

# Combined Sewer Overflow Control

During heavy rainstorms when combined sewers in Seattle are full, untreated wastewater and stormwater may discharge into Puget Sound, the Duwamish Waterway, Elliott Bay, Lake Union, the Lake Washington Ship Canal, or Lake Washington.<sup>1</sup> These discharges, called combined sewer overflows (CSOs), help protect treatment plants and prevent sewer backups into buildings and onto streets. Although the wastewater in CSOs is greatly diluted, CSOs can carry chemicals and disease-causing pathogens that may be harmful to public health and aquatic life.

The RWSP calls for continued improvements to CSO control. RWSP CSO control policies provide direction regarding control project schedules, stipulating that highest priority be given to controlling CSOs that have the greatest potential to impact human health, bathing beaches, and/or species listed under the federal Endangered Species Act. So far, close to half of the county's CSO locations are controlled to meet the Washington State Department of Ecology (Ecology) standard of no more than an average of one untreated discharge per year at each CSO location. The RWSP identifies 21 projects to control all King County's CSOs by 2030. The policies also direct the county to implement its long-range sediment management strategy and, where applicable, to participate with partners in sharing responsibilities and costs of cleaning up sites such as the Superfund sites in the Duwamish Waterway.

This chapter provides information on CSO control and sediment management activities in 2008. The discussions include plans for activities in 2009.

## 5.1 CSO Control Activities in 2008

Key achievements of the CSO control program in 2008 are as follows:

- Made progress in improving the operation of the Mercer/Elliott West and Henderson/Norfolk CSO control systems
- Completed the 2008 CSO control plan update and started planning and procurement for the 2011 CSO program review
- Continued planning and project development of the Puget Sound Beach projects
- Completed 90 percent design of the Ballard Siphon replacement project, which will control CSOs at the Ballard Regulator Station
- Started Phase 2 of the CSO treatment technology pilot program
- Started evaluating use of green infrastructure technologies as CSO control alternatives
- Continued coordinating with the City of Seattle on CSO and stormwater management
- Responded to a program audit conducted by the U.S. Environmental Protection Agency.

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<sup>1</sup> Combined sewers exist in older cities across the nation, including Seattle.

### 5.1.1 Mercer/Elliott West CSO Control System

The Denny Way/Lake Union CSO control project was under way prior to adoption of the RWSP.<sup>2</sup> This project was a joint effort of King County and the City of Seattle to control CSOs into Lake Union and Elliott Bay. The new Mercer/Elliott West CSO control system was brought online in May 2005. It will control several of the city's CSOs in addition to the county's Denny Way and Dexter Avenue CSOs.

The system has now operated through three wet seasons (June through May).<sup>3</sup> Although volumes and frequencies at the Denny Way and Dexter Avenue CSOs have been substantially reduced, these locations are not yet controlled to the state standard.

The city and county have made adjustments to improve system operation and are continuing to assess the need for other refinements to address permit compliance issues. Because these facilities operate only seasonally and intermittently, several rounds of monitoring, planning and design, implementation, and testing over several seasons may be required to ensure the efficacy of solutions (see Chapter 10).

### 5.1.2 Henderson/Norfolk CSO Control System

The Henderson/Norfolk CSO control project was under way prior to adoption of the RWSP. The new system came online in May 2005. It was built to control two CSOs in Lake Washington and one CSO on the Duwamish Waterway at Norfolk.

With completion of this system, all of the county's CSOs along Lake Washington are controlled. Refinements of the Henderson Tunnel, which discharges treated CSOs to the Duwamish Waterway, are under way in order to bring the Norfolk CSO under control. Work to improve the operation of the disinfection system began in 2008 (see Chapter 10).

### 5.1.3 2008 CSO Control Plan Update and 2011 CSO Program Review

In 2008, the county's Wastewater Treatment Division (WTD) submitted the 2008 CSO plan update to Ecology as part of the West Point Treatment Plant's National Pollutant Discharge Elimination System (NPDES) permit renewal application.<sup>4</sup> Work on the update began in 2006 with a public workshop and continued in 2007 and early 2008 with public outreach and document production activities.

WTD also began planning and procurement for its second CSO program review, scheduled for transmission to the King County Council by the end of 2011. As with the 2006 program review, the purpose of the 2011 review is to prepare for the next CSO control plan update.

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<sup>2</sup> The Mercer/Elliott West CSO control system was the outcome of the Denny Way/Lake Union CSO control project.

