

Comprehensive Sediment Quality Summary Report for CSO Discharge Locations

December 2009



King County

Department of Natural Resources and Parks

Wastewater Treatment Division

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1.0 INTRODUCTION

King County manages 38 combined sewer overflow (CSO) sites in the City of Seattle. These sites are regulated through the National Pollutant Discharge Elimination System (NPDES) permit for the county's West Point Wastewater Treatment Plant. In the most recent permit renewal, effective July 1, 2009, the Washington State Department of Ecology (Ecology) required submittal, by December 31, 2009, of a Comprehensive Sediment Quality Summary Report for the sediment near the county's CSO outfalls. The requirement reads as follows:

S18.J.1. The Permittee must submit to Ecology for review and approval a Comprehensive Sediment Quality Summary Report for all CSO discharge locations (CSO treatment plant outfalls and all other CSO outfalls) no later than December 31, 2009. The purpose of this report is to provide information for an assessment, based on existing information, of the potential for sediment impacts from CSO discharges and provide a basis for determining data gaps. This report must provide a summary of all available information on the site history, quantity and quality of the discharges, receiving water characteristics, and current and past sediment quality near the CSO outfalls. The report must also include status of sediment cleanup sites and monitoring plans. An annotated outline and list of references for the report will be submitted to Ecology for review and approval by September 1, 2009.

This report provides monitoring data on sediments around King County's CSO outfalls that have been collected for a variety of purposes, including compliance with state sediment standards. For most CSOs, data are available to help determine whether impacts have occurred and next steps are needed. For CSOs where sediment data have not been collected, information provided on site history, quantity and quality of discharges, and receiving water characteristics can help to determine the potential for sediment impacts.

Under state sediment standards, data that exceed the sediment criteria trigger structured administrative procedures and criteria for identifying, screening, ranking, prioritizing, and cleaning up sites with contaminated surface sediments. These more detailed assessments typically include collection of additional data and initiation of source inventories. In complex urban areas like Seattle where sediments reflect a variety of overlapping historical and contemporary pollution inputs, these efforts require the involvement of multiple stakeholder agencies and organizations. King County has participated in many such efforts. Plans and early remediation actions are close to completion for CSOs in the Duwamish River and its East and West Waterways. Planning for the west Lake Washington Ship Canal and Lake Union areas is on hold pending the availability of regulatory agency resources and funding. No planning efforts have undertaken for the Lake Washington areas and Puget Sound shorelines. If data indicate the need for next steps, the county will willingly participate with other stakeholder entities in affected areas.

Ecology manages sediment data in a database called SEDQUAL, now EIM. When SEDQUAL came online in the mid-1990s, Ecology requested that all previous marine sediment data be resubmitted along with expanded QA/QC information to upload to SEDQUAL. Ecology is now moving data, including the county's marine data, from SEDQUAL to EIM. Ecology will most likely add freshwater data to EIM in the future. King County will provide that data when requested.

This chapter describes the King County regional wastewater system and provides the history of the Seattle sewer system and the improvements made to the system by Metro (later King County) in creating the regional system. Maps of the system as it existed in 1958, just prior to when Metro assumed responsibility, and updated versions of these maps that show current conditions are provided at the end of the chapter. The chapter also describes the stages of the county's CSO control efforts, including the monitoring of CSO overflow quality and sediments in response to changing regulations and program needs.

1.1 Description of the Regional Wastewater System

King County's wastewater system is the largest in the state. The system includes two large regional treatment plants (the West Point plant in the City of Seattle and the South plant in the City of Renton), one small treatment plant and one community septic system (Beulah Park and Cove) on Vashon Island, one small treatment plant in Carnation, four CSO treatment facilities (Alki, Carkeek, Mercer/Elliott West, and Henderson/Norfolk—all in the City of Seattle), over 350 miles of pipes, 19 regulator stations, 42 pump stations, and 38 CSO outfalls. The West Point, South, Vashon, and Carnation plants provide secondary treatment; the CSO treatment facilities provide CSO treatment (equivalent to primary treatment). All treatment plants, except the Carnation plant, discharge treated and disinfected effluent to Puget Sound.

There are two types of sewer systems in the King County wastewater service area: separated and combined. In separated systems, different pipes carry stormwater and wastewater. In combined systems, the same pipes carry both stormwater and wastewater. Years ago when sewers were constructed in Seattle, combined sewers were common practice. Until the early 1940s, nearly all sewers constructed in the city were combined sewers. Approximately 41,000 acres of the 55,000 acres in Seattle are served by combined or partially separated sewers. Areas outside of Seattle are served by separated sewers.

The Brightwater Treatment Plant, scheduled for completion in 2011, will serve areas in north King County and south Snohomish County. These areas are currently served by West Point in the summer; their flows are diverted to South plant in the winter to free up capacity at West Point for managing stormwater inputs to the Seattle combined system. Once the new Brightwater plant is online, both the summer and winter flows from these areas will go to Brightwater and almost all flows to West Point will be from the Seattle system.

The wastewater system is managed to send as much flow as possible to secondary treatment plants, to send additional flow to CSO treatment facilities, and to discharge untreated flow only as a last resort to avoid backups into home basements and streets. During heavy rainstorms when sewers are full, untreated wastewater and stormwater in combined sewers discharge directly from CSO outfall pipes into marine waters, lakes, and rivers (Figure 1-1). These untreated discharges occur in three ways:

- Pump stations overflow to protect the stations from flood damage.
- Regulator stations control the volume of flow entering main interceptors from the local system; flows greater than the capacity of an interceptor will overflow.
- Weirs located in pipes allow for passive overflows when flow reaches the level of the weir; flows greater than the capacity of the pipe will overflow.



Figure 1-1. King County and City of Seattle CSO locations

1.2 History of the Seattle Sewer System

The aquatic sediments of the Seattle area tell the story of the history of the city—its population growth and industrial development. A component of that story is the development of the urban wastewater system.

The community was incorporated by the territorial legislature in 1865 when its population was approximately 300. To manage the waste generated by this population, a board of public works undertook construction of the first sewers. These sewers were wooden troughs or boxes that carried wastes to the most convenient water bodies—Elliott Bay and Lake Union. Organized planning and construction of sewers began in 1875, and the first permanent sewer, running from Fifth Avenue along Madison Street to Elliott Bay, was constructed in 1882. As time went on, water pollution rapidly increased to the extent that the design of a larger sewer system was warranted.

Conflicting plans called for separated sewers (1889, the Waring Report) and combined sewers (1891, the Williams Report) (Brown and Caldwell, 1958). Both reports called for construction of a large tunnel (later called the Lake Union tunnel) to carry wastes from the Lake Union area to Elliott Bay. The combined sewer approach was selected, and the first three systems were built to move wastewater from fresh waters to mixed salt waters. The three systems were the Lake Union Tunnel system that discharged to Elliott Bay, most of the North Trunk that discharged to Puget Sound off West Point, and the Beacon Hill Tunnel system that discharged to the Duwamish River. A sewer system for the Ballard area that discharged to Salmon Bay was built in 1904 and was connected to the North Trunk by the Ballard Siphon in 1935. Three combined sewage treatment plants were constructed in 1924 along the eastern edge of Seattle on Lake Washington at Perry Street, Alaska Street, and Massachusetts Avenue.

As concern for the protection of Lake Washington as a drinking water source increased, interceptors were built in the 1930s along the lake, which eliminated the need for the three plants and stopped all discharge of dry-weather flows. Approximately 30 outfalls continued to discharge storm-based flows to the lake. The Lake Washington interceptors were (1) a north section with pump stations to lift wastewater into the North Trunk system; (2) a central section with pumps to lift the flow into the Beacon Hill Tunnel system; and (3) a south section with pumps to lift flow to a new Henderson Street system. Concern for the protection of the Duwamish River also led to decisions to intercept sewers for transport to a new treatment facility where Diagonal Avenue ends on the east side of the river to manage both the Henderson and Duwamish flows. The Diagonal plant, intended to treat only dry-weather flow, was completed in 1940. Overflows of storm-based flows continued in Lake Washington and the Duwamish River.

These efforts did not keep up with growth and pollution. As the volume of raw sewage and the number of points of discharge increased, state and local health authorities, the Pollution Control Commission, and state and local agencies interested in water resources expressed increasing concern. More studies ensued, funding votes failed, and conflicting plans were developed. In 1956, the Pollution Control Commission established a policy aimed at correction of the discharge condition. The City of Seattle hired the engineering firm of Brown and Caldwell to perform a comprehensive survey of metropolitan sewerage systems and needs. Financial participation by Washington State and King County was also negotiated.

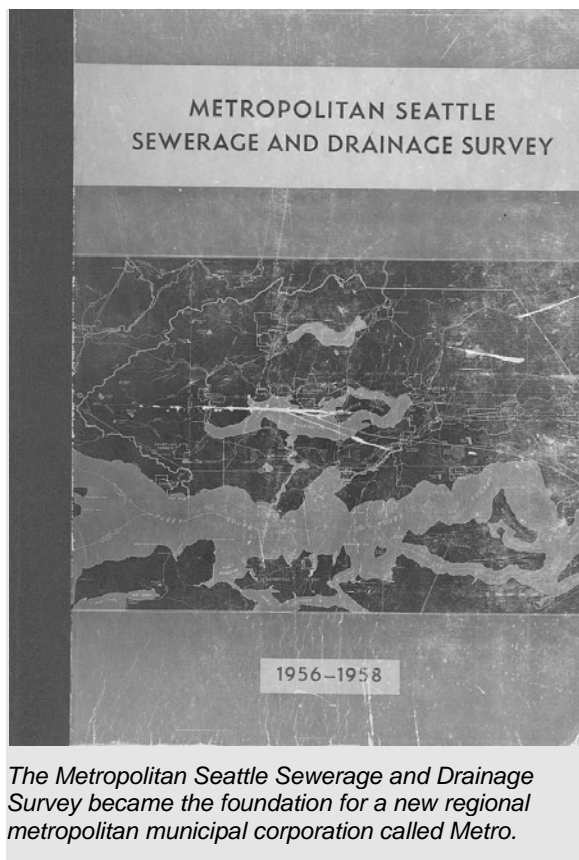
The *Metropolitan Seattle Sewerage and Drainage Survey* (March 1958) became the foundation for a new regional municipal corporation called the Municipality of Metropolitan Seattle (Metro). Metro was empowered to plan, finance, and administer wastewater services. This document provided a thorough baseline snapshot of conditions existing at the start of Metro's responsibilities, and its recommended plan became the approved Metro comprehensive sewerage plan. It can be found at <http://www.kingcounty.gov/environment/wtd/About/History/PlanningSystem/1958Plan.aspx>.

Metro assumed ownership and responsibility for regional facilities in 1962. In Seattle, regional facilities, including CSOs, were defined as those beginning at the confluence of the drainage of 1,000 acres or more. Metro's responsibility was to provide wholesale conveyance and treatment to the local agencies, who retained responsibility for their local systems and the primary retail relationship with customers. The City of Seattle retained responsibility for CSOs in drainage areas less than 1,000 acres. Figures 1-3 through 1-22 (located in Section 1.6) show the 1958 baseline sewer system and updated versions of the same areas to show current conditions.

In subsequent years, Metro built conveyance facilities to new treatment plants and decommissioned old plants. CSOs remained at the intersections of the old raw sewage outfalls and the new interceptors and from pump stations to provide storm relief, but the dry-weather wastewater and the vast majority of storm-related flows were captured for treatment. Once the regional system was completed, work began to reduce CSOs. Metro also implemented an industrial pretreatment program and intercepted all industrial process water discharges that had previously gone to local waters.

