk • Keeps flow in system to ensure treatment of all flows • Relatively quick, conventional construction	• Downstream capacity (conveyance & treatment) • Provide larger, local capacity • Coordination with other agencies • Doesn't manage flooding risk as well
Inter-Basin Transfer—Transfer excess system flows from an NPDES basin with limited flow capacity to another basin with available capacity. Transfer may be achieved by removing flow restriction devices, increasing pipe sizes or installing parallel lines. It is assumed that inter-basin flow transfer will only be considered if flows are routed by gravity to an adjacent NPDES basin. This type of project may also result in consolidation of individual outfalls.	• Positive control • Known technology • Conventional maintenance • Minimum public resistance/disruption • More flexibility • Can lessen exceedance risk	• Need receiving point that considers downstream impact • Need to share in remote impacts • Shift water quality impacts • Control logistics • Regulatory resistance • Need to integrate with real-time control
Real-Time Control— Real-time control (RTC) is a system that dynamically adjusts the operation of combined sewer facilities (gates, weirs) in response to measurements (flows and levels) in the field to reduce or eliminate combined sewer overflows. For example, a PLC may be programmed to maintain the level set-point in a diversion structure. When the measured level exceeds the set-point level, a signal will be sent to the RTC to open an adjustable slide gate to bypass flows until the level reaches the set-point level once again. RTC is only viable if the existing combined sewer system has available upstream capacity.	• Low cost potential • Meets Nine Minimum Controls (maximize flow to treatment plant and maximize storage) • Flexibility (better with larger area) • Reduces operation and maintenance costs (pump station, treatment plant) • More efficient treatment by treatment plant • Minimizes flooding	• Any available system capacity • Control ability (SCADA) • Extensive coordination with King County • Power requirement • Need a good system model and SCADA

TABLE 5-3.
STORAGE ALTERNATIVES FOR CSO REDUCTION

Name and Description	Benefits	Constraints
Street Storage—Street storage uses streets as large paved open channels or reservoirs to store stormwater, with control structures (inlets, catchbasins and flow regulators) providing a slow release of stormwater into the downstream combined sewer system. The goal is to make use of the street and inlet system as an alternative to installing expensive underground facilities. Street storage is established by installing berms 7 to 9 inches high at the curb line that detain water on the street surface. Flow regulators restrict the flow and regulate the flow of stormwater into the combined sewer system.	• Minimal disruption during construction (noise, dust) • No mechanical equipment required • Construction limited to the public right-of-way • Minimal aesthetic impact • Optimizes existing asset	• Applicable only on flat streets • Increased flood potential due to plugging of catchbasins/inlet • Ongoing maintenance essential to prevent plugging • Improperly designed berms can interfere with vehicular traffic • Possible icing during freezing temperatures • Solids deposition or accumulation in catchbasins. • Modifications of curb and gutter • Community perception of "flooding" • Requires Memorandum of Agreement between SPU and Seattle Department of Transportation with drainage policy modifications
In-Line Storage—In-line storage uses flow regulators, in-line tanks and relief sewers to provide storage capacity in the main line of a combined sewer. Flows in excess of downstream system capacity are stored until capacity becomes available. Storage locations must be strategically placed to have the desired effect. This is usually near the downstream end of a basin.	• Provides maximum utilization of existing capacity in system • Development of in-line storage piping can be coupled with other sewer rehabilitation projects • Known technology • Less King County coordination • Can be less problematic to expand compared to conveyance	• Sediment build-up in oversized tanks and pipes during dry weather flows. • Increased potential for basement backups and street flooding • Large footprint may require easements • Maintenance and potential odors from debris buildup
Off-Line Storage—Off-line storage facilities are tanks, pipes or tunnels located off-line from the combined sewer system that fill only when a specific flow elevation is exceeded and empty when sufficient conveyance becomes available downstream. Storage location is preferably near the downstream end of a basin. For large storage volumes, two smaller storage tanks or twin parallel storage conduits can be used to minimize impact outside of the right-of-way. After an event, the flows from the off-line storage system are sent to the downstream conveyance system.	• Provides large storage volumes that can be treated in downstream facilities • Below-ground storage facility results in less visual impact • Allows for removal of settleable solids and floatables • Disruption due to construction is confined to a smaller area in comparison to sewer separation • Existing sanitary connections and storm lateral connections are not disturbed.	• Land area requirement results in limited siting alternatives within urban areas • Larger consolidation pipelines to convey large volumes to and from the storage facility require deeper and wider excavation areas • Geotechnical considerations, including avoiding steep slopes, unstable areas and dewatering during construction • Odor control requirements • Maintenance of mechanical equipment • Property acquisition and permitting / cost and time requirements

TABLE 5-4.
WET-WEATHER TREATMENT OF CSOs

Description	Benefits	Constraints
The volume of untreated CSOs can be reduced by providing treatment for CSO flows prior to discharge. Conveyance is required to divert overflows to the treatment site. Treatment reduces the CSO pollutant load on the receiving water body and helps protect human health. Treatment facilities would most likely be sited at the shoreline near the overflow location. This alternative assumes extensive ongoing sampling and analysis to demonstrate adequate pollutant removal for regulatory compliance.	• Consolidates operation and maintenance at a single site • Properly designed plant can be sized to handle a wide range of flow rates from different size storm events • Can handle back-to-back storm events	• Site selection difficult in urban areas • A new department within SPU for treatment administration, operation, testing and reporting functions would likely need to be created and staffed • City will need to operate treatment plant (certified treatment plant operators required) • Public opposition (odor, noise, traffic, aesthetics) • Must meet water quality requirements • Permitting process including environmental review • High operation and maintenance costs associated with lab work for monitoring water quality and operating plant • Extensive regulatory reporting • Harder to operate infrequently used treatment system • Regional and public resistance to Lake Washington discharges • Locally potentially higher pollutant loading compared to King County treatment plant

SELECTION OF ALTERNATIVES

This section describes the CSO reduction alternative evaluation and selection process that was used for the development of the 2010 Plan Amendment. The process is a broad approach for identifying alternatives that have significant merit for analysis in future project phases or the Long-Term Control Plan (LTCP), which will be developed by 2015. Additional evaluation in the future development of each project or in the LTCP will likely affect the recommendations in various ways:

- Control volumes may change when detailed modeling is performed and boundary conditions with King County are determined, and that could affect the recommended solutions and estimated costs.
- Future detailed investigation of individual basins may indicate new alternatives that need to be investigated.
- Collaborative projects with King County may be identified.
- Community involvement and environmental review process may influence selection of preferred alternatives.
- The implementation process will involve a thorough benefit/cost analysis that includes an awareness of locations of sensitive areas and appropriate prioritization for project implementation.
- Implementation needs to be an iterative process as information is further developed and non-cost factors are integrated into the recommended alternatives.

Cost Estimating Approach

Costs for each alternative were estimated using data from SPU, Tetra Tech and other sources. Project cost estimates include construction costs and other project costs such as planning, design, and construction management, all escalated to the October 2009 Seattle ENR CCI index of 8644.84. Operation and maintenance (O&M) costs were also estimated using data from SPU and Tetra Tech. Construction and annual O&M costs were then combined to determine a life-cycle cost.

Using design criteria established for this Amendment, each alternative was evaluated to estimate the CSO volume removed. This information was then used to determine a parameter of "life-cycle cost per gallon removed." This parameter allowed the effectiveness of the wide variety of alternatives to be compared on an equivalent basis. Figure 5-2 shows the values of this parameter for each alternative over a range of CSO removal volumes. Some alternatives discussed in this chapter are omitted from the life cycle unit cost chart for the following reasons:

- Life cycle costs for green roofs, inter-basin transfer and sewer separation are not included because they were found to be cost-prohibitive compared to the rest of the CSO reduction alternatives and therefore are not considered in the selection of alternatives.
- Real-time control is a basin-specific alternative that requires detailed analysis (monitoring and modeling); therefore it was not considered in the alternative selection evaluation.

Alternative Evaluation Process

The following steps were used to select preferred CSO reduction alternatives for each NPDES basin:

- **Step 1—**Determine the basin's control status:
  - Controlled (≤ 1.0 CSO/year)—No further action necessary.
  - Uncontrolled (> 1.0 CSO/year)—Follow remaining steps of decision matrix.
- **Step 2—**Using the composite 100-year life cycle cost curves (Figure 5-2) and the required control volume, identify the alternative with the least cost.
- **Step 3—**Perform a feasibility screen to determine probable feasibility of the alternative within each uncontrolled basin. If not feasible, follow Step 4. If feasible, follow Step 5.
- **Step 4—**Identify the next alternative with the least cost, and repeat Step 3.
- **Step 5—**Perform a basin-level analysis to determine the volume controlled by the alternative.
- **Step 6—**If the volume controlled by the alternative is equal to or greater than the control volume, follow Step 8. If not, follow Step 7.
- **Step 7—**Subtract the volume controlled by the alternative from the control volume and repeat Steps 2 through 6 with the next lowest cost alternative.
- **Step 8—**Validate with a site inspection.

Step 1—Basin Control Status

The initial step in the decision matrix—identifying the control status of each basin—is described in Chapter 4, and the results are summarized in Table 4-2. Based on that evaluation, 43 NPDES basins encompassing 41 outfalls require CSO reduction measures to achieve control. Control volumes used in the evaluation are also summarized in Table 4-2.

Step 2—Cost Determination

Figure 5-2 presents unit life-cycle costs for CSO reduction/control alternatives based on costs developed for this Amendment. This graph was used to identify least-cost alternatives for each NPDES basin.

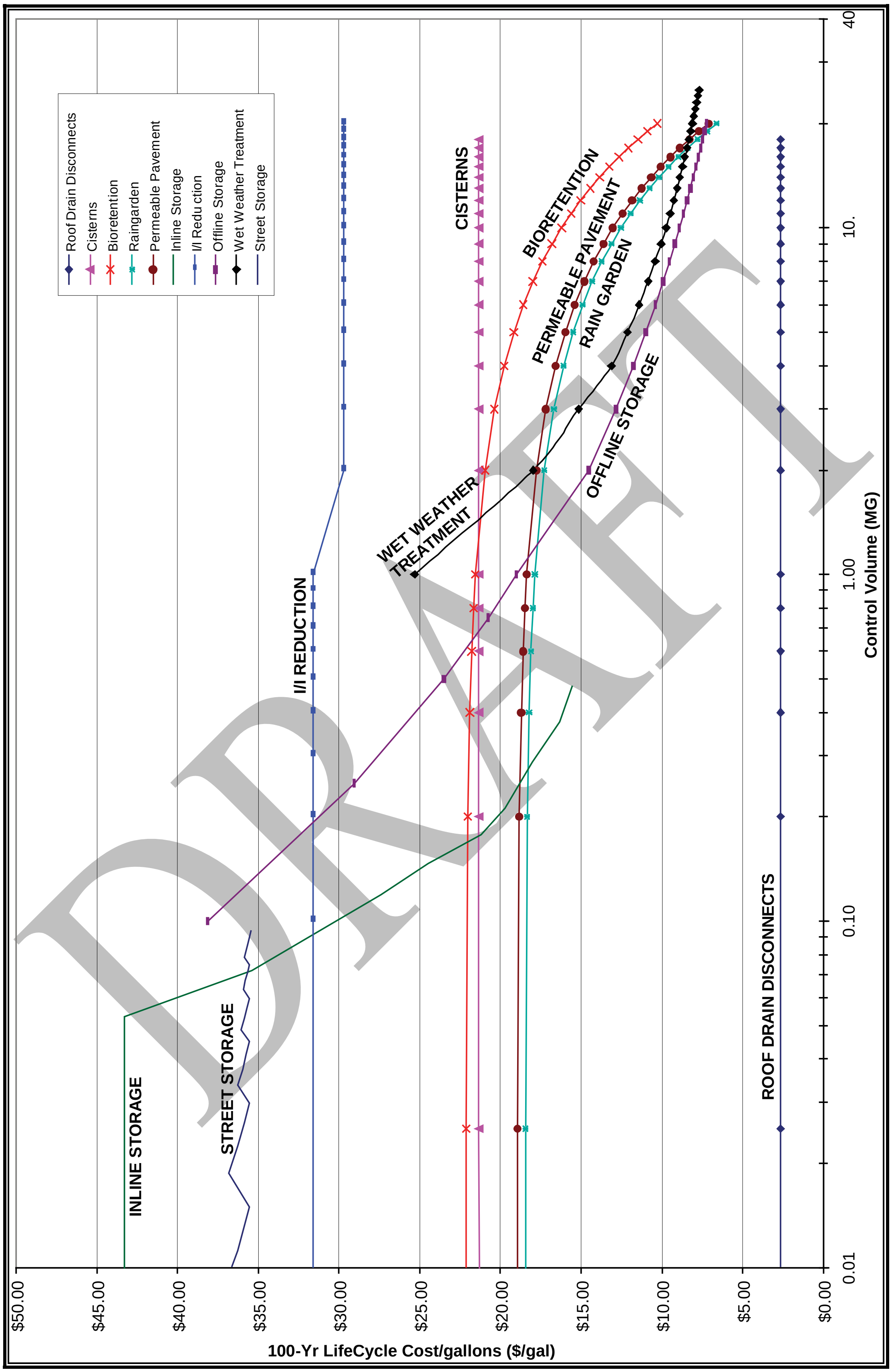


Figure 5-2. 100-Year Life-Cycle Costs for CSO Control Alternatives

Steps 3 and 5—Feasibility Screening and Basin-Level Analysis

Once an alternative was determined based on the cost curve in Step 2, a feasibility screen was performed on the alternative (Step 3). The feasibility screen used GIS analysis to determine whether an alternative is feasible for a specific basin. Once the feasible alternative(s) were identified, a basin-level analysis was performed (Step 5). Again, a GIS analysis was conducted for each feasible alternative within the basin to determine the maximum volume controlled by that alternative.