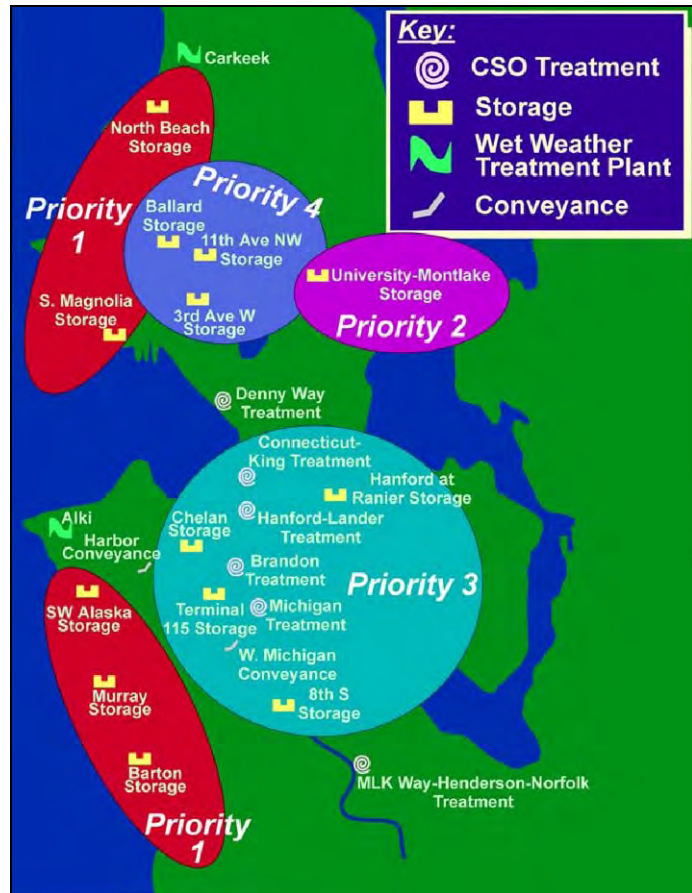
<sup>3</sup> CSO volumes and frequencies are assessed for the period from June 1 through May 31 each year in order to capture data for a whole wet season.

<sup>4</sup> CSO control plan updates are prepared in conjunction with NPDES permit renewal applications for the West Point Treatment Plant. The permit is renewed about every five years.

The CSO program review will reevaluate the prioritization of RWSP CSO control projects according to their potential to protect human health, the environment, and endangered species, and will consider adjustments to the schedule for completing the projects.

The project priorities put forth in the RWSP and carried forward in the 2008 CSO control plan update are shown in Figure 5-1 and described below:

- **Priority 1, CSOs near Puget Sound Beaches.** Four projects are under way and are scheduled for completion in 2014 (described later in this chapter).<sup>5</sup>
- **Priority 2, University-Montlake CSO.** This CSO is located at the east end of the Lake Washington Ship Canal. The control project, scheduled for completion in 2015, was given a high priority because of the amount of boating in that area and the associated potential for secondary contact with the water.
- **Priority 3, CSOs Along the Duwamish River and in Elliott Bay.** The RWSP calls for completion of nine projects along the Duwamish Waterway and in Elliott Bay between 2017 and 2027. These projects were given third priority because King County's 1999 Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay indicated that the level of bacterial pollution originating upstream of CSOs was high enough to dwarf any improvements in water quality resulting from CSO control projects.



Note: The SW Alaska Storage project is no longer needed; updated monitoring and modeling data indicate that this CSO is already controlled.

**Figure 5-1. Prioritized RWSP CSO Projects**

- **Priority 4, CSOs at the West End of the Ship Canal.** Three projects to control CSOs at the west end of the Lake Washington Ship Canal are scheduled to be completed by 2030. These are the last projects to be completed because significant CSO control had been accomplished in this area prior to adoption of the RWSP. As described later in this

<sup>5</sup> The SW Alaska CSO control project, included as a Puget Sound Beach project in the RWSP, was removed from the list. The CSO at this site is controlled as a result of a project to transfer flows from the Alki drainage basin to West Point and to treat excess flows at the Alki CSO Treatment Plant.

chapter, the Ballard CSO will now be controlled through the Ballard Siphon replacement project, scheduled for completion in 2012.

WTD is in the process of analyzing the differences between predicted and actual CSO frequency and volume in order to update and recalibrate its hydraulic model. Recalibration is done routinely to ensure that the model accurately predicts actual conditions. The process should be complete in early 2010 and may lead to changes in sizing, schedules, and costs of CSO control projects.