Metro was designated the Clean Water Act Section 208 regional watershed planning agency in the late 1970s, and has since participated in collaborative water quality assessments and restorations. As the quality of the regional water column improved, attention shifted to sediment quality. In compliance with Chapter 173-245 WAC, Metro characterized the CSO discharges and sediments off the outfalls in the West Point Treatment Plant system between 1988 and 1994.

Since 1994, when King County assumed Metro's responsibilities for regional wastewater management, sediment characterization has expanded to comply with the new Sediment Management Standards. King County published a sediment management plan in 1999 (King County, 1999), participates in collaborative sediment restoration efforts, including the Elliott Bay/Duwamish Restoration Program and the Lower Duwamish Waterway and Harbor Island East Waterway Superfund initiatives, and is poised to participate in other efforts as they become regional priorities.



The Metropolitan Seattle Sewerage and Drainage Survey became the foundation for a new regional metropolitan municipal corporation called Metro.

The sediments near CSOs reflect the legacy of the development of Seattle as a major urban and industrial area. Metro and King County's contributions since the 1960s has been to capture the majority of discharges to these sites, limit chemical components, steadily reduce the remaining CSO discharges, and implement several sediment remediations.

King County is committed to participating in any necessary sediment cleanups in partnership with the other entities that have contributed to the contamination of the sediments and/or have a stake in their restoration.

1.3 History of King County CSO Control Planning

In response to the Clean Water Act of 1972, Metro adopted the *Combined Sewer Overflow Control Program* in 1979. Since adoption of this first program, Metro and then King County have modified plans to respond to evolving CSO regulations, including Ecology's control standard of no more than an average of one untreated discharge per year at each CSO location.

The most recent CSO control plan was adopted in 1999 as part of the Regional Wastewater Services Plan (RWSP) and was updated in 2000 and again in 2008 as a part of the West Point plant's NPDES permit renewal. No changes to the RWSP CSO control plan were recommended in these updates.

Construction of CSO control facilities in the region began in the late 1970s. So far, about \$360 million (2008 dollars) has been spent to control CSOs and another \$400 million is planned to implement the CSO control projects in the RWSP. Many early projects involved sewer separation, flow diversion, and storage tunnels. Most current and future projects involve construction of conveyance improvements, storage tanks, and treatment facilities.

Control facilities that were under construction prior to RWSP adoption—the Mercer/Elliott West and the Henderson/Norfolk CSO control systems—were brought online in 2005. Now, based on the last seven years of monitoring, 16 of King County's 38 CSOs are controlled to Ecology's standard. The control status at two more CSO sites where projects have recently been completed will be assessed after the facilities have operated a sufficient number of years. (The projects to build the systems were called the Denny Way/Lake Union and Henderson/MLK/Norfolk CSO

CSO-Related Studies, 1958–2000

1958 *Metropolitan Seattle Wastewater and Drainage Study* recommended sewer separation and storage, as needed, to control CSOs as part of a larger schedule of projects.

1978 Areawide Section 208 Water Quality Plan recommended sewer separation and storage, as needed, to control overflows.

1979–1984 *Toxicant Pretreatment Planning Study* recommended that CSO control be part of a coordinated Elliott Bay Action Plan and that source control, including enhancement of Metro's pretreatment program, should be a priority.

1983 *Water Quality Assessment of the Duwamish Estuary* identified CSOs as a minor contributor to the larger pollution problem and CSO control as one part of the solution.

1988 *Elliott Bay Action Plan* recommended elimination of direct industrial discharges into the bay and implementation of stormwater source control to improve CSO quality; set Denny Way and Michigan Street as priorities for CSO control.

1988–1996 Metro Receiving Water Monitoring Program affirmed that CSOs were not a major part of larger wet-weather problems and that CSO control would not yield the largest benefit to water quality.

1988–1997 Metro/King County CSO Discharge and Sediment Quality Characterization affirmed the Denny Way CSO as a priority for control based on pollutant concentrations.

1999 *CSO Water Quality Assessment of the Duwamish River and Elliott Bay* recommended continuation of CSO control to meet state regulations and helped set control priorities.

1999 *Sediment Management Plan* recommended that sediment remediation at CSO sites proceed ahead of CSO control because most contamination was from historical inputs.

control projects.) The remaining 20 uncontrolled CSOs will meet state standards as capital improvement projects are completed between 2013 and 2030. The first four RWSP projects near Puget Sound beaches are in design.

Since 1988, when systematic monitoring and measuring of CSOs began, these control efforts have reduced CSO volumes from an estimated 2.4 billion gallons per year to approximately 900 million gallons per year (Figure 1-2).

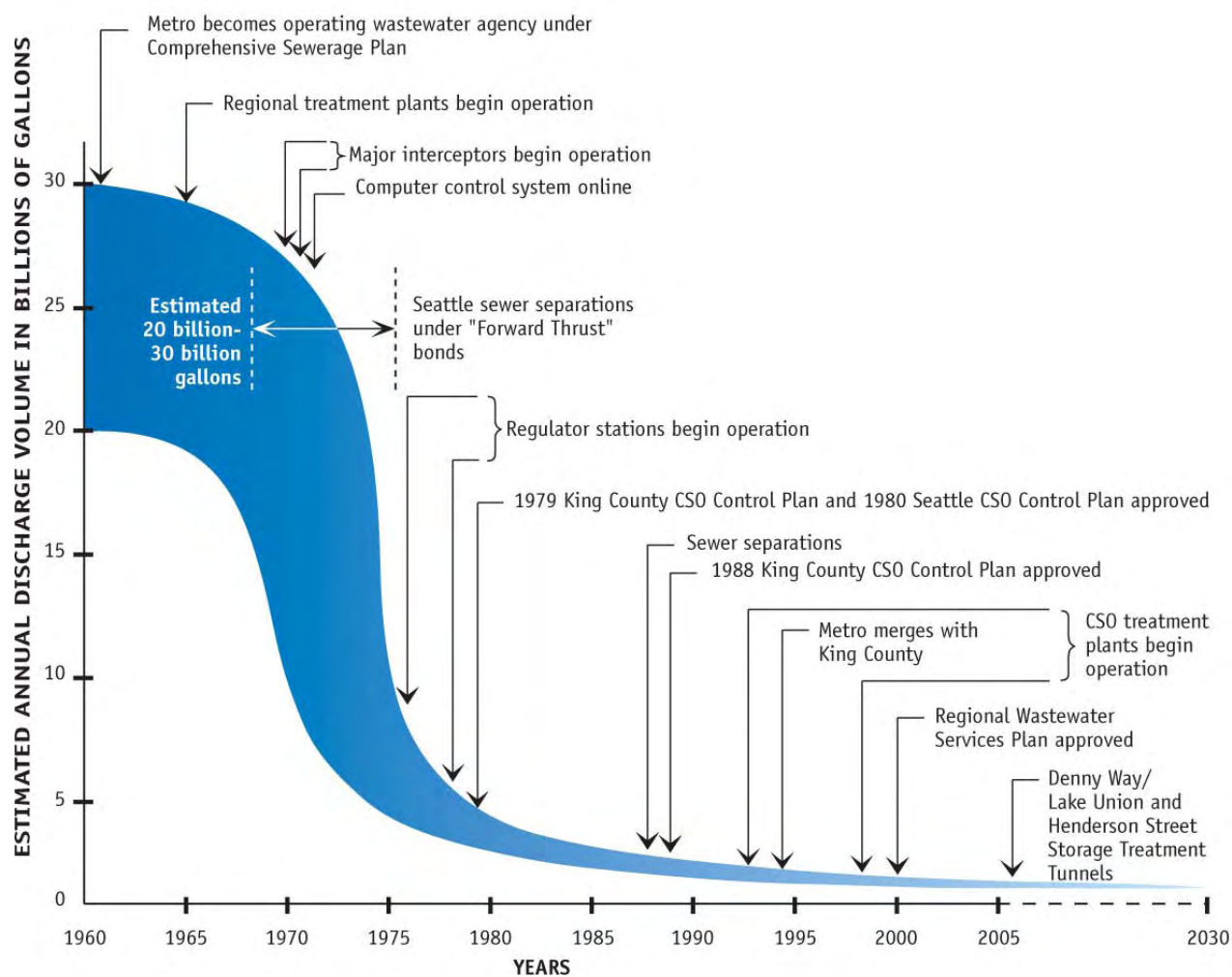


Figure 1-2. Estimated Annual CSO Discharge Volume, 1960–2030

1.4 History of King County CSO Sediment Management Program—Monitoring and Data

The following chronology describes the evolution of King County's Sediment Management Program and its interaction with CSO control decisions.

In the early 1980s, Metro performed overflow and sediment sampling at selected CSO sites to characterize CSO impacts for CSO planning and control projects. Later, in response to new Chapter 173-245 WAC requirements, Metro expanded its monitoring to characterize the CSOs. Data were submitted in CSO control plan updates and project facility plans.

WAC 173-245-040(2) states:

(2) CSO reduction plans shall include the following information together with any other relevant data as requested by the department.

(a) Documentation of CSO activity. Municipalities shall complete a field assessment and mathematical modeling study to establish each CSO's location, baseline annual frequency, and baseline annual volume; to characterize each discharge; and to estimate historical impact by:

(i) Flow monitoring and sampling CSOs. Monitoring and sampling at one or more CSO sites in a group that are in close proximity to one another is sufficient if the municipality can establish a consistent hydraulic and pollutant correlation between or among the group of CSO sites. Sampling may not be required for CSO sites that serve residential basins; and

(ii) Developing a rainfall/stormwater runoff/CSO model to simulate each CSO site's activity; and

(iii) Verifying the model's accuracy with data collected under (a)(i) of this subsection; and

(iv) In circumstances where an historical impact may be discernible, observing and sampling the receiving water sediments adjacent to each CSO site or group of sites to establish the presence and extent of any bottom deposits; and

(v) If the sewer service area upstream of a CSO site includes sanitary sewer sources other than domestic sewage, samples of the sediment deposits shall receive heavy metal analysis and organic pollutant screening. Pending review of results of these analyses, the department may require additional pollutant analyses. If two or more CSO sites serve the same industrial/commercial sources, sediment sampling adjacent to one representative CSO site may suffice.

Metro submitted a monitoring plan on December 8, 1988; the plan was verbally approved by Gary Anderson of Ecology on January 4, 1989. The monitoring plan laid out systematic sampling of overflow quality and sediments in front of the active West Point system outfalls. Ecology described the purpose of this monitoring as a one-time characterization to identify control priorities around which the CSO control plan would be developed. At that time, the sewer systems for the Carkeek and Alki treatment plants had not yet been connected to the West Point system. They were independent systems with their own NPDES permits that did not

include requirements to characterize CSOs and develop control plans. Because the plants served residential areas with only light commercial development, sampling of CSOs from their outfalls was not done.

The CSO monitoring plan was implemented and completed in 1995. The results affirmed that the sediments around CSOs were of concern. The only location that stood out as needing early action was the Denny Way CSO. It was decided that the monitoring data would not determine the order and timing of the remaining control projects in the control plan and that other priorities would be considered.

In 1990, Sediment Management Standards (Chapter 173-204 WAC) were established. The sediment standards provide “the basis for management and reduction of pollutant discharges” and a “management and decision process for the cleanup of contaminated sediments.” They establish “administrative procedural requirements and criteria to identify, screen, rank and prioritize, and clean up contaminated surface sediment sites.” In response to the standards, Metro proposed a comprehensive plan to structure the sampling according to the new protocols, perform any needed bioassays, model the discharge impact zones, and apply for sediment impact zones as needed. Ecology determined that it was too early to implement such a plan. King County submitted a sediment sampling plan to Ecology on October 31, 1994, and updated it on January 31, 1995. The plan was also included in the NPDES permit renewal application for West Point in June 1995. Implementation of the plan was completed in 1997.