Steps 4 and 7 – Iterative Process

If the first (lowest life-cycle cost) alternative from Step 3 does not yield the required control volume, the process is repeated for the next-lowest-cost alternative. This iterative process is repeated until the desired control volume is achieved.

Step 8 – Field Validation

Once the suite of alternatives for control is determined, a site investigation is conducted to validate results of the analysis.

RECOMMENDED ALTERNATIVES

Recommended CSO reduction/control alternatives are presented for each basin in Table 5-5. The alternatives indicate the estimated volume of CSO reduced/controlled, the estimated project cost, and the projected year of substantial completion. Substantial completion indicates the facility is in operation, but contract closeout procedures would be continuing. Because of the planning-level nature of this Amendment, a cost range of +100% to –50% is also presented for most basins to conform with Level 5 estimating criteria established by the Association for the Advancement of Cost Engineering (AACE). For Windermere Basin 13 AACE Level 4 (+50% to –30%) criteria were used since the work is already in the preliminary engineering phase.

TABLE 5-5.
PRELIMINARY RECOMMENDED CSO CONTROL PROJECTS

Design Control Volume (gallons)	Recommended Alternatives[a]	Control Volume[b] (gallons)	Estimated Project Cost	Project Cost Range (AACE Level 5) Low	Project Cost Range (AACE Level 5) High
Project Name: Windermere					
NPDES Basin 13; Substantial Completion - 2014					
1,900,000	Offline Storage	1,900,000	$42,700,000	$37,700,000[c]	$51,000,000[c]
	Total	***1,900,000***	***$42,700,000***	***$37,700,000***[c]	***$51,000,000***[c]
NPDES Basin 15; Substantial Completion – 2010					
3,000	Retrofit	3,000	$4,000	$3,000	$5,000
	Total	***3,000***	***$4,000***	***$3,000***	***$5,000***
Project Name: Genesee					
NPDES Basin 40; Substantial Completion – 2015					
177,000	Roof Drain Disconnects	24,000	$63,000	$31,000	$126,000
	I/I Reduction	31,000	$553,000	$276,000	$1,106,000
	Off-line Storage	122,000	$3,718,000	$1,860,000	$7,436,000
	Total	***177,000***	***$4,334,000***	***$2,167,000***	***$8,668,000***
NPDES Basin 41; Substantial Completion – 2015					
194,000	Roof Drain Disconnects	19,000	$50,000	$25,000	$100,000
	Off-line Storage	175,000	$5,001,000	$2,500,000	$10,002,000
	Total	***194,000***	***$5,051,000***	***$2,525,000***	***$10,102,000***
NPDES Basin 43; Substantial Completion – 2015					
180,000	Roof Drain Disconnects	36,000	$95,000	$47,400	$190,000
	Off-line Storage	144,000	$4,271,000	$2,140,000	$8,542,000
	Total	***180,000***	***$4,366,000***	***$2,187,000***	***$8,732,000***
Project Name: Henderson					
NPDES Basin 44; Substantial Completion – 2018					
2,173,000	Roof Drain Disconnects	84,000	$225,000	$112,000	$449,000
	Off-line Storage	2,089,000	$32,540,000	$16,270,000	$65,080,000
	Total	***2,173,000***	***$32,765,000***	***$16,382,000***	***$65,529,000***
NPDES Basin 45; Substantial Completion – 2018					
174,000	Roof Drain Disconnects	20,000	$52,000	$26,000	$105,000
	Roadside Rain Gardens	3,000	$43,000	$21,000	$85,000
	In-line Storage	151,000	$1,871,000	$936,000	$3,744,000
	Total	***174,000***	***$1,966,000***	***$983,000***	***$3,934,000***
NPDES Basin 46; Substantial Completion – 2018					
200,000	Roof Drain Disconnects	38,000	$100,000	$50,000	$200,000
	Off-line Storage	162,000	$4,710,000	$2,350,000	$9,410,000
	Total	***200,000***	***$4,810,000***	***$2,400,000***	***$9,610,000***
NPDES Basin 47; Substantial Completion – 2018					
277,000	Roof Drain Disconnects	111,000	$295,000	$147,000	$590,000
	Off-line Storage	166,000	$4,794,000	$2,397,000	$9,588,000
	Total	***277,000***	***$5,089,000***	***$2,544,000***	***$10,178,000***

a. Recommendations may change based on future analysis of projects or the 2015 Long-Term Control Plan. Final recommendations and schedule will be specified in an Engineering Report/Facility Plan submitted to Ecology.
b. Control volume is the overflow volume reduction necessary to achieve permit compliance
c. Level 4 cost criteria per AACE (preliminary design)

TABLE 5-5 (continued).
PRELIMINARY RECOMMENDED CSO CONTROL PROJECTS

Design Control Volume (gallons)	Recommended Alternatives[a]	Control Volume[b] (gallons)	Estimated Project Cost	Project Cost Range (AACE Level 5) Low	High
Project Name: Henderson (continued)					
NPDES Basin 49; Substantial Completion – 2018					
156,000	Roof Drain Disconnects	23,000	$62,000	$31,000	$125,000
	Roadside Rain Gardens	23,000	$295,000	$147,000	$589,000
	I/I Reduction	16,000	$275,000	$138,000	$550,000
	Off-line Storage	94,000	$2,981,000	$1,490,000	$5,962,000
	Total	***156,000***	***$3,613,000***	***$1,806,000***	***$7,226,000***
NPDES Basin 171; Substantial Completion – 2018					
153,000	Roof Drain Disconnects	23,000	$61,000	$31,000	$122,000
	Roadside Rain Gardens	23,000	$289,000	$145,000	$578,000
	I/I Reduction	15,000	$270,000	$135,000	$540,000
	Off-line Storage	92,000	$2,748,000	$1,374,000	$5,496,000
	Total	***153,000***	***$3,368,000***	***$1,685,000***	***$6,736,000***
Project Name: Ballard					
NPDES Basin 150/151; Substantial Completion - GSI by 2015; In-Line Storage by 2018 – 2025					
324,000	Roadside Rain Gardens	84,000	$1,060,000	$530,000	$2,120,000
	In-line Storage	240,000	$4,560,000	$2,280,000	$9,120,000
	Total	***324,000***	***$5,620,000***	***$2,810,000***	***$11,240,000***
NPDES Basin 152; Substantial Completion - GSI by 2015; Off-Line Storage by 2018 – 2025					
1,500,000	Roadside Rain Gardens	245,000	$3,080,000	$1,540,000	$6,160,000
	Residential Rain Gardens	47,000	$586,000	$293,000	$1,172,000
	Permeable Pavements	135,000	$1,991,000	$996,000	$3,982,000
	Cisterns	249,000	$2,020,000	$1,010,000	$4,040,000
	I/I Reduction	143,000	$2,529,000	$1,264,000	$5,058,000
	Off-line Storage	682,000	$13,650,000	$6,825,000	$27,300,000
	Total	***1,500,000***	***$23,856,000***	***$11,928,000***	***$47,712,000***
NPDES Basin 60; Substantial Completion - GSI by 2015; In-Line Storage by 2020					
185,000	Roof Drain Disconnects	19,000	$50,000	$25,000	$100,000
	Roadside Rain Gardens	1,000	$10,000	$5,000	$20,000
	In-line Storage	165,523	$2,324,000	$1,162,000	$4,648,000
	Total	***185,000***	***$2,384,000***	***$1,192,000***	***$4,768,000***
Project Name: N. Union Bay					
NPDES Basin 18; Substantial Completion – Roof Drains by 2015; In-line Storage by 2020					
213,000	Roof Drain Disconnects	71,000	$190,000	$95,000	$380,000
	In-Line Storage	142,000	$1,760,000	$880,000	$3,520,000
	Total	***213,000***	***$1,950,000***	***$975,000***	***$3,900,000***

a. Recommendations may change based on future analysis of projects or the 2015 Long-Term Control Plan. Final recommendations and schedule will be specified in an Engineering Report/Facility Plan submitted to Ecology.
b. Control volume is the overflow volume reduction necessary to achieve permit compliance

TABLE 5-5 (continued).
PRELIMINARY RECOMMENDED CSO CONTROL PROJECTS

Design Control Volume (gallons)	Recommended Alternatives[a]	Control Volume[b] (gallons)	Estimated Project Cost	Project Cost Range (AACE Level 5) Low	Project Cost Range (AACE Level 5) High
Project Name: Interbay					
NPDES Basin 68; Substantial Completion – Roof Drains by 2015; In-line Storage by 2020					
89,000	Roof Drain Disconnects	45,000	$119,000	$59,000	$238,000
	In-Line Storage	44,000	$552,000	$276,000	$1,104,000
	Total	***89,000***	***$671,000***	***$335,000***	***$1,342,000***
Project Name: Central Waterfront					
NPDES Basin 69; Substantial Completion - 2018					
500,000	Offline Storage	500,000	$11,536,000	$5,768,000	$23,072,000
	Total	***500,000***	***$11,536,000***	***$5,758,000***	***$23,072,000***
NPDES Basin 70/71; Substantial Completion - 2018					
100,000	Offline Storage	100,000	$3,150,000	$1,575,000	$6,300,000
	Total	***100,000***	***$3,150,000***	***$1,575,000***	***$6,300,000***
Project Name: Fremont/Wallingford					
NPDES Basin 147; Substantial Completion – Roof Drains by 2015; Off-line Storage by 2018-2025					
3,996,000	Roof Drain Disconnects	79,000	$209,000	$105,000	$418,000
	Offline Storage	3,917,000	$45,074,000	$22,537,000	$90,148,000
	Total	***3,996,000***	***$45,283,000***	***$22,642,000***	***$90,566,000***
NPDES Basin 174; Substantial Completion – Roof Drains by 2015; Off-line Storage by 2018-2025					
2,112,000	Roof Drain Disconnects	126,000	$336,000	$168,000	$672,000
	Offline Storage	1,986,000	$29,472,000	$14,736,000	$58,944,000
	Total	***2,112,000***	***$29,808,000***	***$14,904,000***	***$59,616,000***
Project Name: Duwamish					
NPDES Basin 111; Substantial Completion - 2018 – 2025					
2,062,000	Offline Storage	2,062,000	$30,220,000	$15,110,000	$60,440,000
	Total	***2,062,000***	***$30,220,000***	***$15,110,000***	***$60,440,000***
Project Name: Longfellow/Delridge					
NPDES Basin 168; Substantial Completion - 2015					
33,000	Retrofit	33,000	$4,500,000	$2,250,000	$9,000,000
	Total	***33,000***	***$4,500,000***	***$2,250,000***	***$9,000,000***
NPDES Basin 169; Substantial Completion - 2015					
285,000	Retrofit	285,000	$4,500,000	$2,250,000	$9,000,000
	Total	***285,000***	***$4,500,000***	***$2,250,000***	***$9,000,000***

a. Recommendations may change based on future analysis of projects or the 2015 Long-Term Control Plan. Final recommendations and schedule will be specified in an Engineering Report/Facility Plan submitted to Ecology.
b. Control volume is the overflow volume reduction necessary to achieve permit compliance

**TABLE 5-5 (continued).
PRELIMINARY RECOMMENDED CSO CONTROL PROJECTS**

Design Control Volume (gallons)	Recommended Alternatives[a]	Control Volume[b] (gallons)	Estimated Project Cost	Project Cost Range (AACE Level 5) Low	High
Project Name: West Seattle					
NPDES Basin 95; Substantial Completion - 2015					
163,000	Retrofit	163,000	$500,000	$250,000	$1,000,000
	Total	***163,000***	***$500,000***	***$250,000***	***$1,000,000***
Project Name: Montlake					
NPDES Basin 20; Substantial Completion - 2020					
87,000	Roof Drain Disconnects	36,000	$95,000	$48,000	$190,000
	Roadside Rain Gardens	16,000	$196,000	$98,000	$392,000
	I/I Reduction	36,000	$637,000	$318,000	$1,274,000
	Total	***88,000***	***$928,000***	***$464,000***	***$1,856,000***
NPDES Basin 140; Substantial Completion - 2015					
11,000	Roadside Rain Gardens	1,000	$11,000	$6,000	$22,000
	Residential Rain Gardens	1,000	$10,000	$5,000	$20,000
	Permeable Pavements	3,000	$42,000	$21,000	$84,000
	Cisterns	3,000	$21,000	$10,000	$42,000
	Bioretention Swales	4,000	$74,000	$37,000	$148,000
	Total	***12,000***	***$158,000***	***$79,000***	***$316,000***
Project Name: Leschi					
NPDES Basin 28; Substantial Completion - 2018 – 2025					
175,000	Cisterns	3,000	$21,000	$11,000	$43,000
	In-line Storage	172,000	$2,140,000	$1,070,000	$4,280,000
	Total	***175,000***	***$2,161,000***	***$1,081,000***	***$4,323,000***
NPDES Basin 29; Substantial Completion - 2018 – 2025					
372,000	In-line Storage	372,000	$4,704,000	$2,352,000	$9,408,000
	Total	***372,000***	***$4,704,000***	***$2,352,000***	***$9,408,000***
NPDES Basin 30; Substantial Completion - 2018 – 2025					
80,000	Roof Drain Disconnects	30,000	$81,000	$41,000	$162,000
	Roadside Rain Gardens	16,000	$198,000	$99,000	$396,000
	I/I Reduction	34,000	$598,000	$299,000	$1,196,000
	Total	***80,000***	***$877,000***	***$439,000***	***$1,754,000***
NPDES Basin 31; Substantial Completion - 2018 – 2025					
352,000	Offline Storage	352,000	$8,212,000	$4,106,000	$16,424,000
	Total	***352,000***	***$8,212,000***	***$4,106,000***	***$16,424,000***
NPDES Basin 32; Substantial Completion - 2018 – 2025					
89,000	Roof Drain Disconnects	7,000	$18,000	$9,000	$36,000
	Offline Storage	82,000	$2,673,000	$1,336,000	$5,346,000
	Total	***89,000***	***$2,691,000***	***$1,345,000***	***$5,382,000***

a. Recommendations may change based on future analysis of projects or the 2015 Long-Term Control Plan. Final recommendations and schedule will be specified in an Engineering Report/Facility Plan submitted to Ecology.
b. Control volume is the overflow volume reduction necessary to achieve permit compliance