The 2011 CSO control program review will incorporate information from the recalibrated hydraulic model. The program review will also incorporate information from an assessment of technologies including the results of CSO treatment pilots under way, an evaluation of green stormwater infrastructure as a CSO control alternative, and any new environmental or public health findings with implications for CSO control.

The 2008 CSO control plan update and the 2006 CSO control program review are available at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/PlanUpdates.aspx>.

### 5.1.4 Puget Sound Beach Projects

In January 2007, King County initiated the project development and predesign phases of the four CSO control projects along Puget Sound beaches—Murray and Barton in West Seattle, South Magnolia along north Elliott Bay, and North Beach near Carkeek Park. Because the Barton Pump Station sends flow to the Murray Pump Station and anything that happens at one affects the other, design and construction of the pump station upgrades and CSO control projects are being coordinated.

Control options that may be considered, either alone or in combination, are as follows:

- Store peak flows during large storms and send flows to the existing treatment plant once the storm passes
- Increase pumping and conveyance capacity to direct peak flows to existing treatment facilities
- Reduce peak flows of stormwater and groundwater into the wastewater collection system
- Treat peak flows at a new local treatment facility during large storms.



Alternative control options and sites will be identified based on screening criteria. Initial criteria have been developed and will be further refined based on community feedback. Community meetings are being held in each of the four project basins.

Flow monitoring in the City of Seattle's sewer system has been conducted in each of the four basins to assess whether removing stormwater from these sewers is a viable option for CSO control. In addition, the use of green stormwater infrastructure will be explored as an alternative for CSO control in one of the basins (see the discussion later in this chapter). The most suitable basin will be identified in cooperation with the City of Seattle, and the feasibility and costs of the strategy will be assessed.

Predesign will continue through 2009 and end with issuance of facility plans in 2010. Washington State low-interest loans were awarded to fund facility plans for all but the South Magnolia project. Construction is expected to begin in late 2013.

More information can be found at  
<http://www.kingcounty.gov/environment/wtd/Construction/Seattle/BeachCSO.aspx>.

### 5.1.5 Ballard Siphon Replacement Project and CSO Control

WTD continues to find opportunities to optimize cost-effectiveness by coordinating CSO control with other WTD projects. The Ballard Siphon replacement project is one example of such coordination. The project—initiated in 2006 and scheduled for completion in 2012—will protect water quality in the Lake Washington Ship Canal by replacing the 70-year-old wooden sewer pipe that extends across the floor of Salmon Bay near the Hiram M. Chittenden Locks.

The project is being designed to bring the CSO at the Ballard Regulator Station under control and eliminate the need for the CSO storage project at this location that was scheduled in the RWSP for completion in 2029. Replacement of the siphon also will reduce CSOs at the 11th Avenue Regulator Station, likely reducing the size of the CSO storage project planned to be completed at this location in 2030.

### 5.1.6 CSO Treatment Technology Pilot Program

The RWSP calls for satellite CSO treatment for CSOs at four sites—Kingdome-Connecticut, Hanford-Lander, Brandon, and Michigan. Flows at these CSO sites are so high that storage facilities to hold all the flows would be large, difficult to site, and prohibitively expensive. Even if such storage facilities could be built, they could not be drained to regional plants before the next storm begins to fill them again.

The RWSP specified the use of conventional primary sedimentation for CSO treatment. Since adoption of the RWSP, some technological advances have occurred that could have application to CSO control. In 2007, a program was started to pilot test emerging treatment technologies for these sites. The objective of the program is to determine whether high-rate sedimentation technologies hold the potential to be cost-effective alternatives to the currently planned conventional primary CSO treatment. The program will provide reliable information to support decision-making and will help the county to better understand the capabilities and limitations of various technologies.

The pilot program was designed to be completed in three phases:



- **Phase 1 (2007–2008) – Project development, jar testing, and technology identification.** Phase 1 was completed in 2008. After a review and assessment of the adequacy of the operating data elsewhere in the United States of available and developing technologies, the Phase 1 work plan recommended testing of two technologies: chemically enhanced clarification and chemically enhanced clarification with lamella plates (Figure 5-2).<sup>6</sup> These technologies were selected for testing because they have the potential to reduce the footprint and costs of large CSO treatment facilities but pose technical questions that can be evaluated through pilot testing. Testing of these technologies will allow them to be considered side-by-side with other technologies during future full-scale alternatives analyses.
- **Phase 2 (2008–2009) – Pilot-scale testing at a treatment plant.** Phase 2 pilot-scale testing was initiated at the West Point Treatment Plant in late 2008 and is anticipated to continue into the fourth quarter of 2009. The testing is evaluating optimum loading rates and contaminant removal using fabricated CSO water (diluted wastewater) and a variety of chemicals designed to enhance settling of solids.
- **Phase 3 (2009) – Pilot-scale testing at a CSO site, if necessary.** It appears, based on work done to date, that Phase 3 testing will not be necessary.