Also in 1990, Metro and the City of Seattle signed a consent decree to settle natural resource damage claims in Elliott Bay and the Duwamish River regarding releases from storm drains and CSOs. Metro was one of the members of the Elliott Bay/Duwamish Restoration Panel formed to implement the settlement. In 1994, a concept document was prepared that reviewed all available information and prioritized sediment remediation sites based on several factors. Three sites were initially selected for sediment cleanup; two were near Metro CSOs at Diagonal/Duwamish and Norfolk. Both these sites also had considerable storm drain input.

In 1991, Metro implemented the Denny Way Capping Project. Ten years of post-remediation monitoring was completed to identify any migration of contaminants through the cap and any recontamination on the cap surface. No migration was found, and despite the continuing overflows from the Denny Regulator Station, limited recontamination was seen. Data were submitted when collected and in reports and were later included in SEDQUAL.

In 1999, King County implemented a comprehensive study, *CSO Water Quality Assessment of the Duwamish River and Elliott Bay* (WQA), to better understand CSO impacts in relation to other sources and to establish science-based control priorities.¹ The study indicated that contamination near CSOs was primarily from historical inputs from raw sewage outfalls and industrial discharges. Little ongoing sediment contamination appeared to be occurring from CSOs. Industrial pretreatment controls, water softening, and the high proportion of combined sewage capture were controlling most current CSO sources. The study identified risks to sediment-dwelling organisms from organic enrichment in the immediate vicinity of CSOs and possibly from 1,4-dichlorobenzene (commonly used in urinal cakes) and bis(2-ethylhexyl) phthalate (ubiquitous in environment).

¹ The water quality assessment can be found at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/WaterQuality.aspx>.

As the findings of the 1999 WQA were emerging and as a result of conversations with Ecology, King County developed its 1999 sediment management plan. The plan focused on marine areas for which Sediment Quality Standards (SQS) had been developed and on Ecology-listed areas in the Duwamish River and Elliott Bay. It reaffirmed the WQA findings that uncontrolled CSOs were not expected to recontaminate sediments, except at the Denny Way CSO (controlled later in 2005), the Brandon Street Regulator Station CSO (above the lead cleanup screening level [CSL]), all sites above the CSL for bis(2-ethylhexyl) phthalate, and all sites above SQS for chrysene (a polycyclic aromatic hydrocarbon).

The sediment management plan proposed a list of remediation projects, with schedules and budgets. It also recognized that the EFDC model used for the WQA and sediment management plan was a “far-field model” with poor resolution near the outfall and that a near-field model needed to be developed.² The near-field model is expected to be complete the end of 2009. The sediment management plan also recommended that a regional approach to solving the areawide phthalate contamination problem be developed. Ecology has coordinated discussions in an ongoing workgroup composed of agencies and stakeholders.

The findings of the WQA and sediment management plan led King County to decide that remediations should move forward ahead of CSO control. The historical contamination was thought to present a greater risk than contamination from current CSOs and remediation should not be delayed while the slower CSO control projects were implemented. If any recontamination occurred between remediation and CSO control, the county understood it would have to be addressed.

King County sampled freshwater sediments in Lakes Sammamish, Washington, and Union between 1999 and 2001 as part of the Sammamish Washington Assessment and Modeling Program (SWAMP). SWAMP was designed to provide water quality and quantity resource information to county decision-makers as they implemented the RWSP. Extensive sediment and water column data were collected and used, along with existing data, in hydrodynamic, fate, and transport modeling. The models simulated various water use and reuse options and compared predicted sediment and water quality under these options to baseline conditions. Results from the models were also used to conduct various ecological and human health risk assessments. As part of the SWAMP sediment sampling, surface sediments were collected and analyzed from areas near many of King County’s freshwater CSOs in Lake Washington.

In the late 1990s, King County recognized that total maximum daily loads (TMDLs) would eventually be required for Sediment Management Standards violations and began discussing the need for a sediment-specific TMDL methodology with Ecology. Ecology proposed a joint project with the county, contributing their staff person, Pam Elardo, whose salary was to be paid by both agencies. Pam worked with both agencies and other interested parties. The Bellingham Bay cleanup was used as the vehicle to develop a model sediment TMDL. EPA subsequently approved this TMDL.

TMDL discussions with the Port of Seattle, Seattle, Boeing, and Ecology evolved into planning for the Lower Duwamish Waterway. EPA had proposed development of a non-Superfund approach to cleaning up the waterway. The approach focused on early actions at known “hot-spots.” Two of these spots were associated with county CSOs: Norfolk (already remediated at

² EFDC = Environmental Fluids Dynamic Computer Code.

that time) and Diagonal/Duwamish. The county, Seattle, Port of Seattle, and Boeing, along with EPA and Ecology, signed an Administrative Order of Consent in December 2000 to carry out the remedial investigation and feasibility study of the Lower Duwamish Waterway. The area was listed as a Superfund site in 2001. The draft remedial investigation, summarizing recent data and recommending additional sampling, was issued, and the draft feasibility study laying out the proposed next steps has now been published (April 24, 2009).³

Sediments near nine active King County CSOs are being addressed under the Lower Duwamish Waterway Superfund/MTCA:

- Norfolk CSO (remediation completed in 1999)
- Brandon Street Regulator
- 8th Avenue South Regulator
- Michigan Regulator
- Michigan, West
- East Marginal Way (has never overflowed)
- Terminal 115 CSO
- Hanford #1 CSO and Duwamish Pump Station, East Siphon (Duwamish/Diagonal remediation completed in 2005)
- Duwamish, West

The county's Norfolk CSO, along with several City of Seattle and Boeing storm drains, were remediated under the Elliott Bay/Duwamish Restoration Program in 1999. A five-year post-remediation sampling plan was completed in 2007. Early monitoring results suggested that erosion of unremediated shoreline areas was recontaminating the site. Another area was remediated to address the recontamination. The Norfolk CSO was controlled in 2005. Sediment data were submitted to Ecology in the various planning reports and were added to SEDQUAL.

In 2005, King County completed a remediation of the Duwamish/Diagonal site, also under the Elliott Bay/Duwamish Restoration Program. A 10-year post-remediation sampling program is being implemented through 2013. Polychlorinated biphenyls (PCBs) are increasing to near SQS levels but are not expected to exceed them. Phthalates are increasing and may reach pre-cleanup levels in the future. All data are submitted to Ecology as they are collected and are available on the county Web site (<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/DuDi/Library.aspx>) and in SEDQUAL/EIM.

Following the completion of the Denny Way CSO control project in 2005, a Phase 2 remediation of nearshore areas around the old outfall was implemented. The remediation was completed in early 2008, followed by a six-year post-remediation monitoring program. The need for a third phase of remediation will be assessed based on that monitoring. All data are submitted as they are collected and are available on both the county's Web site

³ A link to the feasibility study can be found at <http://www.kingcounty.gov/environment/wastewater/DuwamishWaterway.aspx>.

(<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/DennyWay/Library.aspx>) and in SEDQUAL/EIM.

Remediation of the area near the Hanford and Lander CSOs is currently occurring under the Harbor Island East and West Waterway Superfund effort. The Harbor and Chelan CSOs are also in this Superfund area.

Of the eight sites listed in the county's sediment management plan, three have been remediated (Norfolk; Duwamish Pump Station, East Siphon; and Denny Way Regulator), data are suggesting that remediation at two sites may not be needed (Chelan Avenue Regulator and Brandon Street Regulator), and remediation at two sites is being completed by the Port of Seattle (Hanford #2 Regulator and Lander Street Regulator). Only the area near the county's King Street CSO remains to be done, pending decisions by the Washington State Department of Transportation (WSDOT) to move forward in remediating the area near their Coleman Dock terminal. The county is scheduling an update to its sediment management plan that may add new areas for consideration.⁴

A coordinated multi-agency planning group, called the Lake Union Action Team, was initiated in the mid-1990s to evaluate contaminated sediments in Lake Union and areas of the Ship Canal and to develop an action plan. This process was suspended until regulatory agency funding and resources become available. An assessment of the areas around Salmon Bay has also been discussed more recently. King County recommends that further monitoring and evaluation of sediment needs of the following CSOs be done under pending coordinated multi-agency efforts:

- King Street and Connecticut (Kingdome) CSOs—southeast Elliott Bay area with WSDOT's Coleman Dock expansion
- Ballard, 11th Avenue NW and 3rd Avenue West CSOs—west Lake Washington Ship Canal area in coordination with any Salmon Bay planning effort
- Dexter CSO—southwest Lake Union area in coordination with the Lake Union Action Team work

⁴ Information on King County's Sediment Management Program, including the sediment management plan, can be found at <http://www.kingcounty.gov/environment/wastewater/SedimentManagement.aspx>.

The following areas do not have any known coordinated sediment planning efforts:

- Freshwater areas of the Montlake Cut of the Lake Washington Ship Canal (county CSOs: University and Montlake Regulators) and the southwest Lake Washington area (county CSOs: Henderson Pump Station and Martin Luther King Jr. Way CSO; both now controlled).
- Puget Sound Beach areas (county CSOs: Murray, Barton, South Magnolia, and North Beach), which are influenced by residential/light commercial uses only. CSO control projects are in design for these CSOs. A post-construction monitoring plan that includes these sites will be submitted to Ecology by July 1, 2010.

Discharge Locations of King County CSOs	
11th Ave. NW weir	Ship Canal
30th Ave. NE pump station bypass	Union Bay
3rd Ave. W regulator station	Ship Canal
53rd Ave. SW pump station bypass	Puget Sound
63rd Ave. pump station bypass	Puget Sound
8th Ave. regulator station bypass	Duwamish Waterway
SW Alaska St. weir	Puget Sound
Ballard regulator station	Ship Canal
Barton Street pump station bypass	Puget Sound
Belvoir pump station bypass	Union Bay
Brandon St. regulator station	Duwamish Waterway
Canal St. weir	Ship Canal
Chelan Ave. regulator station	Duwamish Waterway
Kingdome/Connecticut regulator station	Elliott Bay
Denny Way regulator station	Elliott Bay
Dexter Ave. regulator station	Lake Union
Duwamish Siphon W	Duwamish Waterway
Duwamish pump station bypass/Siphon E	Duwamish Waterway
Hanford #1 regulator station (Hanford at Rainier)	Lake Washington
Hanford #2 regulator station	Duwamish Waterway
Harbor Ave. regulator station	Elliott Bay
Henderson pump station bypass	Lake Washington
King Street regulator station	Elliott Bay
Lander II St. regulator station	Duwamish Waterway
S Magnolia weir	Puget Sound
East Marginal pump station bypass	Duwamish Waterway
Matthews Park pump station bypass	Lake Washington
S Michigan St. regulator station	Duwamish Waterway
W Michigan regulator station	Duwamish Waterway
Martin Luther King Jr. Way weir	Lake Washington
Montlake regulator station	Ship Canal
Murray pump station bypass	Puget Sound
Norfolk St. regulator station	Duwamish Waterway
North Beach pump station bypass	Puget Sound
North Beach pump station inlet	Puget Sound
E Pine St. pump station bypass	Lake Washington
Rainier Ave. pump station bypass	Lake Washington
Terminal 115 weir	Duwamish Waterway
University regulator station	Ship Canal

1.5 Organization of this Report

King County CSO outfalls are located in five distinct water bodies: the Central Basin of Puget Sound, Elliott Bay, the Duwamish River, the Lake Washington Ship Canal/Lake Union/Portage Bay system, and Lake Washington. In order to facilitate discussion of receiving water characteristics, this report is organized by these five water bodies. Although Elliott Bay is located in the Central Basin, Elliott Bay is discussed separately because of its unique characteristics.