TABLE 5-5 (continued).
PRELIMINARY RECOMMENDED CSO CONTROL PROJECTS

Design Control Volume (gallons)	Recommended Alternatives[a]	Control Volume[b] (gallons)	Estimated Project Cost	Project Cost Range (AACE Level 5)	
				Low	High
Project Name: Leschi (continued)					
NPDES Basin 34; Substantial Completion - 2018 – 2025					
32,000	Roof Drain Disconnects	23,000	$60,000	$30,000	$120,000
	I/I Reduction	9,000	$168,000	$84,000	$336,000
	Total	***32,000***	***$228,000***	***$114,000***	***$456,000***
NPDES Basin 35; Substantial Completion - 2018 – 2025					
11,000	Roof Drain Disconnects	11,000	$30,000	$15,000	$60,000
	Total	***11,000***	***$30,000***	***$15,000***	***$60,000***
NPDES Basin 36; Substantial Completion - 2018 – 2025					
115,000	In-line Storage	115,000	$1,426,000	$713,000	$2,852,000
	Total	***115,000***	***$1,426,000***	***$713,000***	***$2,852,000***
Project Name: Union Bay					
NPDES Basin 25; Substantial Completion - 2018 – 2025					
701,000	Roof Drain Disconnects	7,000	$19,000	$9,000	$38,000
	Offline Storage	694,000	$13,886,000	$6,943,000	$27,772,000
	Total	***701,000***	***$13,905,000***	***$6,952,000***	***$27,810,000***
Project Name: East Waterway					
NPDES Basin 107; Substantial Completion - 2018 – 2025					
938,000	Offline Storage	938,000	$18,552,000	$9,276,000	$37,104,000
	Total	***938,000***	***$18,552, 000***	***$9,276, 000***	***$37,104,000***
Project Name: Lake Union/Portage Bay					
NPDES Basin 138; Substantial Completion - 2018 – 2025					
391,000	In-line Storage	391,000	$4,545, 000	$2,273,000	$9,090,000
	Total	***391,000***	***$4,545,000***	***$2,273,000***	***$9,090,000***
Total					
20,505,000		**20,505,000**	**$330,461,000**	**$181,580,000**	**$626,511,000**

a. Recommendations may change based on future analysis of projects or the 2015 Long-Term Control Plan. Final recommendations and schedule will be specified in an Engineering Report/Facility Plan submitted to Ecology.
b. Control volume is the overflow volume reduction necessary to achieve permit compliance

CHAPTER 6.
2010 – 2015 IMPLEMENTATION PLAN

SPU's focus through 2015 is to reduce CSOs at the most critical and sensitive sites through a protective and cost-effective blend of traditional and sustainable infrastructure. The path forward involves a four-pronged approach: (1) optimize existing CSO infrastructure through low-cost retrofits, (2) construct large CSO infrastructure projects to reduce overflows to Lake Washington, (3) construct natural "green" solutions to reduce CSOs throughout the City, and (4) develop a Long-Term Control Plan to control all remaining CSOs and achieve water quality goals. By the end of 2015, the City will have accomplished the following:

- Constructed CSO retrofits to optimize CSO control infrastructure in multiple uncontrolled CSO basins
- Completed the construction of the Windermere CSO Reduction Project
- Substantially completed the construction of the Genesee CSO Reduction Project
- Started construction on the Henderson and Central Waterfront CSO Reduction Projects (completion in 2018)
- Constructed green stormwater infrastructure (GSI) project in the Ballard CSO basin to measure effectiveness of green solutions followed by full-scale implementation of GSI in Ballard, North Union Bay, Interbay, Montlake, Fremont/Wallingford
- Completed the 2015 CSO Reduction Plan Amendment (aka LTCP), which will include evaluation of potential collaborative Seattle – King County CSO projects and identification of projects to reduce remaining CSOs

This section describes SPU's plan for implementing its CSO Program from 2010-2015. An implementation schedule is shown in Figure 6-1, with project locations shown in Figure 6-2. Estimated project costs are presented in Table 6-1.

MAJOR CSO CONTROL PROJECTS NOW UNDERWAY

The Windermere, Genesee and Henderson basin groups received the highest priority for CSO reduction, as described in Chapter 4. The NPDES basins within these groups account for the majority of the CSO volume discharged to Lake Washington. The CSO Reduction projects for these basins will reduce CSOs to an average of one untreated discharge per year per outfall as required by WAC 173-245-020 (22).

Windermere CSO Project

The Windermere CSO Reduction Project will involve constructing a 2.05 million gallon off-line storage tank in the Windermere basin. It will include a tipping bucket cleaning system with flushing channels, a buried facilities vault for odor control facilities and for mechanical and electrical equipment, motor operated gates to control inflow, a pumping system for draining the tank, and approximately 300 feet of sewer for diversion and discharge. The Windermere project is scheduled for completion in 2014. The projected is expected to cost between $38-51 million.

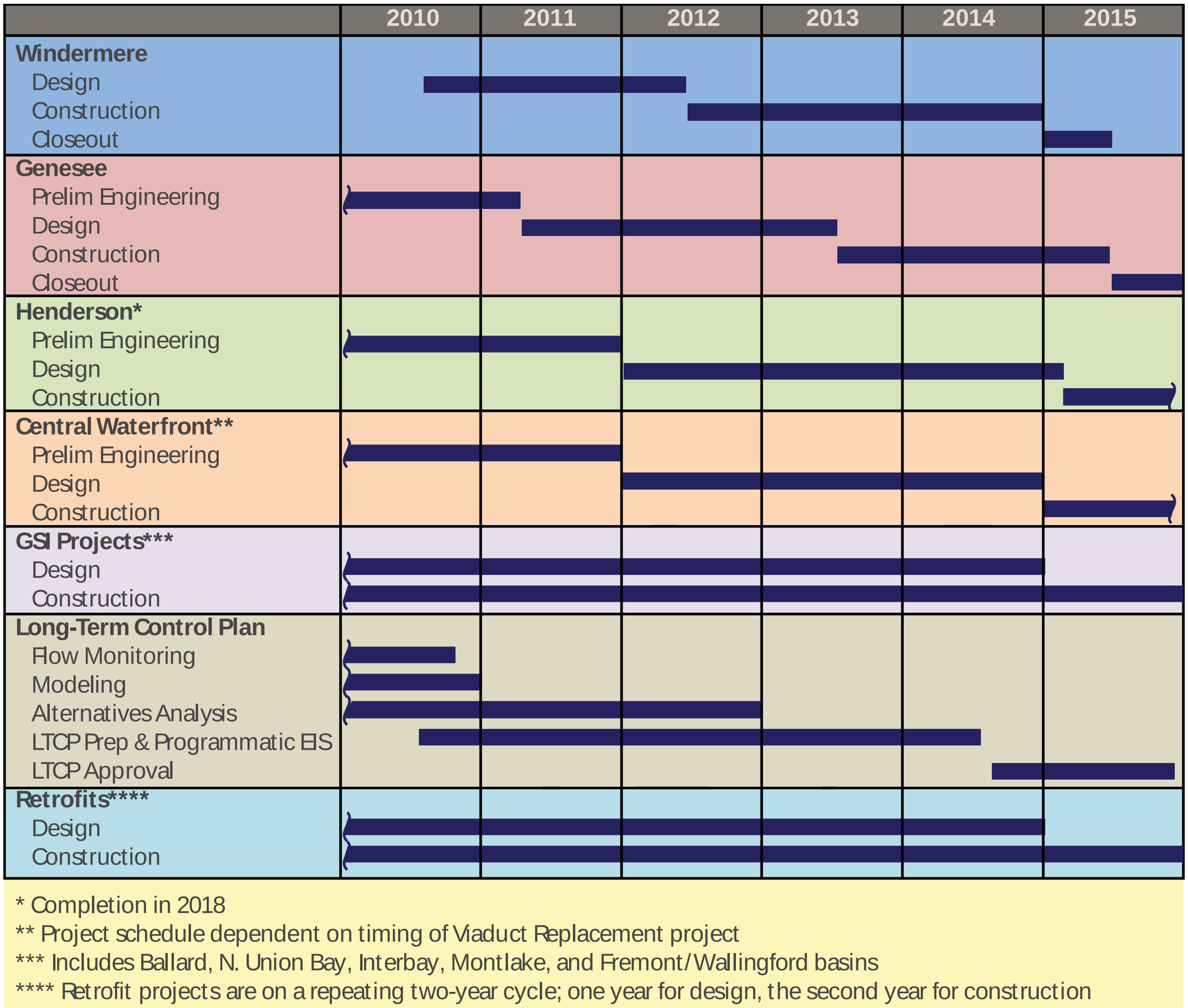
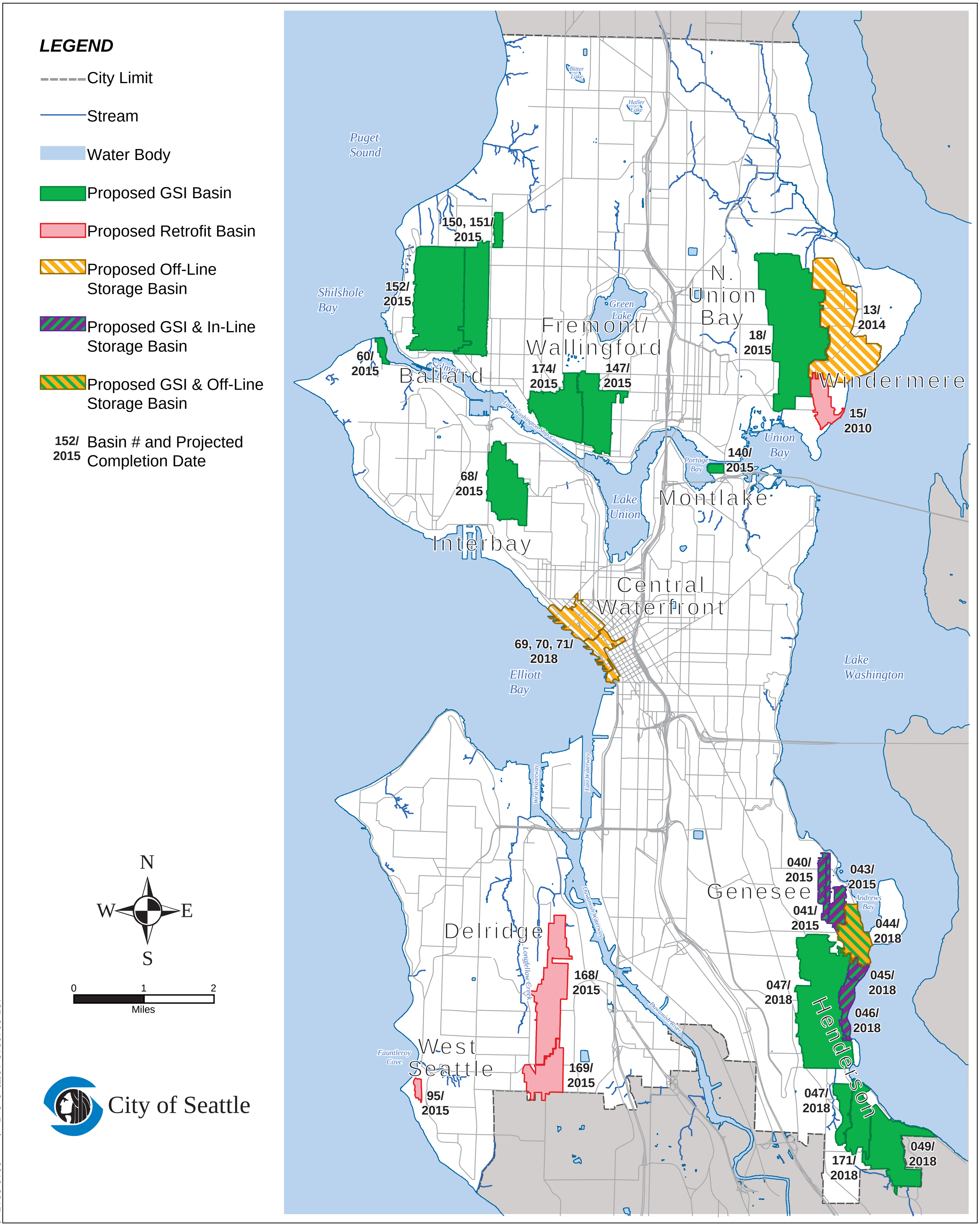


Figure 6-1. Implementation Schedule, 2010 – 2015



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Seattle Public Utilities
2010 CSO REDUCTION PLAN AMENDMENT