**Figure 5-2. Exterior of the CSO Treatment Pilot Plant (Left) and Lamella Plates (Right)**

### 5.1.7 Evaluation of Green Stormwater Infrastructure

In 2007, the U.S. Environmental Protection Agency (EPA) and other national organizations (National Association of Clean Water Agencies, Natural Resources Defense Council, Low Impact Development Center, and Association of State and Interstate Water Pollution Control Administrators) agreed to promote a set of techniques, technologies, approaches and practices—

<sup>6</sup> Lamella plate technology reduces turbulence, allowing solids to settle more rapidly.

collectively referred to as green stormwater infrastructure (GSI)—as an environmentally preferable approach to wet-weather management.

GSI can be used to eliminate or reduce the amount of water and pollutants that run off a site and ultimately are discharged into adjacent water bodies. It generally refers to systems and practices that use or mimic natural processes to infiltrate, evapotranspire (to return rainwater to the atmosphere either through evaporation or by plant metabolism), or reuse stormwater or runoff on the site where it is generated. Approaches currently in use include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, porous and permeable pavements, and vegetated median strips. These approaches can be used to keep rainwater out of the sewer system so that it does not contribute to a CSO. They may also provide greater adaptability in responding to potential climate change impacts on wastewater systems.

Following its 2007 agreement, EPA released an action strategy in 2008 for managing wet-weather flows with GSI. In addition, EPA has required a number of agencies across the country to analyze GSI alternatives in their CSO long-term control plans. In response to this national trend, WTD will evaluate the Puget Sound Beach projects and future CSO control projects for opportunities to use GSI.

### 5.1.8 Coordination with the City of Seattle

Extensive coordination with the City of Seattle, including exchange of rainfall, modeling, flow, and Geographic Information System (GIS) data, continues to occur. The county is providing data in support of the city's work in developing a system hydraulic model and in implementing CSO control projects in the Windermere, Genesee, and Diagonal areas. The city has provided data to the county in support of system characterization and consideration of GSI alternatives for the county's Puget Sound Beach projects. Each agency is participating and will continue to participate in the other's planning processes.

### 5.1.9 Program Audit

In December 2007, EPA began an audit of King County's CSO control program for alignment with EPA's 1994 CSO Control Policy. The City of Seattle's CSO control program underwent a similar audit at the same time. These audits are being routinely conducted across the country in larger communities with CSOs. The audits sometimes result in consent decrees covering CSO long-term control plans and project schedules. The county expects to receive initial audit findings in spring 2009.

## 5.2 Sediment Management Activities in 2008

King County is responsible for remediating CSO-related sediment contamination under the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the state Model Toxics Control Act (MTCA).<sup>7</sup> To meet RWSP policies, WTD is carrying out a sediment management plan developed in the late 1990s to remediate sediment near CSO

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<sup>7</sup> CERCLA is commonly known as Superfund.

outfalls that are contaminated with a variety of heavy metals (such as lead, copper, and zinc), phthalates, polychlorinated biphenyls (PCBs), and hydrocarbons.<sup>8</sup> Most of the contamination dates from the first half of the twentieth century.

Since completion of the sediment management plan, King County has been coordinating its sediment management efforts in the Duwamish Waterway with two federal Superfund projects: the Harbor Island and the Lower Duwamish Waterway projects. The Harbor Island Superfund project will remediate sediments at the county's Lander and Hanford CSOs. The Lower Duwamish Waterway project area includes nine county CSOs; it is likely that not all these CSOs will require sediment cleanup under Superfund.

### 5.2.1 Sediment Management Plan

The sediment management plan calls for cleanup of the Denny Way, Hanford/Lander, and Chelan CSOs and development of a model to better predict the fate and transport of contamination.<sup>9</sup>

In mid-2007, design was completed for cleanup of the old Denny Way CSO site off of Myrtle Edwards Park. Ecology finalized an Agreed Order and Interim Action Work Plan in October 2007. King County dredged and capped the area in November 2007–February 2008. Dredging occurred over 32 days, removing approximately 14,376 cubic yards (CY) of sediment contaminated with PCBs, hydrocarbons, and mercury (Figure 5-3). A total of 47 pounds of PCBs were removed from the environment. The excavated area was then backfilled over a 26-day period with approximately 19,460 CY of clean sand, armor rock, and habitat-enhancing gravel. In April 2008, the county began a 10-year program to monitor sediment quality at the site. After completion of five years of monitoring, the county will evaluate alternatives for cleaning up nearby areas.