King County is providing descriptions of each water body based on its understanding of the conditions under which it plans its CSO control and sediment management programs. The descriptions are not exhaustive or complete. Many other entities are studying these water bodies and developing various kinds of data to contribute to the greater understanding of the water body. The following entities also collect information on these water bodies:

- U.S. Geological Survey (USGS)
- United States Navy
- National Oceanic and Atmospheric Administration (NOAA)
- Muckleshoot Indian Tribe
- Suquamish Tribe
- Tulalip Tribes
- Washington State Department of Ecology
- Washington State Department of Fish and Wildlife (WDFW)
- Puget Sound Partnership
- University of Washington
- Washington State University
- King County Department of Natural Resources and Parks, Water and Land Resources Division

After describing the water body, each chapter provides the following information for each CSO that discharges to the water body: the 1958 baseline facilities, discharge location and outfall characteristics, the baseline overflow and frequency set in 1983 at the start of the post-regional system CSO control planning, current overflow quantity and frequency, control project history, CSO effluent quality monitoring, post-construction monitoring, sediment sampling information, and sediment remediation activity. Two maps are provided for each CSO—one showing the location of the CSO outfall in relation to any known stormwater outfalls and a map showing sediment sampling locations. Photographs of the CSO vicinity are also included. Effluent quality and sediment monitoring data are provided in the accompanying CD. User study ID numbers are given for sediment data that are available in EIM.

Information on known outfalls not managed by the county is included to provide context for the county's approach to CSO control and sediment management. The information was taken from the City of Seattle's geographic information system. The completeness and accuracy of the data were not verified. The quantities or qualities of the discharges are not included. Ecology's

databases of reported information under other regulatory programs, such as stormwater NPDES, contain the most current and complete information.

1.6 Sewer System Maps

Figures 1-3 through 1-22 show the 1958 baseline sewer system and updated versions of the same areas.

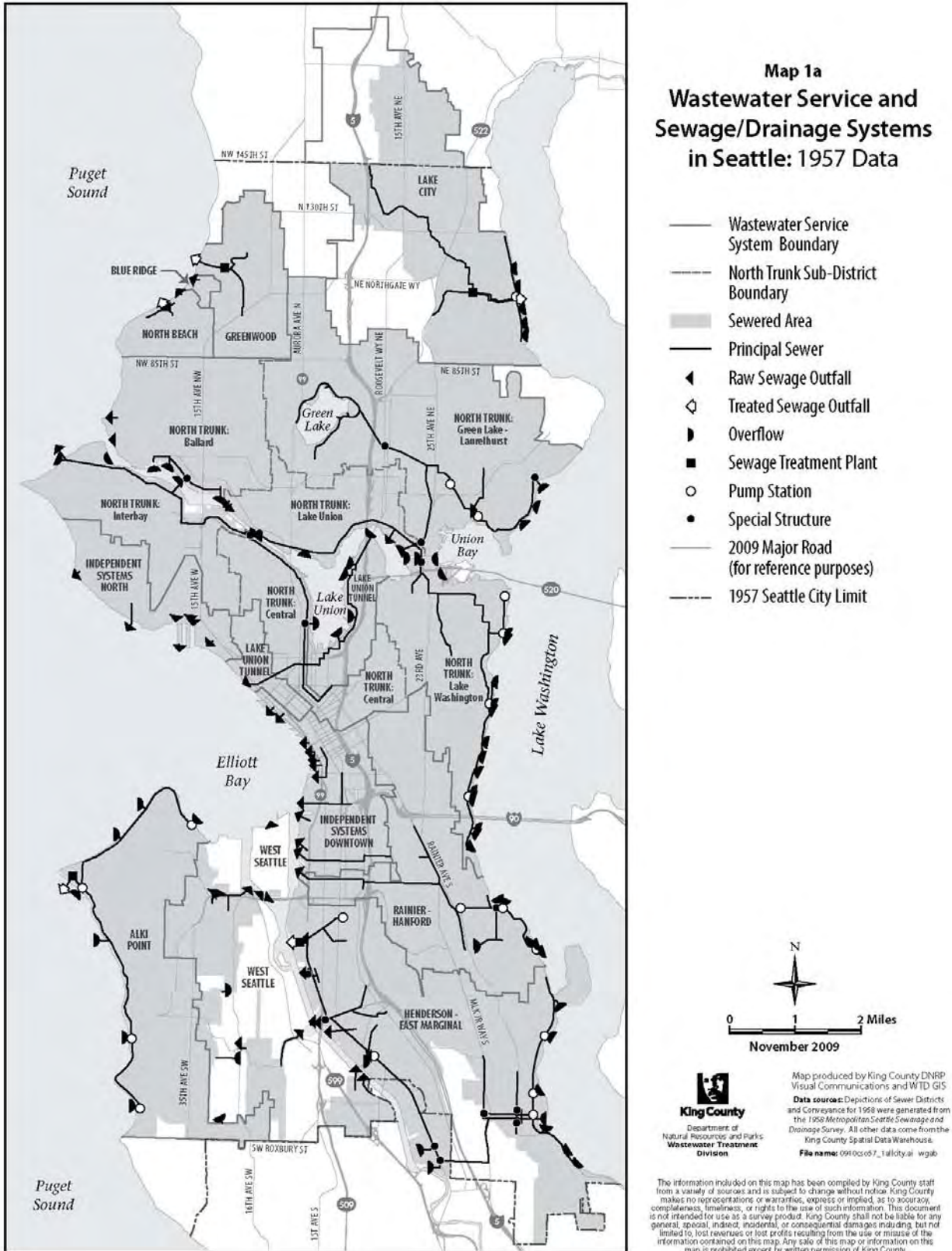


Figure 1-3. Wastewater Service and Sewage/Drainage Systems in Seattle: 1957 Data

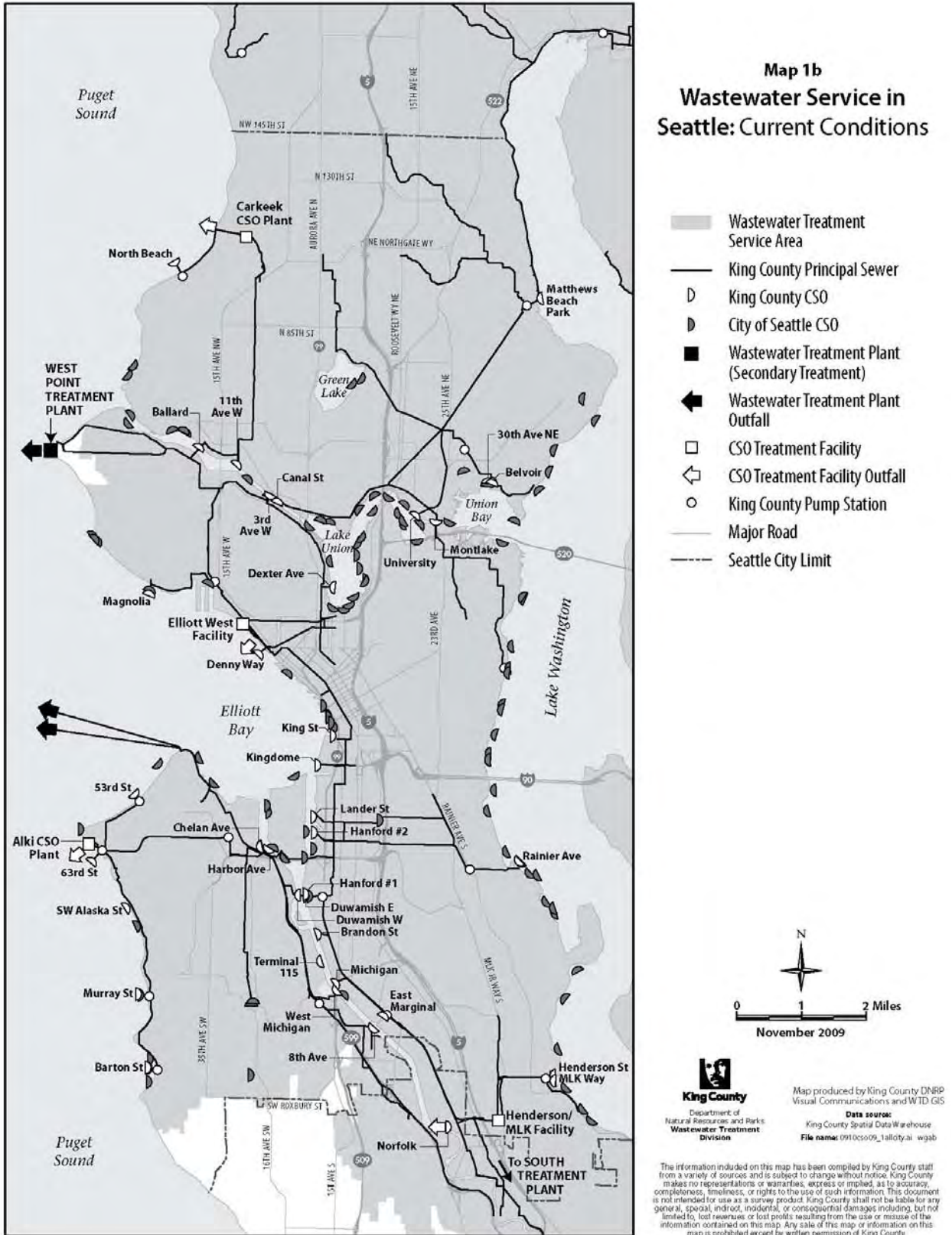
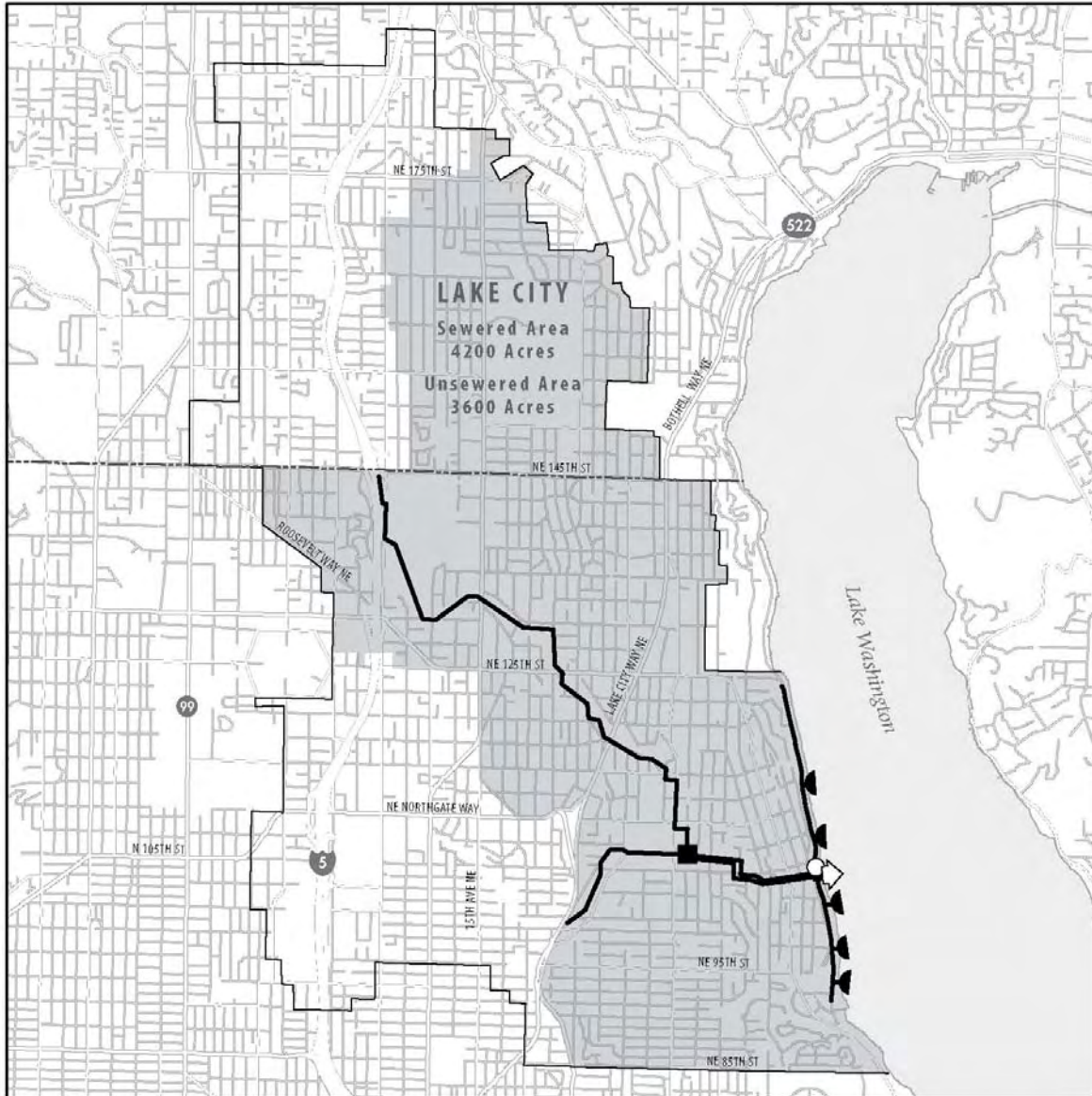