Figure 6-2
RECOMMENDED CSO REDUCTION PROJECTS 2010 - 2015

TABLE 6-1.
2011-2015 CSO CONTROL PROJECTS

NPDES Basin No.	Project	Volume Reduced (gallons)	Project Cost Range Low	Project Cost Range High	Projected Year of Completion
Basin Group: Windermere					
13	Off-Line Storage	1,900,000	$37,700,000	$51,000,000	2014
15	Retrofit	3,000	$3,000	$5,000	2010
Basin Group: Genesee					
40	GSI, Inline Storage	177,000	$2,167,000	$8,668,000	2015
41	GSI, Inline Storage	194,000	$2,525,000	$10,102,000	2015
43	GSI, Inline Storage	180,000	$2,187,000	$8,732,000	2015
Basin Group: Henderson					
44	GSI, Off-Line Storage	2,173,000	$16,382,000	$65,529,000	2018
45	GSI, In-Line Storage	174,000	$983,000	$3,934,000	2018
46	GSI, In-Line Storage	200,000	$2,400,000	$9,610,000	2018
47	GSI, Off-Line Storage	277,000	$2,544,000	$10,178,000	2018
49	GSI, Off-Line Storage	156,000	$1,806,000	$7,226,000	2018
171	GSI, Off-Line Storage	153,000	$1,685,000	$6,736,000	2018
Basin Group: Ballard					
150 / 151*	GSI	84,000	$530,000	$2,120,000	2015
152*	GSI	819,000	$5,103,000	$20,412,000	2015
60*	GSI	20,000	$30,000	$120,000	2015
Basin Group: N. Union Bay					
18*	GSI	71,000	$95,000	$380,000	2015
Basin Group: Interbay					
68*	GSI	45,000	$59,000	$237,000	2015
Basin Group: Central Waterfront					
69, 70, 71	Off-Line Storage	600,000	$7,343,000	$29,372,000	2018
Basin Group: West Seattle					
95	Retrofit	163,000	$250,000	$1,000,000	2015
Basin Group: Montlake					
140	GSI	12,000	$79,000	$316,000	2015
Basin Group: Fremont/Wallingford					
147*	GSI	79,000	$105,000	$418,000	2015
174*	GSI	126,000	$168,000	$672,000	2015
Basin Group: Longfellow/Delridge					
168	Retrofit	33,000	$2,250,000	$9,000,000	2015
169	Retrofit	285,000	$2,250,000	$9,000,000	2015
Total		**7,924,000**	**$88,644,000**	**$254,768,000**	

* First phase – See Table 5-5 for projects beyond 2015

Genesee CSO Project

The Genesee CSO Reduction Project involves construction of a combination of GSI, storage and conveyance piping to control approximately 600,000 gallons. Solution alternatives are currently being developed and analyzed to identify the facilities to be built under this project. The Genesee project is scheduled for completion in 2015. The project is expected to cost between $7-27 million.

Henderson CSO Project

The Henderson CSO Reduction Project involves construction of a combination of GSI, storage and conveyance piping to control approximately 3 million gallons. Solution alternatives are currently being developed and analyzed to identify the facilities to be built under this project. The Henderson project is anticipated to be complete in 2018. The project is expected to cost between $26-103 million.

Central Waterfront CSO Project

Because of its connection to the Alaskan Way Viaduct and Seawall Replacement Project, the Central Waterfront is also in the preliminary engineering phase as well, with a scheduled completion date of 2018. The Central Waterfront CSO project will involve construction of approximately 600,000 gallons of storage in the area of the Alaskan Way project. The Central Waterfront project is anticipated to be complete in 2018. The project is expected to cost between $7-29 million.

RETROFIT PROJECTS

The City initiated the CSO Retrofit Program in 2002 and will continue investing up to $2 million annually in the program through 2015. The goal of the program is to implement affordable measures that will reduce the frequency and/or volume of CSO discharges by optimizing system performance. Key objectives for retrofit projects are to maximize collection system storage and flow to the treatment facility while minimizing adverse upstream and downstream impacts.

There are two significant efforts within the CSO Retrofit Program. The first is implementation of a Weir Height Adjustment Plan, which was developed as a requirement of the City's amended Compliance Order from the US EPA (Item No. 26, December 3, 2009). The Plan will maximize in-line storage by raising overflow weir elevations, where appropriate and feasible, to minimize the number and volume of CSOs in the City's system. Implementation of the Weir Raising Plan is the Retrofit Program's highest priority and will be completed by late 2011.

A second significant effort within the CSO Retrofit Program is completion of approximately 60 retrofit projects, many of which have been identified by the CSO LTCP Monitoring Program. The types of projects that are being considered in this set of retrofits include:

- Outfall consolidation, abandonment, or reclassification
- Improved operations and maintenance practices
- Elimination of excessive infiltration & inflow
- Overflow structure upgrades

For example, the existing storage structures in the Longfellow/Delridge CSO basin (NPDES 168 and 169) will be modified to reduce the CSO volume from these basins. These projects will be designed and constructed on a prioritized basis through 2015.

GREEN STORMWATER INFRASTRUCTURE PROJECTS

The alternative analysis process described in Chapter 5 resulted in roof drain disconnects being the first choice (life-cycle cost) for CSO reduction in a large majority of the basins (see Table 5-5). Many of the CSO reduction projects will also likely involve other green stormwater infrastructure (GSI) techniques such as rain gardens (both residential and right-of-way/curb bulbs), bioretention swales and cisterns. These opportunities will be evaluated during preliminary engineering to verify where they are feasible and how they can be blended into the overall CSO reduction program. The City is committed to implementing green stormwater infrastructure where feasible and cost-effective.

In addition to GSI projects in the Genesee and Henderson basins, the City plans to implement GSI projects in the following areas, with completion anticipated by 2015:

- Ballard (NPDES 150/151, 152, 60)
- N. Union Bay (NPDES 18)
- Interbay (NPDES 68)
- Montlake (NPDES 140)
- Fremont/Wallingford (NPDES 147, 174)

The schedules and costs of each proposed green stormwater infrastructure project are shown in Figure 6-1 and Table 6-1.

2015 CSO REDUCTION PLAN AMENDMENT (AKA LONG-TERM CONTROL PLAN)

SPU is preparing for its final phase of CSO reduction by preparing the 2015 CSO Reduction Plan Amendment (aka Long Term Control Plan). The Plan Amendment will identify all remaining CSO projects throughout the City to achieve the Washington State requirement to reduce CSOs down to an average of one untreated CSO per year per outfall. The Plan Amendment will build upon the work performed in the City's 2001 CSO Plan Update and 2005 CSO Plan Amendment, will use the 2010 CSO Reduction Plan Amendment as the starting basis for alternatives analysis, and will present more detailed strategies for each uncontrolled CSO basin in the City. A significant addition in the Plan Amendment will be the identification and evaluation of joint King County – City of Seattle projects to control both City and County uncontrolled CSOs. The scope of Plan Amendment will include the following tasks:

- Gather sufficient flow monitoring information to characterize the hydrology and hydraulics of all uncontrolled City CSO basins and the overall King County system to calibrate the City's CSO basin models and the King County system model
- Develop and calibrate the City CSO basin models and the King County system model to represent City/County boundary conditions, evaluate joint CSO project opportunities and size CSO control volumes
- Establish clear boundary conditions between the City and County's systems for each CSO reduction project to ensure continued compliance and proper project sizing
- For each uncontrolled City CSO basin, identify and evaluate alternatives (i.e., triple bottom line analysis) that cost-effectively reduce CSOs down to regulatory targets
- Work with King County to identify collaborative alternatives that will benefit both agencies
- Develop an implementation plan for all preferred alternatives

- Execute a programmatic environmental review process

SPU has already begun aspects of the Plan Amendment by implementing a two-year flow monitoring and modeling program. Quality assurance plans were developed for each uncontrolled basin to document system operations and identify critical flow monitoring sites that will be used to calculate control volumes for each uncontrolled basin. The control volumes will be used as the basis for sizing each project.

Model development has been proceeding in parallel with the flow-monitoring program and will produce basin models of each of the City's uncontrolled CSO basins. In addition, the City is contributing resources to assist King County in the development of their system-wide model The City's basin models will be used to analyze independent basin alternatives, and the County's system-wide model will be used to analyze collaborative alternatives and boundary conditions to ensure proper sizing and elimination of detrimental downstream effects.

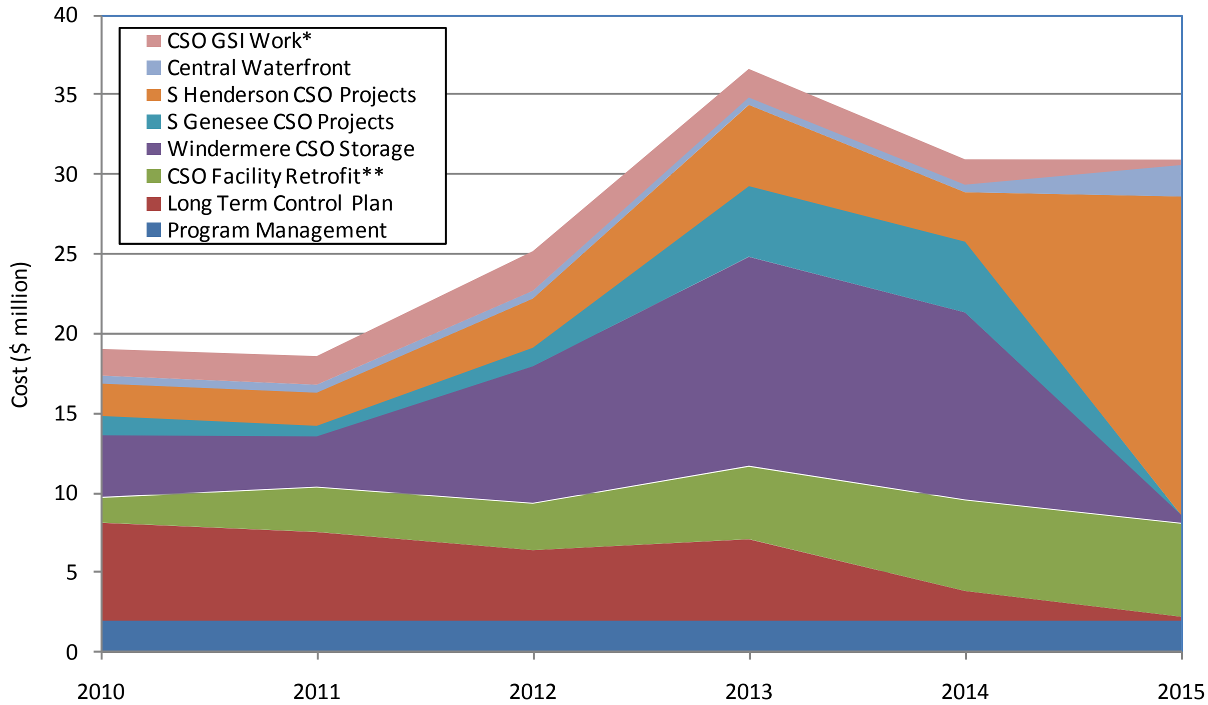
The City and King County started the Collaborative Alternatives development in 2009. Four joint workshops were held and approximately 40 collaborative alternatives have been identified for analysis and screening in 2010. The overall schedule for development of the 2015 CSO Reduction Plan Amendment can be found in Figure 6-1.

PROGRAM COSTS AND RATE IMPACTS

Significant financial investment in CSO control is necessary for the City to achieve its environmental objectives of complying with regulatory requirements and improving water quality in the City's surrounding receiving waters. This section describes the projected costs for the CSO Program from 2010 through 2015 and the associated incremental rate increases that will be necessary to fund the program.

Projected Program Costs

Over the next six years, the City will make significant investment in the Windermere, Genesee, and Henderson CSO projects, green solutions, CSO retrofits, and the development of the Long-Term Control Plan (LTCP). The total cost of these projects from 2010 to 2015, including overall program management, is currently estimated at $162 million. Figure 6-3 shows the projected capital spending for the 2010-2015 period.



* Excludes Genesee & Henderson GSI
** Includes Longfellow/Delridge Large Retrofits

Figure 6-3. Estimated Annual Expenditures, 2010 – 2015

The City is actively working to control the costs of the program by selecting the most affordable alternatives. In addition, the City is already pursuing federal funding to minimize the impact of this investment on City of Seattle ratepayers.

Projected Rate Increases

Rate increases will be necessary to fund the level of capital expenditures that SPU has planned through 2015. Based on the current budget estimate of $162 million for CSO projects from 2010 to 2015, SPU estimates that a typical residential wastewater and drainage monthly bill will increase by $4.62 over the period. The current 2010 typical residential monthly wastewater and drainage bill is $63.87. This analysis is based on the following assumptions:

- The 2010 revenue requirement is the base.
- SPU continues its financial policy to fund capital improvement projects through 25 percent cash and 75 percent debt financing;
- Approximately 55 percent of combined sewer overflow costs support the drainage system. These costs were previously assigned entirely to wastewater until 2007. SPU's 2008-2009 rate proposal initiated the sharing of CSO costs by allocating one-sixth (9.2 percent) of these costs in 2008 and an additional one-sixth (18.3 percent) in 2009. This analysis assumes a continuation of the CSO cost shift from wastewater to drainage, achieving a 55 percent allocation to drainage in 2014;
- Tax payments are made to both the city and state at the current tax rates;
- No changes to the King County Metro Wastewater Treatment rate.

For the period of 2010 to 2015, Table 6-2 outlines the annual CSO and remaining CIP projections, the Combined Systems Shift between drainage and wastewater for the period of the analysis, and the CIP accomplishment rate. Figure 6-4 illustrates the cumulative combined bill increase for a typical drainage and wastewater customer over the 5-year period. The City projects that the incremental rate increase to fund the CSO Program will increase the typical residential monthly drainage and wastewater bill by $4.62 by 2015.