The model to better predict deposition of contaminants around CSO outfalls will be ready in 2009. The model will help to identify which CSOs are likely to have contaminated sediments and will inform cleanup decisions.

Visit the Sediment Management Program Web site for more information:  
<http://www.kingcounty.gov/environment/wastewater/SedimentManagement.aspx>.

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<sup>8</sup> The sediment management plan is available at  
<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/ManagementPlan.aspx>.

<sup>9</sup> The Hanford/Lander and Chelan CSOs are discussed under "Harbor Island Superfund Site."





**Figure 5-3. Dredging of Contaminated Sediments at the Old Denny Way CSO Site**

### 5.2.2 Harbor Island Superfund Site

The Harbor Island Superfund site is divided into the West Waterway Operable Unit and East Waterway Operable Unit. In 2003, EPA issued a Record of Decision stating that no remedial action is necessary in the West Waterway, which includes sediment near the Chelan CSO. No future cleanup is anticipated at this CSO. The county continues to monitor the location.

In 2006, King County, the Port of Seattle, and the City of Seattle formed a group to complete the work necessary to determine the final cleanup of the East Waterway. Work on the site began in 2007 after EPA approved the scope of the remedial investigation and feasibility study. In 2008, dredging began in front of Terminal 30 near the county's Lander CSO; 20,000 CY of contaminated sediment will be removed and disposed of at an upland facility. The Lander project will be completed in 2009.

In 2008, the King County Industrial Waste Program (KCIW) began planning and implementing source control activities, including business inspections and sampling, in order to supplement available chemistry data on the Hanford and Lander CSOs. The program also collected samples of stormwater runoff to assess potential PCB concentrations in stormwater that enters the combined sewers from the south end of the old Rainier Brewery site that drains to the East Waterway (see Chapter 10).

### 5.2.3 Lower Duwamish Waterway Superfund Site

The county continues to work to improve water quality in the Lower Duwamish Waterway through actions such as reducing CSOs, restoring habitats, capping and cleaning up sediments, and controlling toxicants from industries and stormwater runoff. King County is partnering with the City of Seattle, the Port of Seattle, and the Boeing Company under a consent agreement with EPA and Ecology to prepare a remedial investigation and feasibility study for the Lower Duwamish Waterway Superfund site. The draft remedial investigation, which defines the extent and inherent risks of contamination, was completed in 2008 and is expected to be finalized in 2009. The work that began on the draft feasibility study in 2008, which will identify cleanup alternatives, will be completed in 2009.

The county is participating in two early action sites—the Diagonal/Duwamish CSO/Storm Drain (part of the sediment management plan) and the Slip 4 CSO—to clean up portions of the waterway earlier than required.<sup>10</sup> The cleanup at Diagonal/Duwamish was completed in 2004. The dredged area was capped with 3 to 6 feet of clean sediment and gravel to provide new fish habitat. Follow-up work was completed at the site in February 2005, and post-remediation monitoring is providing critical information that can be used for determining cleanup alternatives for the entire Superfund site.<sup>11</sup> In early 2007, source control sampling from areas upland of Slip 4 indicated that PCBs were still entering the storm drains that discharge to the slip. EPA put the cleanup of Slip 4 on hold until contamination can be adequately controlled to prevent recontamination after cleanup.

The Lower Duwamish Source Control Work Group continues to meet to discuss source control issues and activities that can affect sediment remediation in the area. KCIW participates in this work group and has collected and analyzed industrial waste discharge and rainfall samples for contaminants, such as phthalates, found in the cleanup area. In 2008, the program published final reports on its findings (see Chapter 10).

Visit the Duwamish Waterway Programs Web site for more information:  
<http://www.kingcounty.gov/environment/wastewater/DuwamishWaterway.aspx>.

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<sup>10</sup> The Slip 4 cleanup is being managed by the City of Seattle. King County is partnering with the city on this effort. WTD serves as the county's lead agency on behalf of WTD and the King County International Airport/Boeing Field.

<sup>11</sup> Diagonal/Duwamish project documents can be found at  
<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/DuDi/Library.aspx#Closure>.