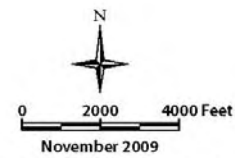
Figure 1-4. Wastewater Service in Seattle: Current Conditions



Map 2a
Lake City System: 1957 Data

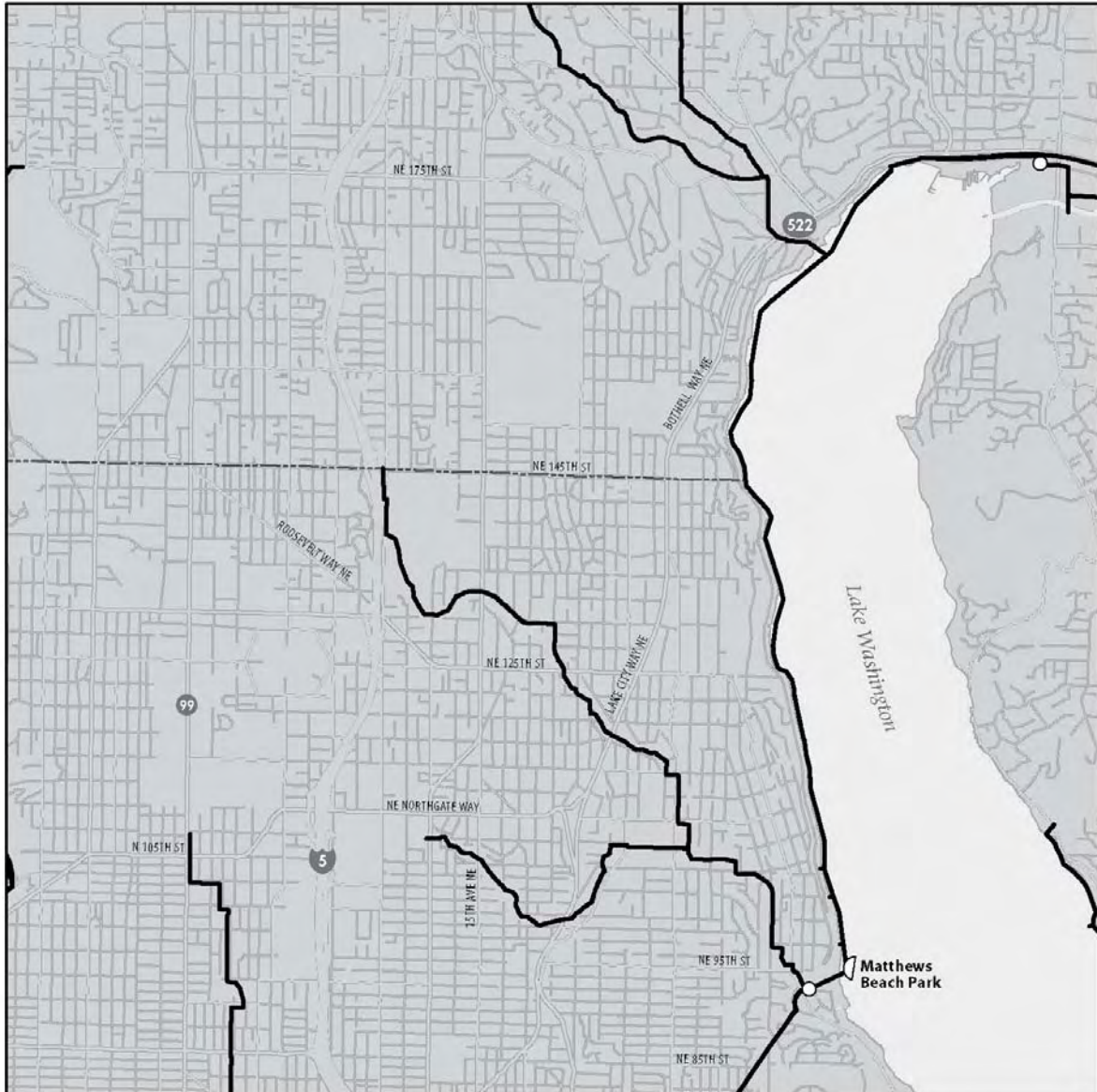
- Service Area Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- ◻ Treated Sewage Outfall
- ◐ Overflow
- Sewage Treatment Plant
- Pump Station
- 2009 Street Network (for reference purposes)
- - - 1957 Seattle City Limits


King County
 Department of
 Natural Resources and Parks
Wastewater Treatment Division
 Map produced by King County DNRP
 Visual Communications and WTD GIS
 Data sources: Depictions of Sewer Districts and Conveyance
 for 1958 were generated from the 1958 Metropolitan Seattle
 Sewerage and Drainage Survey. All other data come from the
 King County Spatial Data Warehouse.
 File name: 0910cso57_2lakecity.a wgsb



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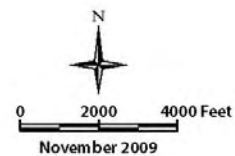
Figure 1-5. Lake City System: 1957 Data



Map 2b
Lake City Area: Current Conditions

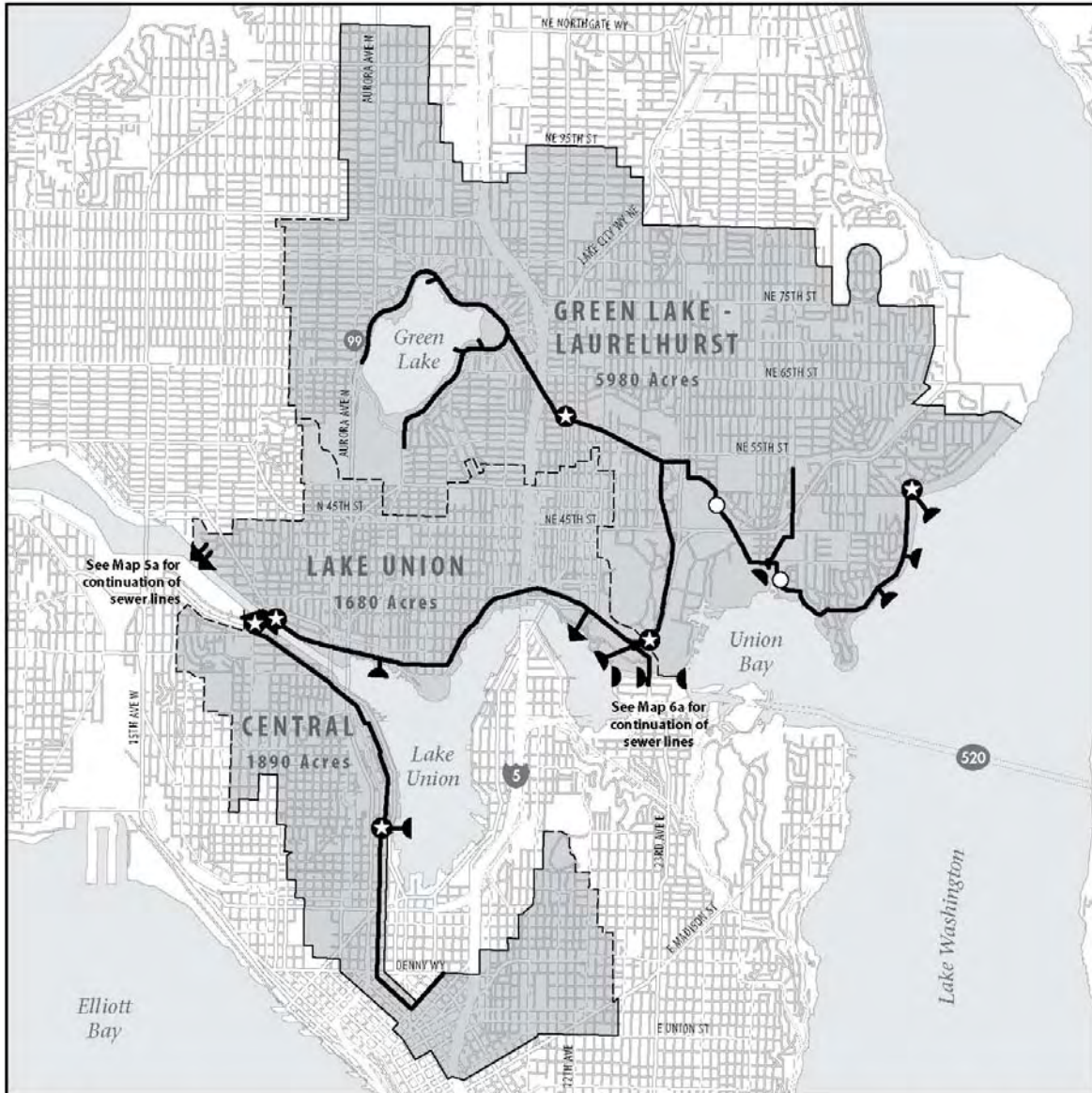
-  Wastewater Treatment Service Area
-  King County Principal Sewer
-  King County CSO
-  King County Pump Station
-  Road
-  Seattle City Limit


King County
 Department of
 Natural Resources and Parks
Wastewater Treatment Division
 Map produced by King County DNRP
 Visual Communications and WTD GIS
 Data source: King County Spatial Data Warehouse
 File name: 0910cs09_2lakecity.ai wgsb