TABLE 6-2.
ANNUAL CSO AND DRAINAGE & WASTEWATER CIP SPENDING, 2010 – 2015

	2010	2011	2012	2013	2014	2015
CSO Spending ($1,000)	$19,084	$18,631	$25,234	$36,689	$31,003	$30,981
Remaining CIP Spending ($1,000)	$59,277	$54,112	$46,780	$47,944	$51,541	$47,635
Total CIP Spending ($1,000)	**$78,362**	**$72,743**	**$72,014**	**$84,633**	**$82,544**	**$78,617**
Accomplishment Rate*	100.0%	90.0%	90.0%	90.0%	90.0%	90.0%
CSO Split to Wastewater	81.7%	72.5%	63.3%	54.2%	45.0%	45.0%
CSO Split to Drainage	18.3%	27.5%	36.7%	45.8%	55.0%	55.0%

* Assumes 100% completion of CSO projects and 90% completion of remaining CIP projects

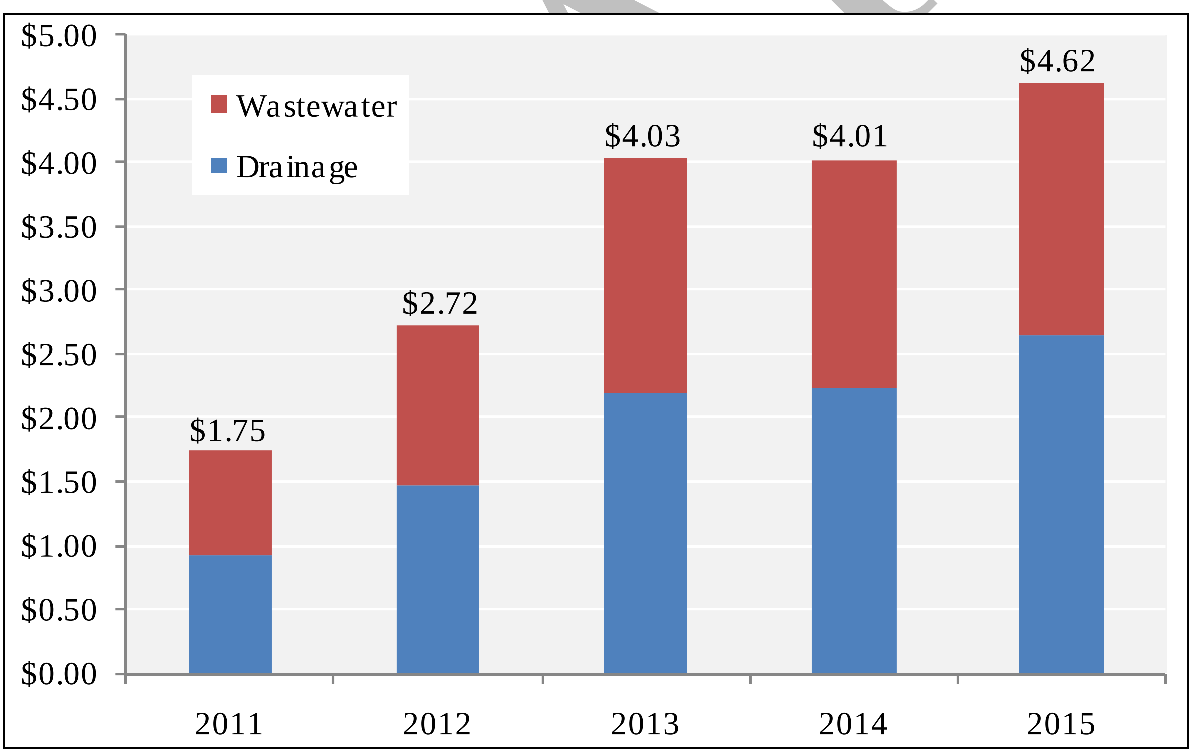


Figure 6-4. Projected Drainage & Wastewater Typical Monthly Household Bill Increases, 2011 – 2015

ABBREVIATIONS

AACE	Association for the Advancement of Cost Engineering
AWVSRP	Alaskan Way Viaduct and Seawall Replacement Project
CCI	Construction Cost Index (ENR)
CIP	Capital Improvement Plan
CSO	Combined Sewer Overflow
CWA	Clean Water Act
DOT	Department of Transportation
Ecology	Washington State Department of Ecology
ENR	Engineering News Record
EPA	US Environmental Protection Agency
GIS	Geographic Information System
GSI	Green Stormwater Infrastructure
gpd/sq.ft.	gallons per day per square foot
I/I	Infiltration and Inflow
LID	Low Impact Development
LOS	Level of Service
LTCP	Long Term Control Plan
MG	Million gallons
MGD	Million gallons per day
MH	Maintenance Hole
MOA	Memorandum of Agreement
NMC	Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
POTW	Publically Owned Treatment Works
RCW	Revised Code of Washington
ROW	Right-of-Way
RTC	Real Time Control
SCADA	Supervisory Control and Data Acquisition
SEA	Street Edge Alternatives
SPU	Seattle Public Utilities
SF	Square foot
TBL	Triple Bottom Line
WAC	Washington Administrative Code

REFERENCES

City of Indianapolis Department of Public Works. 2006. Raw Sewage Overflow Long Term Control Plan and Water Quality Improvement Report.

City of Seattle. 1973. Comprehensive Sewer and Drain Plan Summary Report. Seattle Engineering Department.. 1973.

City of Seattle. 1973. Final Environmental Impact Statement for the City of Seattle Sewer Separation Program. Seattle Engineering Department, September 1973.

City of Seattle. 1978. Public Works in Seattle: A Narrative History of the Seattle Engineering Department, 1875-1975. Seattle Engineering Department.

City of Seattle. 1980. Sewage Collection System Modifications (201 Facility Planning). Seattle Engineering Department. February 1980.

City of Seattle. 1988. Combined Sewer Overflow Control Plan. Brown & Caldwell. 1988.

City of Seattle. 2000. CSO Characterization Project. EVS Environmental Consultants. January 2000.

City of Seattle. 2001. Combined Sewer Overflow Reduction Plan Amendment. CTE Engineers. December 2001.

City of Seattle. 2001. Draft Environmental Impact Statement / 2001 CSO Reduction Plan Amendment. Adolfson Associates, Inc. August 2001.

City of Seattle. 2001. Final Environmental Impact Statement / 2001 CSO Reduction Plan Amendment. Adolfson Associates, Inc. November 2001.

City of Seattle. 2003. Analyses of Precipitation-Frequency and Storm Characteristics for the City of Seattle. MGS Engineering Consultants, Inc.. December 2003.

City of Seattle. 2005. 2004 Comprehensive Drainage Plan. Seattle Public Utilities with Herrera Environmental Consultants, R.W. Beck, and Shannon and Wilson. January 2005.

City of Seattle. 2007. State of the Waters 2007, Volume 1: Seattle Watercourses. Seattle Public Utilities. 2007.

King County Department of Natural Resources and Parks. 2006. 2005 CSO Control Program Review. April 2006.

King County Department of Natural Resources. 1999. Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay. Parametrix, Inc. February 1999

King County Department of Natural Resources. 2003. King County Watershed Modeling Services – Green River Water Quality Assessment, and Sammamish, Washington / Analysis and Modeling Program / Watershed Modeling Calibration Report, Section 3 – Model Development. July 2003.

Massachusetts Department of Environmental Protection. 1997. Guidance for Abatement of Pollution from CSO Discharges.

Seattle Engineering Department. 1987. Lake Union and Ship Canal Sampling and Analysis Program. Kennedy/Jenks/Chilton. July 1987.

Seattle Public Utilities. 2005. Drainage and Wastewater Feasibility Study for the Alaskan Way Viaduct/Seawall. HDR Engineering. August 2005.

Seattle Public Utilities. 2006. 2006 Wastewater Systems Plan. Brown & Caldwell. 2006.

Seattle Public Utilities. 2006. Drainage Rate and Incentive Methodologies Report / Executive Recommendations to the City Council. Seattle Public Utilities. June 2006.

Seattle Public Utilities. 2007. Response to Council Resolutions 30863 and 30928 / Unit Affordability Study. Seattle Public Utilities. June 2007.

Seattle Public Utilities. 2007. Sediment Survey / NPDES Permit No. WA 003168-2 Section S9. Herrera Environmental Consultants. December 2007.

Seattle Public Utilities. 2008. Affordability Measures for City Utility Services and Improvements to Low-Income Assistance Programs. Seattle Public Utilities. May 2008.

Seattle Public Utilities. 2008. Analysis of the Frequency of Storms in 1998-2007 Period Relative to Storms in the Period 1978-2007 for Generation of Combined Sewer Overflows. MGS Engineering Consultants, Inc. January 2008.

Seattle Public Utilities. 2008. Draft Delridge Area Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Draft Duwamish Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Draft East Waterway Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Draft Lake Union / Portage Bay Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Draft North Union Bay Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Draft West Seattle Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Draft West Waterway Combined Sewer Modeling Report. Tetra Tech, Inc. December 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / Henderson Basin Flow Monitoring Study. HDR, Inc. June 27, 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / North Union Bay CSO Flow Monitoring Plan. Tetra Tech, Inc. July 31, 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / West Waterway CSO Flow Monitoring Plan. Tetra Tech, Inc. July 31, 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / Duwamish CSO Flow Monitoring Plan. Tetra Tech, Inc. July 31, 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / Lake Union/Portage Bay CSO Flow Monitoring Plan. Tetra Tech, Inc. July 31, 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / Delridge CSO Flow Monitoring Plan. Tetra Tech, Inc. July 31, 2008.

Seattle Public Utilities. 2008. Quality Assurance Project Plan / Genesee Basin Flow Monitoring Study. CH2M HILL. August 19, 2008.

Seattle Public Utilities. 2008. South Henderson Combined Sewer Overflow (CSO) Reduction Project/ Draft Initial Estimation of CSO Control Volumes for Henderson/Genesee Basins. HDR Engineering. April 14, 2008

USEPA. 1990. Pollution Prevention Act of 1990. United States Code Title 42/ The Public Health and Welfare/ Chapter 133.

USEPA/Washington Department of Ecology. 1997. Memorandum of Agreement between the United States Environmental Protection Agency and the Washington State Department of Ecology regarding the Implementation of Section 303(d) of the Federal Clean Water Act.

Washington State Department of Ecology. 2008. Criteria for Sewage Works Design.

Water Environment Research Foundation (WERF). 2006. Decentralized Stormwater Controls for Urban Retrofit and Combined Sewer Overflow Reduction. WERF Document 03-SW-3. 2006.

APPENDIX A.
PUBLIC PARTICIPATION PLAN & WORKSHOP SUMMARIES

Seattle Public Utilities
2010 CSO Reduction Plan Amendment

2010 CSO REDUCTION PLAN AMENDMENT

Public Information/Involvement Plan

Background

In 2001 Seattle Public Utilities (SPU) prepared a CSO Reduction Plan Amendment to comply with the requirements of the City's 1998 NPDES permit.

SPU is in the process of preparing a new CSO Reduction Plan Amendment (Amendment) that is a required component of Seattle's NPDES permit application, scheduled to be submitted to the Washington State Department of Ecology in 2010. In 2005 SPU initiated data collection and analysis on the City's CSO outfalls as input to developing a plan to comply with this requirement. The purpose of the work is to develop a prioritized list of locations for control projects and to identify approaches to control overflows at high priority locations.

Outreach to the public and agencies is an important and required component of the 2010 Amendment. SPU's public and agency outreach goals are to inform citizens and agencies about the planning process so they understand its purpose, goals and schedule and to provide opportunities for their input at key points in the process.

Approach to Public Information/Involvement

SPU's approach to accomplishing these public information and public involvement goals is to:

- Prepare informational materials to keep interested citizens and groups informed about the progress of plan development and make them available at a dedicated project webpage
- Publicize public involvement opportunities to community groups, district councils and community leaders throughout the City by having the Department of Neighborhoods distribute invitations to these events to their email distribution lists
- Provide briefings to agencies and invite their comments at key points in the process
- Ask for public input on major plan components at workshops held at two points in the process: 1) on priority locations and 2) on alternative approaches to reduce CSOs at priority locations
- Post the draft plan at the project webpage and notify the public of the public comment period through a notice sent by the Department of Neighborhoods to its e-lists
- Ask for feedback on the draft Plan from the City's Creeks, Drainage and Wastewater Advisory Committee during the public comment period before finalizing the Draft 2010 CSO Reduction Plan Amendment and submitting to the City Council for its review and approval.

Schedule of Activities

Spring, 2008

- Create a project webpage where information about the 2010 CSO Reduction Plan Amendment can be posted and update as materials developed by the technical team are available
- Distribute invitations to a first round of public workshops, one each in north Seattle and south Seattle using the Department of Neighborhood's email distribution lists and follow-up with stakeholders
- Conduct the first round of public workshops to receive public input on priority locations for CSO reduction projects
- Meet with the Washington State Department of Ecology and with King County's CSO Program to describe the planning process and the public input received on priority locations, to answer questions, and to request their input.
- Provide informational materials and/or brief the Creeks, Drainage and Wastewater Advisory Committee on the results of the first round of workshops

Fall, 2008

- Update the project webpage with an invitation and agenda for the second round of public workshops (one in north Seattle and one in south Seattle) and informational materials about alternative approaches to reduce CSOs
- Distribute invitations to the public workshops via the Department of Neighborhoods and follow-up with stakeholders
- Conduct the second round of public workshops to receive public input on alternative approaches to control CSOs at priority locations and on SPU's decision-making process
- Meet with the Washington State Department of Ecology and with King County's CSO Program to describe the decision-making process and to discuss alternative approaches to control CSOs
- Brief the Creeks, Drainage and Wastewater Advisory Committee on the results of the second round of workshops

Project Milestones

The schedule of public and agency involvement opportunities in relation to project milestones is as follows:

• Basin prioritization	March 2008
• Public workshops on priority locations	April 2008
• Agency meetings	April 2008
• Briefing of the Creeks, Drainage and Wastewater Advisory Committee	May 2008
• Alternatives evaluation	Aug 2008
• Public workshops on alternative approaches	Sept 2008
• Agency meetings	Sept 2008
• City Council review/approval	- 2010 -
• Submission to Ecology	May 2010

2010 Combined Sewer Overflow (CSO) Reduction Plan Amendment
Public Participation Plan
March – October 2008

Seattle's Combined Sewer Overflow (CSO) Reduction Plan determines how and where Seattle Public Utilities invests taxpayer dollars to control CSOs. These investments protect human health and the environment and ensure that Seattle remains in compliance with state regulations. The City of Seattle manages 92 CSO outfalls.

SPU is in the process of preparing an update to the 2001 CSO Reduction Plan Amendment. The City Council must formally adopt the 2010 CSO Reduction Plan Amendment before it is sent to the Washington State Department of Ecology as a required component of the City's NPDES permit renewal application.

Data gathering, analysis and monitoring have been underway since late fall 2005 to provide the technical basis for the CSO Reduction Plan Amendment. The project team is now at a point where public input can be very helpful in shaping the updated Plan Amendment.

The proposed approaches for public information and public involvement follow. These approaches comply with EPA guidelines for public participation; they also respond to SPU's commitment to involve citizens in significant planning processes.

Public Information

- Webpage at the SPU website with frequently-asked questions, contact information, technical reports, a map of CSO locations – to be updated as the process evolves
- Presentation to Restore Our Waters Stakeholders Group on Dec. 6, 2007
- Notice about the project to the reconstituted Creeks, Drainage and Wastewater Citizen Advisory Committee and request for volunteers, March 12, 2008
- Department of Neighborhoods' email distribution of a Memorandum of Invitation to Workshop #1 from Chuck Clarke to its list of community leaders (5000+)
- Follow-up telephone calls by the consultant to groups and organizations in different geographic locations to encourage participation

Public Involvement

Two rounds of public workshops are planned.

- Workshop #1: The first round of workshops (meeting details below) are planned for April 2008 when the project team will share what it has learned about locations and volumes of Seattle's CSOs, present the results of a preliminary ranking of CSO locations using EPA-specified national criteria, and give Seattle citizens an opportunity to identify local factors or conditions that should be considered in deciding priorities for the coming decade.

- Workshop #2 (also to be held in two locations) will provide an opportunity for Seattle residents to provide input on approaches for controlling CSOs in the high-priority locations. Options are expected to include traditional approaches like additional storage as well as non-traditional approaches such as rain gardens, Street Edge Alternatives (SEA) Streets, and any others that seem appropriate, or perhaps a combination of approaches.

Workshop #1

- Monday, April 14, 6:30 – 8:30 PM in the Douglas Classroom of the Center for Urban Horticulture (North Seattle)
- Wednesday, April 30, 6:30 – 8:30 PM in the Rainier Community Center Multi-purpose Room (South Seattle)

Workshop #2

- Monday, September 8, 6:30 – 8:30 PM in the Camp Long Lodge (West Seattle)
- Tuesday, September 9, 6:30 – 8:30 PM in the Douglas Classroom of the Center for Urban Horticulture (North Seattle)

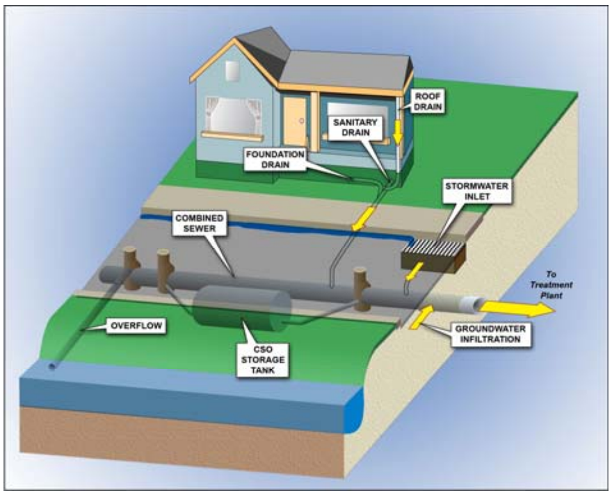
Contact Information

- SPU's Project Manager is Jason Sharpley, Water Quality Group, 615-0030
- Jenna Franklin, SPU Communications Advisor, has provided support for this project since February 2008.
- Susan Harper, Communications, provided support from October 2007 to January 2008.

Seattle Public Utilities

City of Seattle
2010 Combined Sewer Overflow Reduction Plan Amendment

What is a Combined Sewer System and what causes Combined Sewer Overflows – CSOs?
In some areas of Seattle, both wastewater (sewage that goes down the drain from homes and businesses) and storm water (rain that washes off of rooftops, streets and parking lots) flow together in a single pipe to the wastewater treatment plant. This is called a Combined Sewer System.



The advantage of a Combined Sewer System is that both storm water and sewage are treated most of the time. But during heavy rains, the combination of storm water (about 90% of the volume) and sewage may exceed the capacity of the Combined Sewer, so the excess overflows into nearby lakes, streams or Puget Sound. These are called Combined Sewer Overflows, or CSOs. Seattle manages about 90 CSO locations.

Why care about Combined Sewer Overflows?
CSOs can pose public heath and environmental concerns for cities like Seattle that have combined sewer systems. This is because the storm water, untreated sewage and waste that end up in bodies of water may present a danger to fish, wildlife or swimmers in the area.

Why have a Combined Sewer Overflow System?
Combined sewer overflows are a very important tool for managing urban runoff during peak flows. If not managed, these excess flows can result in sewer backups into homes, businesses, and onto streets. In the case of extreme events, high volumes of rainfall have posed a threat to public safety.

What is Seattle doing to improve water quality?
The City of Seattle is committed to improving water quality by reducing CSOs. Seattle's CSO Reduction Plan determines how and where Seattle Public Utilities invests taxpayer dollars to control CSOs. These investments protect human health and the environment and ensure that Seattle remains in compliance with state regulations.

Seattle Public Utilities is currently preparing the 2010 CSO Reduction Plan Amendment which will establish priority locations and approaches for controlling CSOs in the coming decade.

How can you be involved?
SPU invites your participation in two upcoming workshops to shape this important Plan. The first is scheduled for Monday, April 14 from 6:30 to 8:30 pm at the UW's Center for Urban Horticulture. The focus will be on prioritizing CSO locations for control projects. The second, in the fall, will focus on preferred approaches to control CSOs in the priority locations. These approaches include traditional methods like additional storage as well as innovative approaches like rain gardens and natural drainage (Street Edge Alternative or SEA Streets).

To learn more about the April 14 workshop, get more information about SPU's CSO Reduction Plan, or provide your comments, please contact Project Manager Jason Sharpley by telephone (206 615-0030), by email (jason.sharpley@seattle.gov), or by mail at Seattle Public Utilities, P.O. Box 34018, Seattle, WA 98124-4018.

Seattle Public Utilities
2010 Combined Sewer Overflow (CSO) Reduction Plan Amendment

Workshop #1, Prioritization of Basins for CSO Control Projects
April 14, 6:30 to 8:30 PM
Douglas Classroom, Center for Urban Horticulture
April 30, 6:30 to 7:00 PM

Summary

Seattle Public Utilities (SPU) hosted public workshops on April 14 in the Douglas Classroom of the Center for Urban Horticulture and on April 30 in the Rainier Community Center Multi-Purpose Room.

The purposes of the public workshops were to

- Provide background information on the planning process to develop Seattle's 2010 CSO Reduction Plan Amendment (to be submitted to the Washington State Department of Ecology as a required component of the City's application to renew its National Pollutant Discharge Elimination System (NPDES) permit),
- Present preliminary basin rankings based on criteria and scoring in EPA guidance, and
- Get citizen input on priorities for CSO control projects over the coming decade.

Nine individuals participated in the April 14 workshop. (Meeting attendance is at the end of this summary.) Jason Sharpley, SPU's Project Manager, provided background information about Seattle's CSO control program in a PowerPoint presentation and answered numerous questions about the city's CSO basins. Consultant team Project Manager Dennis Eckhardt of Tetra Tech Infrastructure Group described the planning process and presented a preliminary ranking of Seattle's CSO basins based on EPA criteria and scoring guidelines. Vicki King of Triangle Associates facilitated the meeting.

Two individuals participated in the April 30 workshop, one of whom had also participated in the April 14 workshop. The meeting ended at 7 pm.

Input from the workshops is summarized below**.**

Comments/Questions on the Approach to Preparing the 2010 Amendment

Advice on Planning Approach and Priorities

- Use data from the most recent year (07, not 06)
- Base the plan on five years of data, not the two specified in EPA Guidance
- Make dealing with CSOs on fresh water a higher priority than historically polluted areas (like Seattle's closed shellfish beds in Puget Sound)
- Focus control efforts in areas where people fish for subsistence needs because of potential health impacts to them could be significant (South Park, Lake Washington); this is an environmental justice issue

- Agree with ranking CSO locations 91, 99 and 111 high because surface water runoff carries pollutants into the waterways
- Look at Longfellow Creek and at Marine Protected Areas (designated in Seattle's Shoreline Master Program) as possible priorities
- Focus on any areas where the levels of toxicity are high
- Look at the impact of the outfall on oxygen levels in water, for salmonids in the nearshore.
- What wildlife are "missing" that can be attributed to CSOs?
- Should Lake Union which has impacts on wildlife/fish not rank higher?

Comments on EPA criteria

- EPA criteria are OK as a starting point but they are designed for the east coast – we need to focus on our situation in the Puget Sound.
- I disagree with EPA's nearshore ranking approach; it's an example of east-coast bias. Smolt stay near the shore; eel grass is important for nesting for fingerlings.
- The approach is a good one but I am not sure about how good they are at the boundaries between A and B priority groupings.

Comments on CSO Control Approaches

- We prefer low-impact development (LID) approaches.
- We want SPU to put $ on rain gardens and LID projects, not on CIP projects (JSharpley clarified that these types of projects are also CIP projects.)
- Give us more information about locations where LID approaches might work; they may be more cost-effective than big storage projects

Informational Requests and Questions

Informational requests

- Send a list of CSO sampling sites (JS: don't yet have data because of need to sample 3 storms and complexities of scheduling the sampling)
- Send us information about capital projects SPU conducted as a result of the 2001 plan. What was the cost, especially for the completed projects at Magnolia and Diagonal? (Heather Trim) Give us the total cost for Duwamish, Henderson, and Genesee. (Dennis E provided 2005 estimates) (Heather Trim)
- Send us the breakdown of the scores that resulted in the ranking – what went into them?
- Map requests
  - post all of the maps
  - overlay priorities A and B on the general map – don't use yellow to designate basins – it's too hard to see
  - overlay locations of industrial dischargers on CSO locations

Questions

- How much money is SPU spending on capital projects?
- What is the industrial load in CSOs?
- Do you have information about base flows and then the added contribution of storm water?

- Has SPU analyzed storm water *versus* sewage *versus* industrial sources?
- Does SPU have data on pollutant loading?
- What is the range of projects the City has implemented, from storage to source control projects (like rain gardens)?
- What is the cost of treatment relative to the impact on water quality, wildlife?
- Are some basins more susceptible to overflows when the rainfall comes hard and fast?
- How do we know 0's are 0's? Are the numbers based on real measured flows?

Suggestions for the April 30 workshop

- Make materials easier to read
- Provide better maps
- Focus on criteria

General Suggestions

- Send emails when new items are added at the website.

April 14 Meeting Attendance

Randolph Sleight, Fauntleroy Watershed Council
Thomas Mercer, Pinehurst/Victory Heights
Heather Trim, People for Puget Sound
Nancy Malmgren, Creeks, Drainage and Wastewater Advisory Committee
Cheryl Klinker, Thornton Creek Alliance and Creeks, Drainage and Wastewater Advisory Committee
Chas Redmond, Morgan Community Association (MoCA), West Seattle
Kitty Nelson, Ravenna Bryant
Philip Shack, N. District Council
Lydia Heard, Creeks, Drainage and Wastewater Advisory Committee

April 30 Meeting Attendance

Lydia Heard, Creeks, Drainage and Wastewater Advisory Committee
Emily States, Georgetown residents

SPU and Consultant Staff Attendance at Both Workshops

Seattle Public Utilities: Jason Sharpley
Consultants: Dennis Eckhardt, Gareth Grube, Vicki King

Seattle Public Utilities
2010 Combined Sewer Overflow (CSO) Reduction Plan Amendment

Workshop #2, Alternative Approaches for Controlling CSOs

September 8, 2008: Camp Long Lodge, 6:30 to 8:30 PM
September 9, 2008: Center for Urban Horticulture, 6:30 to 8:30 PM,

Summary

Seattle Public Utilities (SPU) hosted public workshops on Monday, September 8 in the Camp Long Lodge (in West Seattle) and on Tuesday, September 9 at the University of Washington's Center for Urban Horticulture (Douglas Classroom). Both workshops began at 6:30 and adjourned by 8:30 PM.

The purposes of these public workshops were to present and get citizen input on

- Alternative approaches to control CSOs at priority locations
- SPU's proposed decision-making process for selecting among the alternative approaches and techniques to control CSOs at high priority locations

Ten individuals participated in the September 8 workshop. Nine individuals participated in the September 9 workshop. (Meeting attendance is at the end of this summary.) Refreshments were provided.

Workshop handouts included the

- Workshop Agenda
- Map of Seattle showing priority CSO basins for control projects
- Fact sheet on SPU's CSO Control Alternative Selection Process and
- Copies of the PowerPoint presentation slides

Welcome, Introductions, Agenda Review
At 6:30 PM, Vicki King of Triangle Associates, facilitator, welcomed participants on behalf of SPU, led a round of introductions, and briefly described the purposes of the workshop.

Presentations
Report on Basin Priorities
Ms. King then invited Dennis Eckhardt, consultant team Project Manager with TetraTech Infrastructure Group to report the results of the basin prioritization process which had been the focus of two public workshops in April. Using a PowerPoint presentation, Mr. Eckhardt briefly described the regulatory framework and requirements for controlling CSOs and the current status of the City's outfalls. Forty-three of the outfalls are considered "controlled," that is, they discharge on average less than once a year. Forty-seven of the outfalls discharge more than once per year on average. It is this latter group that SPU's 2010 CSO Reduction Plan Amendment must consider.