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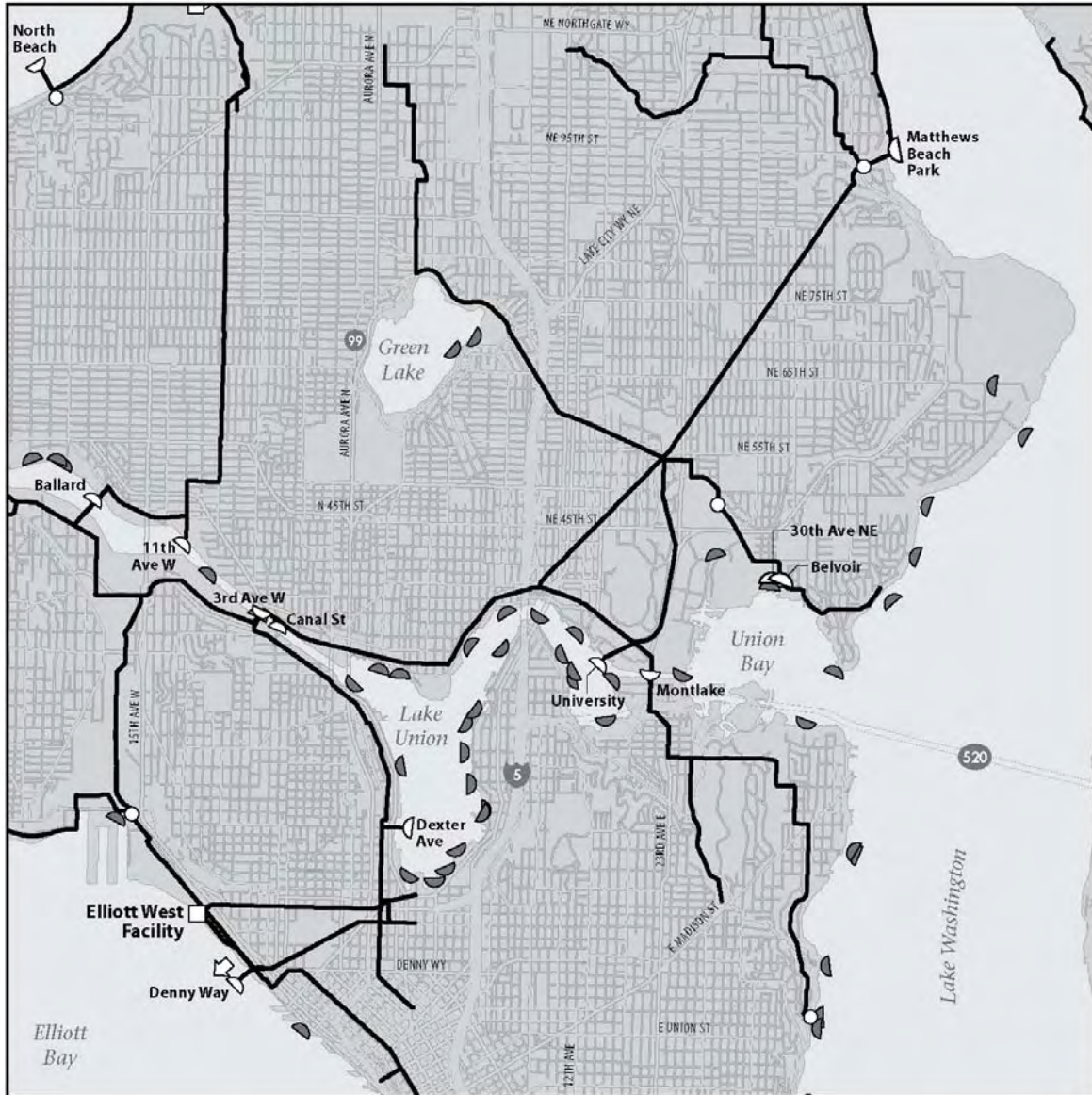
Figure 1-6. Lake City Area: Current Conditions



Map 3a
North Trunk System – Central, Lake Union, and Green Lake/Laurelhurst Sub-Districts:
1957 Data



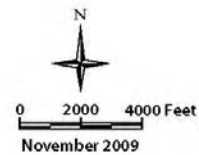
Figure 1-7. North Trunk System – Central, Lake Union, and Green Lake/Laurelhurst Sub-Districts:
1957 Data



Map 3b
Central, Lake Union, and Green Lake/Laurelhurst Area: Current Conditions

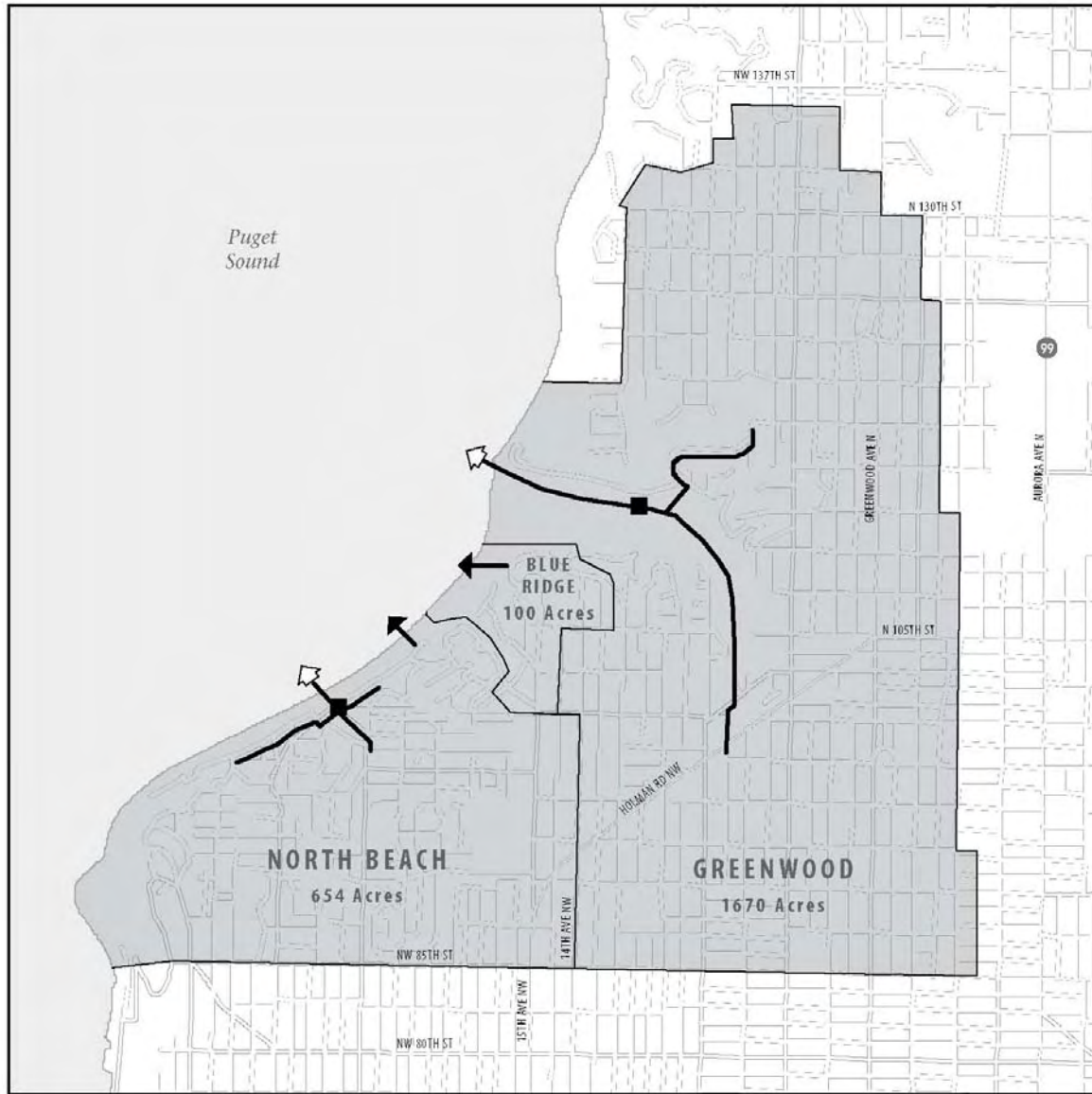
- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road


King County
 Department of
 Natural Resources and Parks
Wastewater Treatment Division
 Map produced by King County DNRP
 Visual Communications and WTD GIS
 Data source: King County Spatial Data Warehouse
 File name: 09100009_3greenlake.sx wgab



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Figure 1-8. Central, Lake Union, and Green Lake/Laurelhurst Area: Current Conditions



Map 4a
Greenwood, North Beach, and Blue Ridge Systems: 1957 Data

- Service Area Boundary
- ▒ Sewered Area
- Existing Trunk Sewer (1957)
- ◀ Raw Sewage Outfall
- ◁ Treated Sewage Outfall
- Sewage Treatment Plant
- 2009 Street Network (for reference purposes)

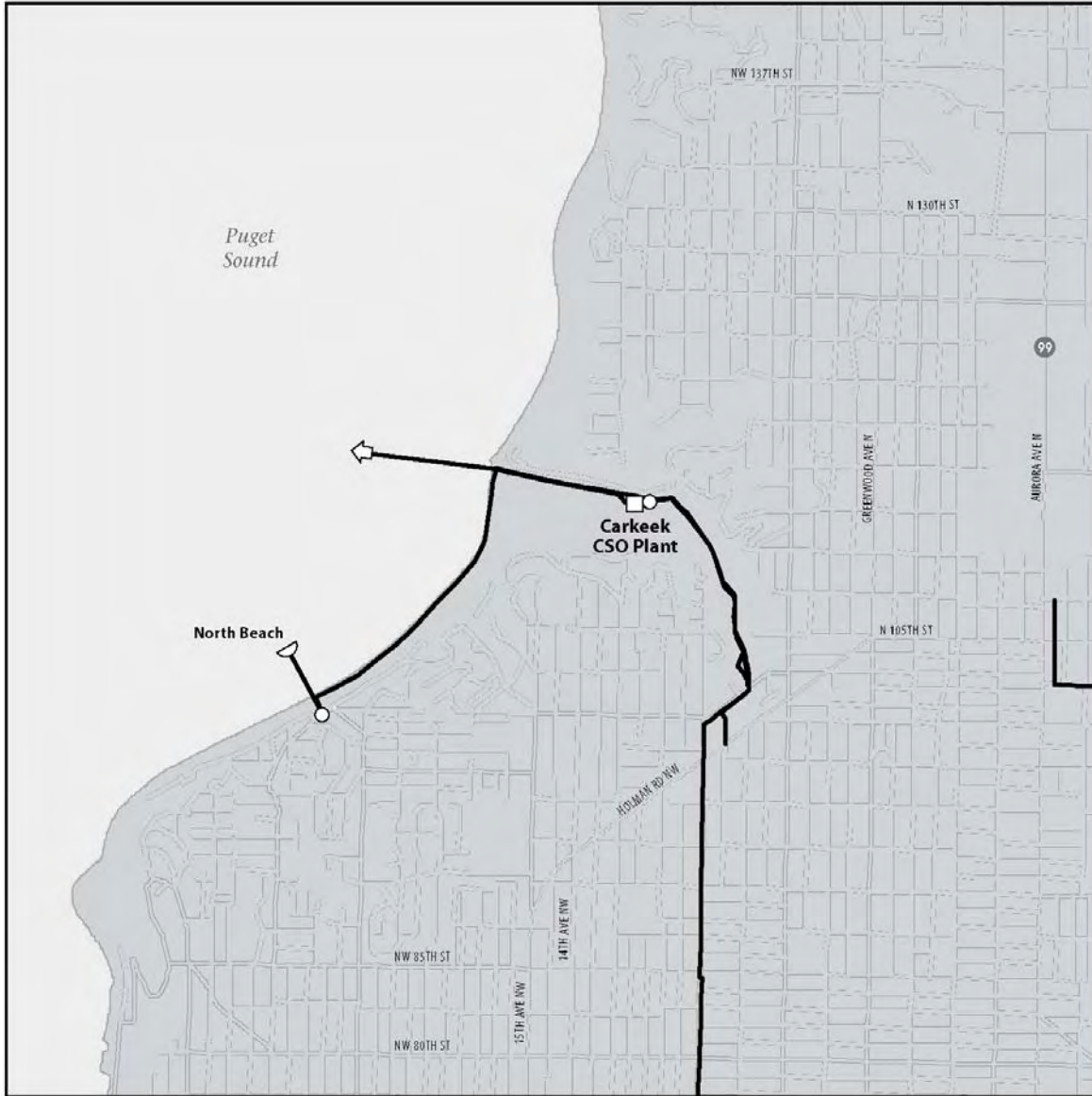


Map produced by King County DNRP Visual Communications and WTD GIS
 Data sources: Depictions of Sewer Districts and Conveyance for 1958 were generated from the 1958 Metropolitan Seattle Sewerage and Drainage Survey. All other data come from the King County Spatial Data Warehouse.
 File name: 0910c057_4greenwood.ai wgab