Mr. Eckhardt summarized the EPA evaluation criteria and public input from the April public workshops that were used to prioritize Seattle's CSO basins. The results of the CSO basin prioritization process were shown in color-coded maps.

Alternative Approaches to Control CSOs

Jason Sharpley, SPU's Project Manager, then described the following four general approaches for reducing CSOs:

- Reduce peak flows
- Improve conveyance of flows
- Store flows
- Treat flows

He then described options within each of these four general approaches to address CSOs, including the potential benefits as well as possible constraints for each. The options he described to reduce peak flows include:

- Infiltration and inflow reduction
- Roof drain disconnection
- Green Stormwater Infrastructure or GSI
- Raingardens
- Bioretention Swales
- Cisterns
- Right of Way Separation

Options to improve conveyance of flows to treatment facilities include

- Inter-basin flow transfer
- Increased conveyance (larger pumps and pipes)
- Best Management Practices (BMPs)
- Real Time Control

Storage options include large above or below-grade tanks or oversize below-grade conveyance pipes. With respect to "street storage," Mr. Sharpley said that this approach has been used successfully in the Midwest where the flat terrain is more conducive to this approach. The final approach is to treat the waste before it is discharged; this approach usually consists of primary treatment and disinfection.

Proposed Decision-Making Process for Selecting Control Alternatives

Mr. Sharpley said that the goals of SPU's decision-making process are a transparent process that results in an achievable plan at a reasonable cost to rate-payers. Key parameters in the evaluation process are cost and feasibility. He indicated that numerous "cost curves" will be generated for priority basin alternatives; these cost curves will factor in 100-year life cycle costs. He presented an example showing two such cost curves and how they can be helpful in making decisions based on the volume of CSOs to be controlled, including how a combination of approaches can achieve the needed results cost-effectively.

At the conclusion of Mr. Sharpley's presentation, workshop participants were invited to ask questions and offer comments on the alternatives being considered and the proposed decision-making process. The questions, issues, and comments raised during both workshops are summarized below**.**

At the conclusion of the discussions, Mr. Sharpley presented the schedule for finalizing the Draft Plan, City Council review (2009), and submittal to the Washington State Dept. of Ecology in 2010, as part of the City's application to renew its National Pollution Discharge Elimination System (NPDES) permit.

Ms. King adjourned the workshops at 8:30 PM.

SUMMARY OF QUESTIONS, COMMENTS, AND SUGGESTIONS

Related to Water Quality

- The quality of the runoff rather than the volume of runoff can have a big impact on water.
- Place more emphasis on protecting water quality, not just addressing the quantity of overflows. It's important to keep ecosystems healthy.
- What about pharmaceuticals in the runoff? Are they having an effect?
- Is the CSO program an outgrowth of the Clean Water Act, which has water quality protection as its goal?

Related to Green Stormwater Infrastructure (GSI)

Cisterns/Raingardens/bioretention swales

- Where soils are not conducive to percolation, we could use rain barrels as surrogate bioswales, get experience with how that approach works, and aim to make improvements year-by-year.
- Is harvesting rainwater (in rain barrels and cisterns) legal?
- The City needs to promote strategies that work. For example, rain barrels hold only one or two days of rain from roofs that are disconnected from the City's combined sewer system. To make rain barrels and cisterns viable approaches to store stormwater, we need to find uses for the water stored in them; otherwise, after they fill up the first time, they will no longer help when the next storms hit.
- If someone adds a cistern and redirects rain from the roof to it, how does that affect rates?
- What do we know about the quality of soils in Delridge (for purposes of allowing surface water to percolate readily into the soil)?
- Can SPU make its "Rainwise" programs long-term projects, with education and incentives, to encourage residents to implement GSI solutions?
- Has Seattle considered use of large-scale flexible bladders to store stormwater such as are commonly used in Australia? They are cheap.
- Given the "gunk" that flows into the SEA Streets from the roads, are they safe to have in the neighborhood?
- Can we assume that GSI includes the full suite of "green" options?

Potential uses/benefits of permeable pavement

- How much thought has been given to the potential benefits of permeable pavement in unimproved alleys as a strategy for dealing with surface water?
- Can permeable pavement be used to reduce stormwater flows in downtown Seattle?

Related to Reducing Flows into the Sewer System

- With respect to reducing flows to the treatment plan in general, how about doing something about the sump pumps that send flows to the treatment plan 24/7?
- Shouldn't Seattle be working on strategies to reduce sewer flows, such as promoting low-flow toilets such as New York City has done?

Related to Inter- and Intra-Agency Coordination

- Are Seattle and King County working collaborative on CSO issues?
- Since Seattle and King County CSO facilities are so close together in the Fauntleroy area, which agency is doing the cumulative impacts analysis?
- Can Seattle's Dept. of Planning and Development provide incentives in the permitting process that will reduce stormwater flows?

Requests for Additional Information/Analysis

- Knowing the menu of options does not let us provide good input. We need to know the water quality at each of the basin outfalls to give better input on appropriate alternatives for each outfall.
- Industrial areas cause more pollution than residential areas. Are you going to overlay the industrial sites, especially those with pretreatment requirements, over the outfall map and analyze the problem from that perspective?
- In the areas where Street Edge Alternative (SEA) Streets have been installed, where does the stormwater go that formerly ran in sheet flows down the streets? Will it ultimately cause problems elsewhere?

Questions about Implementation

- [Example of Windermere] How long has this planning process been going on? At Windermere the planning has been underway for 12-14 years. At what point will you do something?
- Will SPU have a mix and match program for different basins rather than applying one approach everywhere?
- How committed is the City to paying for this?
- Once the plan is approved, are we locked into it?

Comments about the Proposed Decision-Making Process

- Add a step to the decision-making process that identifies the solution needed at specific locations from a water quality perspective.
- Will SPU host a public meeting to review and comment on the Draft Plan? We want such a meeting.

Other

- Does the City have a program that allows use of "gray water?" Is this use legal in Seattle?
- Does Ecology fine Seattle for each overflow? Does Ecology fine entities like Seattle that are not in compliance with CSO reduction goals?
- Storm intensity seems to be increasing. Is SPU factoring climate change into CSO reduction planning?
- How can a homeowner find out where the water from his/her roof goes?
- Why are rates of overflows so varied among the basins?
- In Fauntleroy there have been CSOs from King County outfalls as a result of power outages. What is Seattle doing to prevent similar problems at its facilities?
- How does SPU calculate the amount of water that comes into a house and the amount of sewage that leaves the house?
- What are the volumes from the control methods?
- Treatment is not the answer.

WORKSHOP ATTENDANCE

September 8

Sheila Brown, Longfellow Creek Watershed Council
Donna Horn, Longfellow Creek Watershed Council
Kate Martin, Piper's Creek Watershed Council
Michal Ann McElhany, North Delridge Neighborhood Council
Jay Mitto, Longfellow Creek Watershed Council
Mary Quackenbush, Longfellow Creek Watershed Council
Chas Redmond, Morgan Community Association (MoCA), West Seattle
Kirsten Rohrbach, Longfellow Creek Watershed Council
Randolph Sleight, Fauntleroy Watershed Council
Richard Sleight, West Seattle resident

September 9

Estell Berteig, Mathews Beach area
Naomi Chechowitz
Cathy Hatch-Daniels, Windermere Corp. Board
Lydia Heard, Creeks, Drainage and Wastewater Advisory Committee
James King, View Ridge resident
John Reardon, Puget Ridge Council
John J. Reardon, resident north of University Village
Susie Reardon, resident north of University Village
Heather Trim, People for Puget Sound

SPU and Consultant Staff Attendance at Both Workshops

Seattle Public Utilities: Jason Sharpley
Consultants: Dennis Eckhardt, Gareth Grube, Vicki King

APPENDIX B.
SEPA CHECKLIST

APPENDIX C.
BASIN PRIORITIZATION

APPENDIX C

PRIORITIZATION OF BASINS

A prioritization process developed by the EPA was used to assess the relative priority of the CSO basins with respect to the need for CSO control. EPA's CSO Control Policy contains the following principle:

> *EPA expects a permittee's long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas. Sensitive areas, as determined by the NPDES authority in coordination with State and Federal agencies, as appropriate, include designated Outstanding National Resource Water, National Marine Sanctuaries, waters with threatened and endangered species and their habitat, waters with primary contact recreation, public drinking water intakes or their designated protection areas, and shellfish beds.*

The EPA's 1995 *Combined Sewer Overflows Guidance for Screening and Ranking* uses a set of seven criteria with associated rating points to establish a score for each CSO. The criteria are summarized in Table C-1. Additional scoring requirements are specified based on the most recent CSO performance history. This guidance was used to:

- Rank individual outfalls needing prompt attention
- Better allocate limited resources
- Prioritize any necessary modification.

The EPA scoring system was applied to Seattle's CSO basins. Points for Criterion 7 were assigned based on the results of previous studies and water quality data for known contaminants, as well as input from the public information workshops held in April 2008 (See Chapter 2 and Appendix A). As a first step, the basins were ranked solely on the basis of the EPA Criteria. After that, overflow data from the past two years, as reported to Ecology, were applied using EPA Criteria to achieve a final point score. The basins were then grouped into five categories of priority (A thru E), based on final score, 2008/2009 CSO frequency, and 2008/2009 CSO discharge volume. Table C-2 summarizes the results. Basin locations are shown in Figure C-1, with the Priority A and B basins highlighted.

TABLE C-1.
EPA RANKING CRITERIA

Description	Categories	Scoring		
Criterion 1				
Direct risk to public health	History of beach closings	250		
Contribute to non-attainment of designated uses on an ongoing basis	Significant risk to public health from direct contact with CSO pollutants			
Significant impacts to sensitive areas	Discharges to Outstanding National Resource Waters or National Marine Sanctuaries	200		
	Waters with threatened and endangered species and their habitat			
	Public drinking water intakes or their designated protection areas			
	Shellfish beds			
Criterion 2				
Frequency of dry weather overflows	Chronic (regular basis; not caused by an occasional blockage)	150		
	Infrequent (maintenance related)	75		
Criterion 3				
Receiving water body turbulence and mixing characteristics (energy)	**Water Body Type**	**Low Energy**	**Medium Energy**	**High Energy**
	Estuarine and Wetland	100	N/A	N/A
	Near-Shore Oceanic	60	40	20
	Off-Shore Oceanic	30	15	10
	Lakes and Ponds	100	N/A	N/A
	River	40	20	10
	Streams	60	40	20
Criterion 4				
Estimated proportion of CSO flow rate to receiving water flow rate (including CSO flow) in streams or rivers[a]	More than 50 percent	50		
	Twenty-five to 50 percent	30		
	Less than 25 percent	10		
Criterion 5				
If drinking water intake (downstream in flowing water systems)	Within 5 miles	100		
	Between 5 and 10 miles	50		
Criterion 6				
If the composition of wastewater (based on dry weather flows) includes industrial and commercial discharges or significant individual sources of potentially toxic materials	More than 50 percent	50		
	Thirty to 50 percent	25		
	Less than 30 percent	0		
Criterion 7				
Site-specific concerns not addressed through the other criteria		0 to 200		

Source: Combined Sewer Overflows Guidance for Screening and Ranking (EPA, August 1995) (text modified)
N/A = not applicable
a. Lakes and estuaries automatically receive 30 points

TABLE C-2.
BASIN SCORING TABLE

		2009		2008		
NPDES	Final Score	Frequency (events/ year)	Volume (MG)	Frequency (events/ year)	Volume (MG)	Receiving Water Body
Priority A						
13	730	2	0.83	2	0.04	Lake Washington
15	630	6	0.22	0	0.00	Lake Washington
40	630	3	3.00	1	0.51	Lake Washington
41	730	6	1.88	9	1.81	Lake Washington
43	730	5	0.39	3	1.27	Lake Washington
44	730	9	4.18	12	0.68	Lake Washington
45	730	6	1.47	5	0.31	Lake Washington
46	730	3	0.00	9	0.66	Lake Washington
47	780	12	6.34	3	0.09	Lake Washington
49	630	0	0.00	1	0.01	Lake Washington
171	730	6	2.48	4	4.24	Lake Washington
147	660	39	17.95	50	9.88	Lake Union
168	600	5	4.74	0	0.00	Longfellow Creek
169	600	2	1.40	1	0.19	Longfellow Creek
Priority B						
18	560	5	0.35	3	0.02	Union Bay
14	530	0	0.00	0	0.00	Lake Washington
28	545	5	0.03	26	0.53	Lake Washington
29	545	5	0.49	5	0.30	Lake Washington
30	545	2	0.08	2	0.07	Lake Washington
31	545	6	0.40	4	0.08	Lake Washington
32	545	6	0.12	1	0.02	Lake Washington
35	545	5	0.02	0	0.00	Lake Washington
36	545	6	0.12	0	0.00	Lake Washington
37	530	0	0.00	0	0.00	Lake Washington
38	580	2	0.55	0	0.00	Lake Washington
42	580	2	0.01	0	0.00	Lake Washington
48	530	0	0.00	0	0.00	Lake Washington
107	500	5	1.05	2	0.63	Duwamish River East Waterway
127	585	2	0.01	1	0.15	Lake Union
140	510	3	0.01	1	0.00	Portage Bay
150/151	500	9	0.25	2	0.06	Salmon Bay Waterway
152	500	14	1.54	11	0.36	Salmon Bay Waterway
161	530	0	0.00	0	0.00	Lake Washington
165	580	2	0.01	1	0.00	Lake Washington
170	500	0	0.00	0	0.00	Longfellow Creek
174	520	6	3.89	6	0.94	Lake Washington Ship Canal