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Figure 1-9. Greenwood, North Beach, and Blue Ridge Systems: 1957 Data



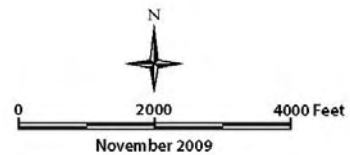
Map 4b
Greenwood, North Beach, and Blue Ridge Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road

King County
 Department of
 Natural Resources and Parks
Wastewater Treatment Division

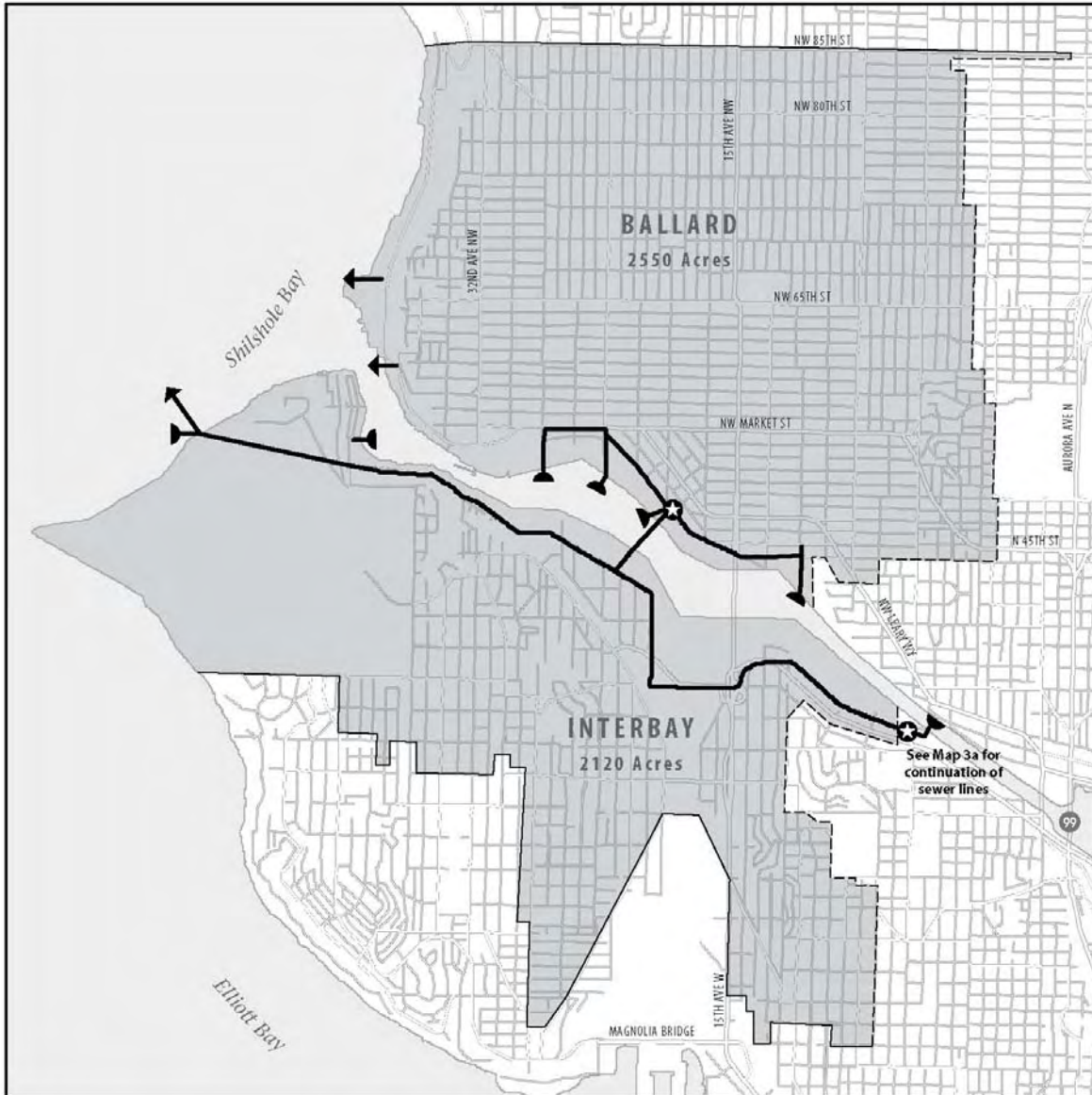
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Data source: King County Spatial Data Warehouse
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Figure 1-10. Greenwood, North Beach, and Blue Ridge Area: Current Conditions



Map 5a
North Trunk System – Interbay and Ballard Districts: 1957 Data

- Service Area Boundary
- - - North Trunk Sub-District Boundary
- Sewered Area
- Existing Trunk Sewer (1957)
- ◀ Raw Sewage Outfall
- ◐ Overflow
- ★ Special Structure
- 2009 Street Network (for reference purposes)

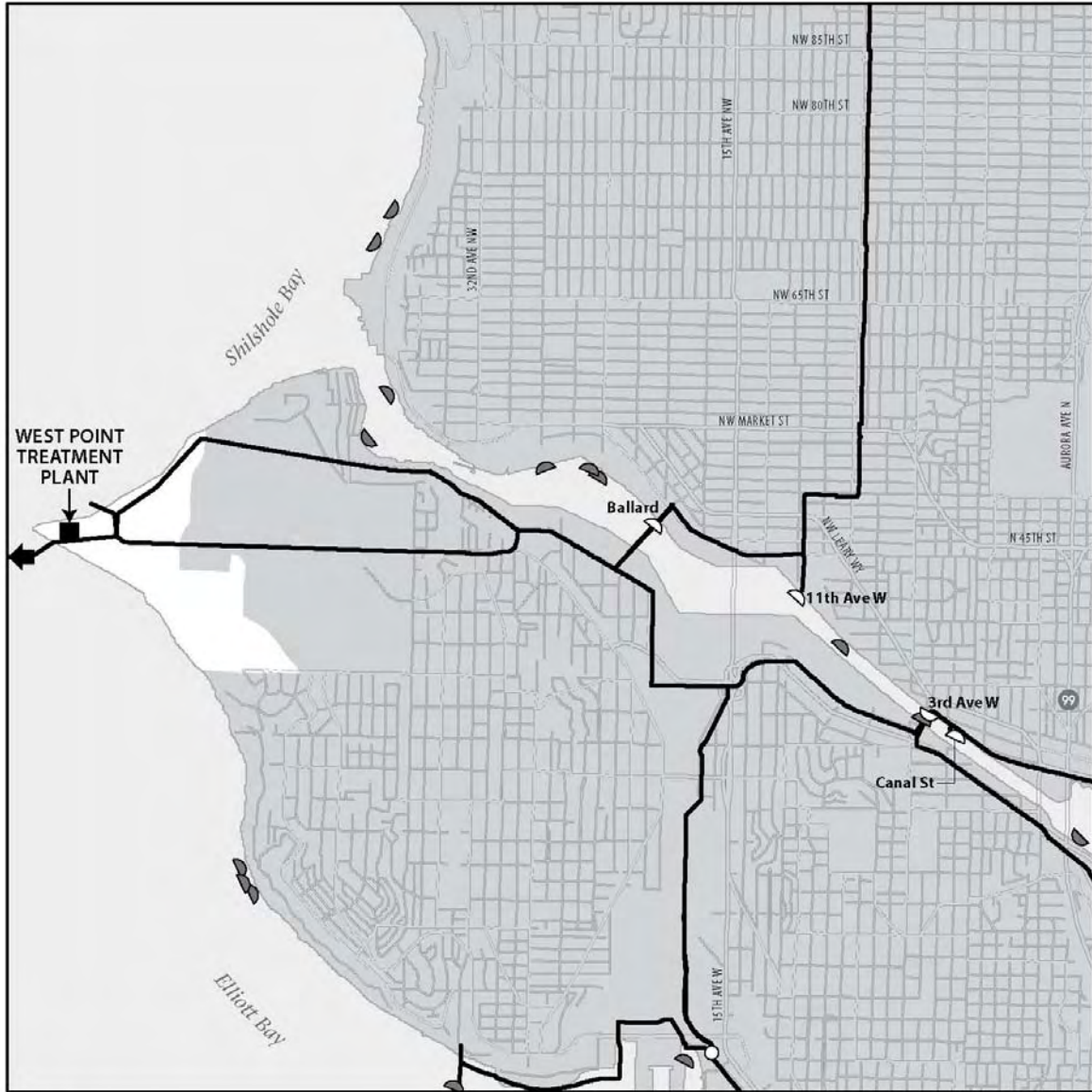


Map produced by King County DNRP Visual Communications and WTD GIS
Data sources: Depictions of Sewer Districts and Conveyance for 1958 were generated from the 1958 Metropolitan Seattle Sewerage and Drainage Survey. All other data come from the King County Spatial Data Warehouse.
 File name: 0910cso57_5ballard.ai wglb



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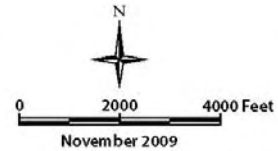
Figure 1-11. North Trunk System – Interbay and Ballard Districts: 1957 Data



Map 5b
Interbay and Ballard Area: Current Conditions

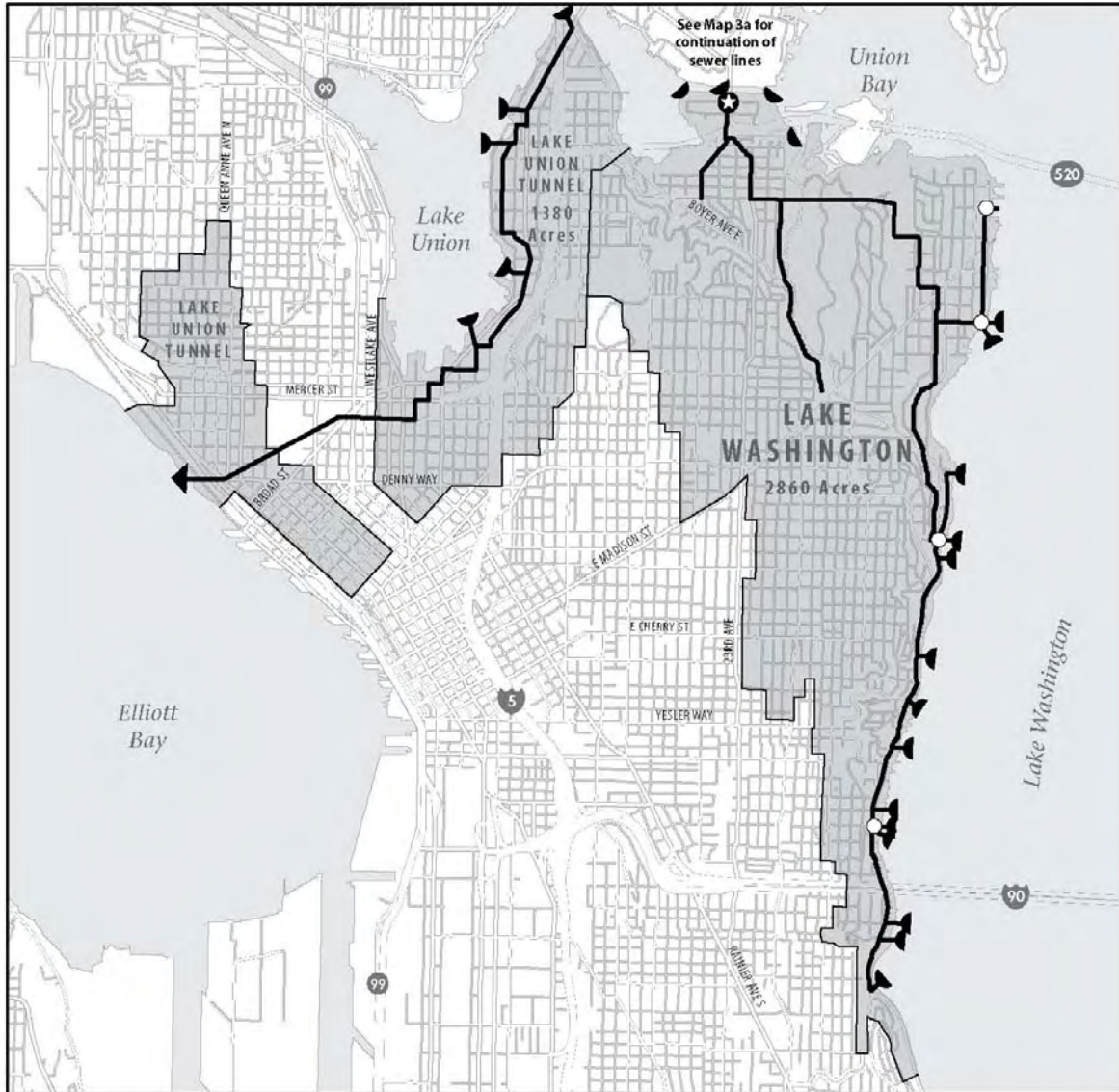
- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- Wastewater Treatment Plant (Secondary Treatment)
- Wastewater Treatment Plant Outfall
- King County Pump Station
- Road