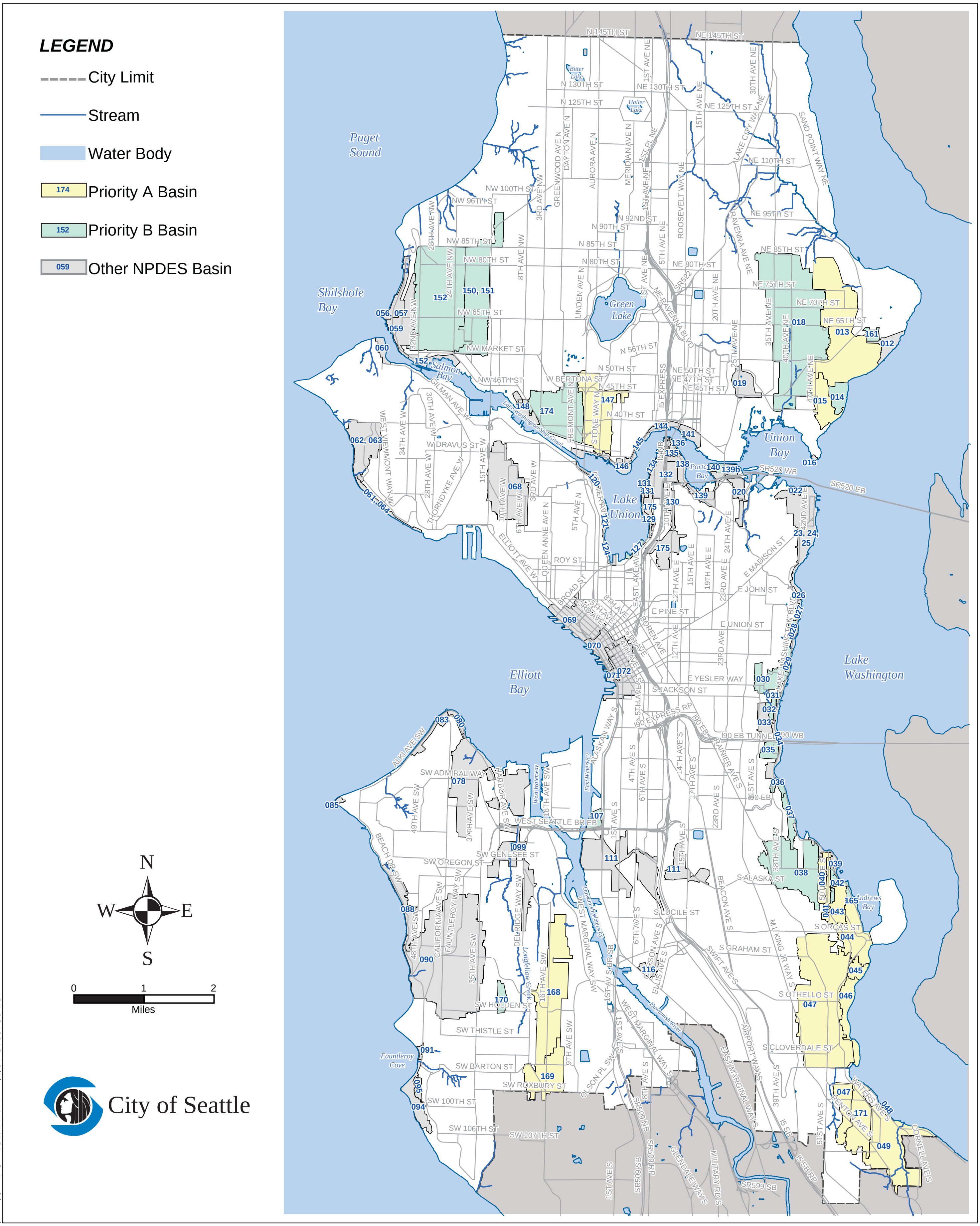
TABLE C-2 (continued).
BASIN SCORING TABLE

		2009		2008		
NPDES	Final Score	Frequency (events/ year)	Volume (MG)	Frequency (events/ year)	Volume (MG)	Receiving Water Body
Priority C						
16	420	0	0.00	0	0.00	Lake Washington
19	460	0	0.00	0	0.00	Union Bay
20	460	2	0.09	0	0.00	Union Bay
22	460	2	0.02	0	0.00	Union Bay
24	410	0	0.00	0	0.00	Lake Washington
25	495	2	0.00	1	0.47	Lake Washington
26	445	0	0.00	0	0.00	Lake Washington
27	445	0	0.00	0	0.00	Lake Washington
33	445	0	0.00	0	0.00	Lake Washington
34	445	0	0.00	0	0.00	Lake Washington
69	405	3	0.19	1	0.07	Elliot Bay
71	405	5	0.37	2	0.15	Elliot Bay
111	480	5	2.07	0	0.00	Duwamish River
120	460	0	0.00	0	0.00	Lake Union
121	460	0	0.00	0	0.00	Lake Union
124	460	0	0.00	0	0.00	Lake Union
129	410	0	0.00	0	0.00	Lake Union
130	410	0	0.00	0	0.00	Lake Union
131	460	0	0.00	0	0.00	Lake Union
132	410	0	0.00	0	0.00	Lake Union
134	460	0	0.00	0	0.00	Lake Union
135	460	2	0.00	0	0.00	Lake Union
136	410	0	0.00	0	0.00	Lake Union
138	460	2	0.39	1	0.04	Portage Bay
139	410	0	0.00	0	0.00	Portage Bay
141	410	0	0.00	0	0.00	Portage Bay
144	460	0	0.00	0	0.00	Lake Union
145	460	0	0.00	0	0.00	Lake Union
146	435	0	0.00	0	0.00	Lake Union
148	420	0	0.00	0	0.00	Lake Washington Ship Canal
175	410	0	0.00	0	0.00	Lake Union
Priority D						
12	395	0	0.00	0	0.00	Lake Washington
60	375	3	0.42	0	0.00	Salmon Bay
68	305	2	0.18	0	0.00	Elliot Bay
70	355	2	0.01	0	0.00	Elliot Bay
72	305	0	0.00	0	0.00	Elliot Bay
78	330	0	0.00	0	0.00	Elliot Bay
80	330	0	0.00	0	0.00	Elliot Bay
83	350	0	0.00	0	0.00	Puget Sound(Central)
95	365	5	0.38	3	0.01	Puget Sound(South Central)
99	350	0	0.00	0	0.00	Duwamish River West Waterway

TABLE C-2 (continued).
BASIN SCORING TABLE

NPDES	Final Score	2009 Frequency (events/ year)	2009 Volume (MG)	2008 Frequency (events/ year)	2008 Volume (MG)	Receiving Water Body
116	380	0	0.00	0	0.00	Duwamish River
Priority E						
56	275	0	0.00	0	0.00	Puget Sound(Central)
57	275	0	0.00	0	0.00	Puget Sound(Central)
59	275	0	0.00	0	0.00	Salmon Bay
61	255	0	0.00	0	0.00	Elliot Bay
62	255	0	0.00	0	0.00	Elliot Bay
64	255	0	0.00	0	0.00	Elliot Bay
85	275	0	0.00	0	0.00	Puget Sound(Central)
88	275	0	0.00	0	0.00	Puget Sound(Central)
90	265	0	0.00	0	0.00	Puget Sound(South Central)
91	265	0	0.00	0	0.00	Puget Sound(South Central)
94	265	0	0.00	0	0.00	Puget Sound(South Central)

* Volume data not available in CSO Annual Report
Priority A = Final Score >=600
Priority B = Final score >=500 to 600
Priority C = Final Score >=400 to 500
Priority D = Final Score >=300 to 400
Priority E = Final Score <=300



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TETRA TECH

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Seattle Public Utilities
2010 CSO REDUCTION PLAN AMENDMENT

Figure C-1
PRIORITY RANKING FOR NPDES BASINS

APPENDIX D.
CSO BASELINES

City of Seattle CSO Program

To: Mark Henley

From: Andrew Lee

Subject: CSO Baseline Annual Frequency and Volumes

Date: April 15, 2010

Cc: Nancy Ahern, Trish Rhay, Andrew Lee, Betty Meyer, Ed Mirabella, Theresa Wagner

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Combined Sewer Overflow Baselines

Annual Frequency and Volume

Purpose

To re-evaluate and document the baseline annual frequency and volume for each permitted Combined Sewer Overflow (CSO) outfall.

Background

On June 26, 2006, Combined Sewer Overflow Baselines for frequency and volume were submitted to Ecology by the City of Seattle and recommended for adoption for the NPDES Permit Annual Report Requirements. It was further recommended that these baselines be updated during the next CSO Reduction Planning effort, pursuant to NPDES Permit WA-003168-2, requirement due May 31, 2010. The updated baselines should be based on the Washington State Department of Ecology's adopted 24-hour inter-event time period.

Recommendation

Table 1 reflects the City's current estimate of annual CSO frequency and volume for each of the permitted CSO outfalls as of 2010. It is recommended that the attached Table 1 baselines be adopted for NPDES Permit Annual Report Requirements. It should be noted that the new baselines reflect recent improvements in the City's flow monitoring program and do not take credit for CSO improvements that have taken place since the June 2006 baselines were established.

Table 1

City of Seattle Baseline Annual CSO Frequency and Volume

Post 1968 to 2009 CSO Reduction Projects

NPDES No.	Frequency (No. Per Year)	Volume (MG Per Year)[Note8]
12	0[1]	0[1]
13	12[1]	6.7[1]
14	0[1]	0[1]
15	1.2[1]	0.3[1]
16	0[2]	0
18	6.6[2]	0.5
19	0.2[2]	0
20	2.6[2]	0.1
22	0.7[2]	0.1
24	0.2[2]	0
25	2.8[2]	1.6
26	0.3[2]	0
27	0[2]	0
28	15[2]	0.4
29	4.7[2]	0.3
30	5.4[2]	0.7
31	9.3[2]	0.5
32	8.4[2]	0.3
33	0.2[2]	0
34	1.4[2]	0.5
35	2.0[3]	0.3
36	2.7[2]	0.1
37	0[4]	0[4]
38	0.7[4]	0.4[4]
39	Abandoned 2006	Abandoned 2006
40	6.0[4]	0.8[4]
41	7.5[4]	0.9[4]
42	0.6[4]	0.02[4]
43	7.0[4]	0.7[4]
44	13[5]	9.3[5]
45	5.9[5]	1.1[5]
46	6.5[5]	0.9[5]
47	5.6[5]	1.8[5]
48	0[5]	0[5]
49	1.6[5]	0.8[5]

56	0[2]	0
57	0[2]	0
59	0.2[2]	0.4
60	1.7[3]	0.8
61	0[2]	0
62	0.7[3]	0
63	Abandoned 2003	Abandoned 2003
64	0.1[2]	0
68	1.4[2]	1.3
69	4.4[6]	1.4[6]
70	0.9[6]	0.2[6]
71	4.3[3]	1.3
72	1.2[6]	0.3[6]
78	0.3[2]	0.2
80	0[2]	0
83	0[2]	0
85	0[2]	0
88	0.3[2]	0.2
90	0.2[2]	0
91	0[2]	0
94	0.1[2]	0
95	3.0[2]	0.4
99	0.5[7]	2.8
107	3.8[2]	1.9
111	3.0[3]	7.9
116	0[2]	0
120	0[2]	0
121	0.1[2]	0
124	0[2]	0
125	Abandoned 2005	Abandoned 2005
127	0.7[2]	0.1
128	Abandoned 2003	Abandoned 2003
129	0.1[2]	0
130	0[3]	0
131	0.1[2]	0
132	0.7[3]	0
134	0[2]	0
135	0.3[3]	0
136	0[2]	0
138	2.3[2]	2.0
139	0.7[3]	1.4
140	4.1[2]	0.3
141	0.1[2]	0

144	0.1^{2}	0.2
145	0^{2}	0
146	0^{2}	0
147	33^{2}	19
148	0^{2}	0
150/151	15^{2}	2.0
152	15^{2}	9.7
161	0^{2}	0
164	Abandoned 2002	Abandoned 2002
165	1.1^{4}	0.02^{4}
168	3.9^{2}	1.6
169	2.2^{2}	49
170	0.4^{2}	0.1
171	4.1^{5}	0.75
172	Abandoned 1986	Abandoned 1986
174	11^{2}	5.9
175	0.7^{3}	0

Note 1 Baseline frequency and volume were determined using long-term (31 year) model simulations as reported in the Windermere CSO Reduction Project Engineering Report, November 18, 2009.

Note 2 Baseline frequency calculated using a 9-year average (2001~2009) of overflow frequencies as reported in the City of Seattle's CSO Annual Report to Ecology.

Note 3 Baseline frequency calculated using a 3-year average (2007~2009) of overflow frequencies as reported in the City of Seattle's CSO Annual Report to Ecology.

Note 4 Baseline frequency and volume were determined using long-term (31-year) model simulations as reported in Technical Memorandum to SPU: Genesee Confidence Bounds; November 17, 2009; prepared by Dan O'Leary, CH2M HILL

Note 5 Baseline frequency and volume were determined using long-term (31-year) model simulations as reported in Technical Memorandum to SPU: Henderson Confidence Bounds; December 15, 2009; prepared by Dustin Atchison, CH2M HILL

Note 6 Baseline frequency and volume were determined using long -term (31 year) model simulations as reported in "Major Project Decisions for Alaskan Way Viaduct Seawall Replacement Project Stormwater and CSO Control For vine, University, Madison and Washington Basins, April 2009."

Note 7 Baseline frequency calculated using a 2-year average (2008~2009) of overflow frequencies as reported in the City of Seattle's CSO Annual Report to Ecology.

Note 8 Baseline volume calculated using 3-year average (2007~2009) of overflow volume as reported in the City of Seattle's CSO Annual Report to Ecology, unless otherwise noted.