King County
 Department of Natural Resources and Parks
Wastewater Treatment Division
 Map produced by King County DNRP Visual Communications and WTD GIS
 Data source: King County Spatial Data Warehouse
 File name: 0910cso09_Ballard.dwg wgs84



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Figure 1-12. Interbay and Ballard Area: Current Conditions

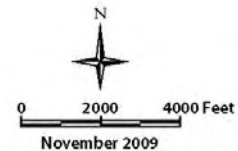


Map 6a
North Trunk System – Lake Washington Sub-District, and Lake Union Tunnel System:
1957 Data

- Service Area Boundary
- Existing Trunk Sewer (1957)
- Pump Station
- ★ Special Structure
- ◀ Raw Sewage Outfall
- ▶ Overflow
- ▨ Sewered Area
- 2009 Street Network (for reference purposes)

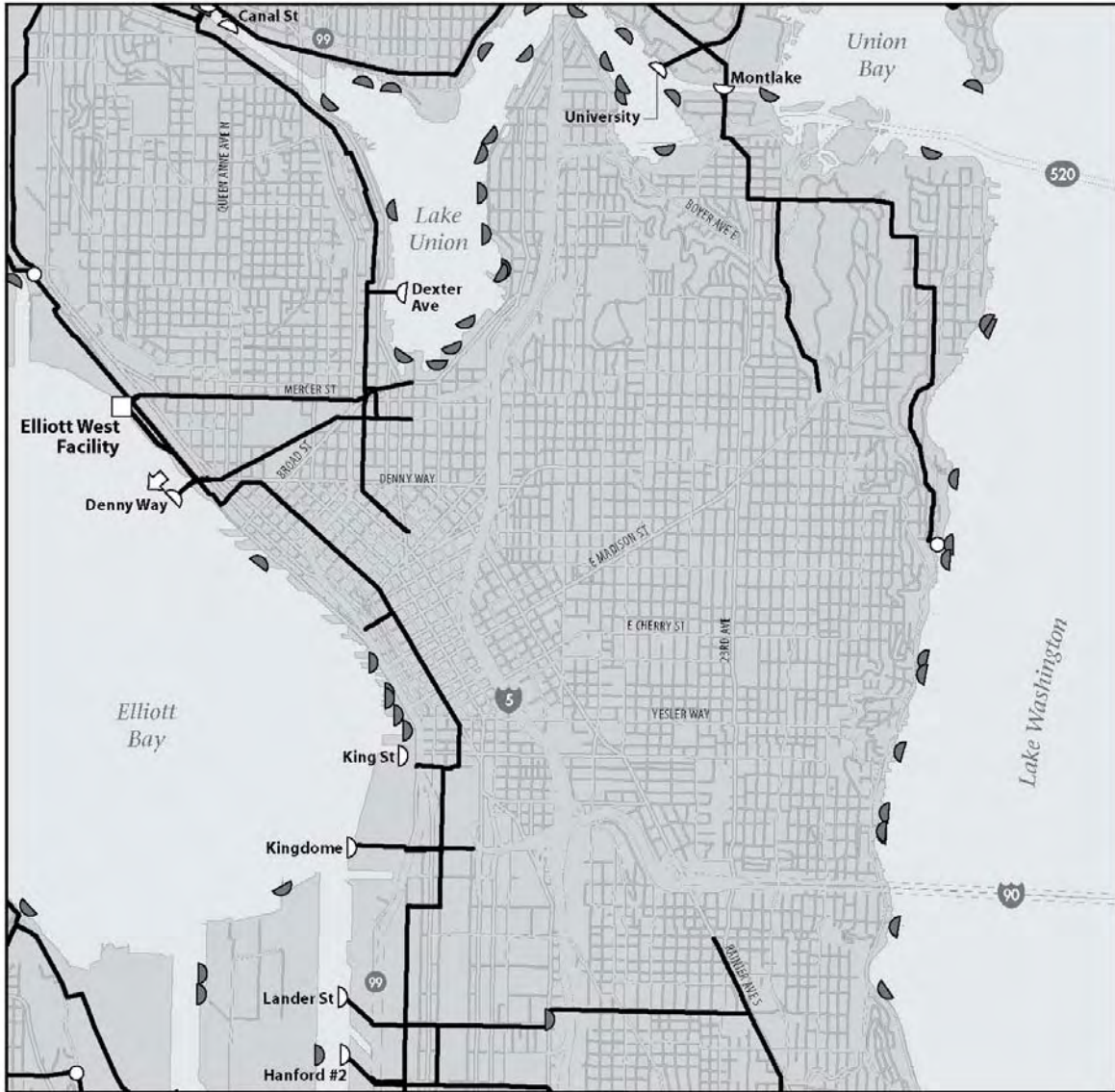


Map produced by King County DNRP Visual Communications and WTD GIS
 Data sources: Depositions of Sewer Districts and Conveyance for 1958 were generated from the 1958 Metropolitan Seattle Sewerage and Drainage Survey. All other data come from the King County Spatial Data Warehouse.
 File name: 0910cs057_0kwwash.ak wgsb



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Figure 1-13. North Trunk System – Lake Washington Sub-District, and Lake Union Tunnel System: 1957 Data

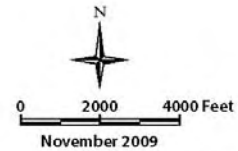


Map 6b
Lake Washington and Lake Union Tunnel Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road



Department of
 Natural Resources and Parks
Wastewater Treatment Division
 Map produced by King County DNRP
 Visual Communications and WTD GIS
 Data source: King County Spatial Data Warehouse
 File name: 091 00so09_6lRwath.ai wgs8



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Figure 1-14. Lake Washington and Lake Union Tunnel Area: Current Conditions



Map 7a
Elliott Bay Independent Systems: 1957 Data

- Service Area Boundary
- ▒ Sewered Area
- Existing Trunk Sewer (1957)
- ◀ Raw Sewage Outfall
- ▶ Overflow
- Pump Station
- ★ Special Structure
- 2009 Street Network (for reference purposes)

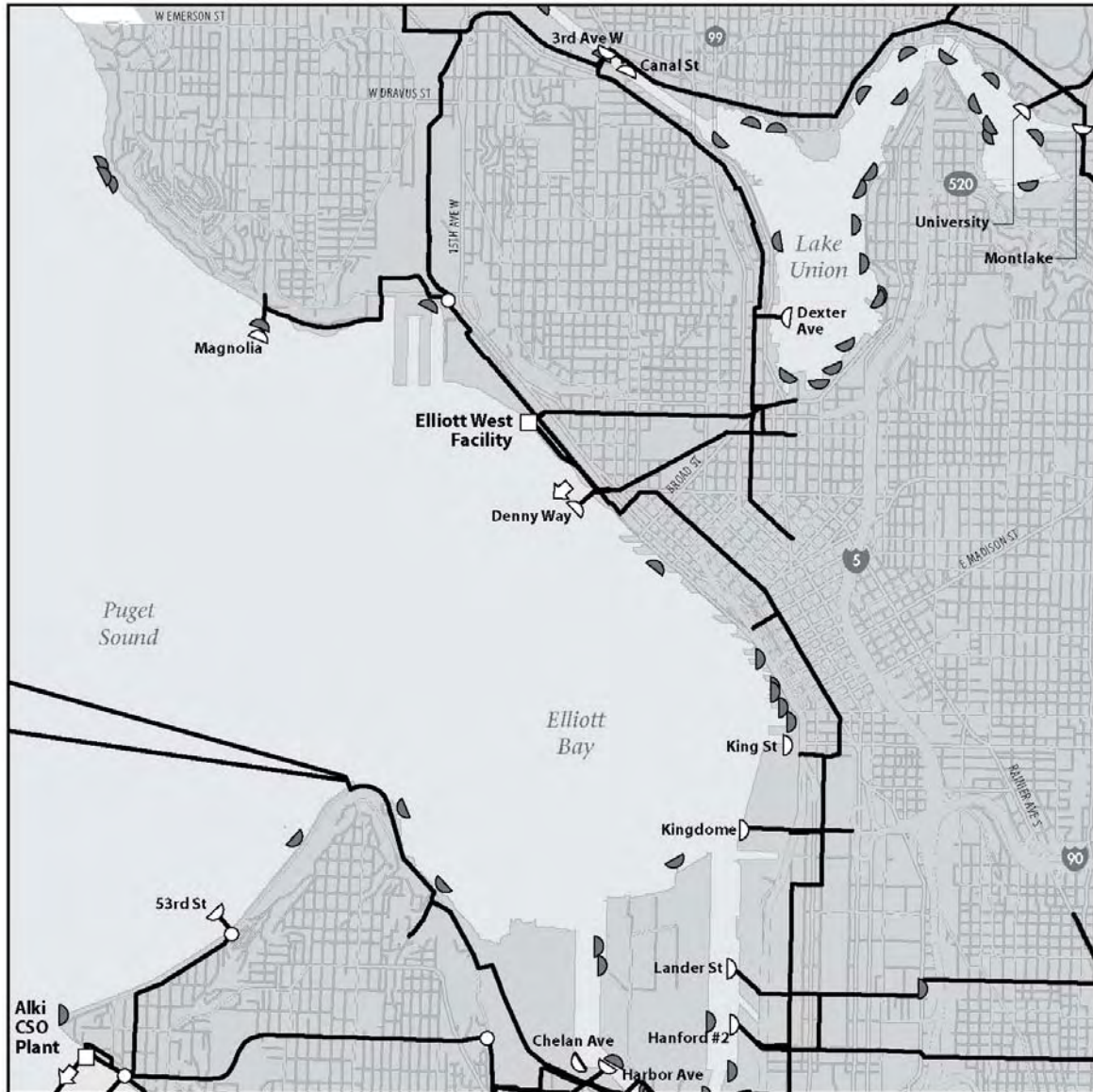


Map produced by King County DNRP Visual Communications and WTD GIS
 Data sources: Depictions of Sewer Districts and Conveyance for 1958 were generated from the 1958 Metropolitan Seattle Sewerage and Drainage Survey. All other data come from the King County Spatial Data Warehouse.
 File name: 0910cso57_Telliottbay.ai wgab



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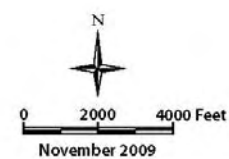
Figure 1-15. Elliott Bay Independent Systems: 1957 Data



Map 7b
Elliott Bay Area: Current Conditions

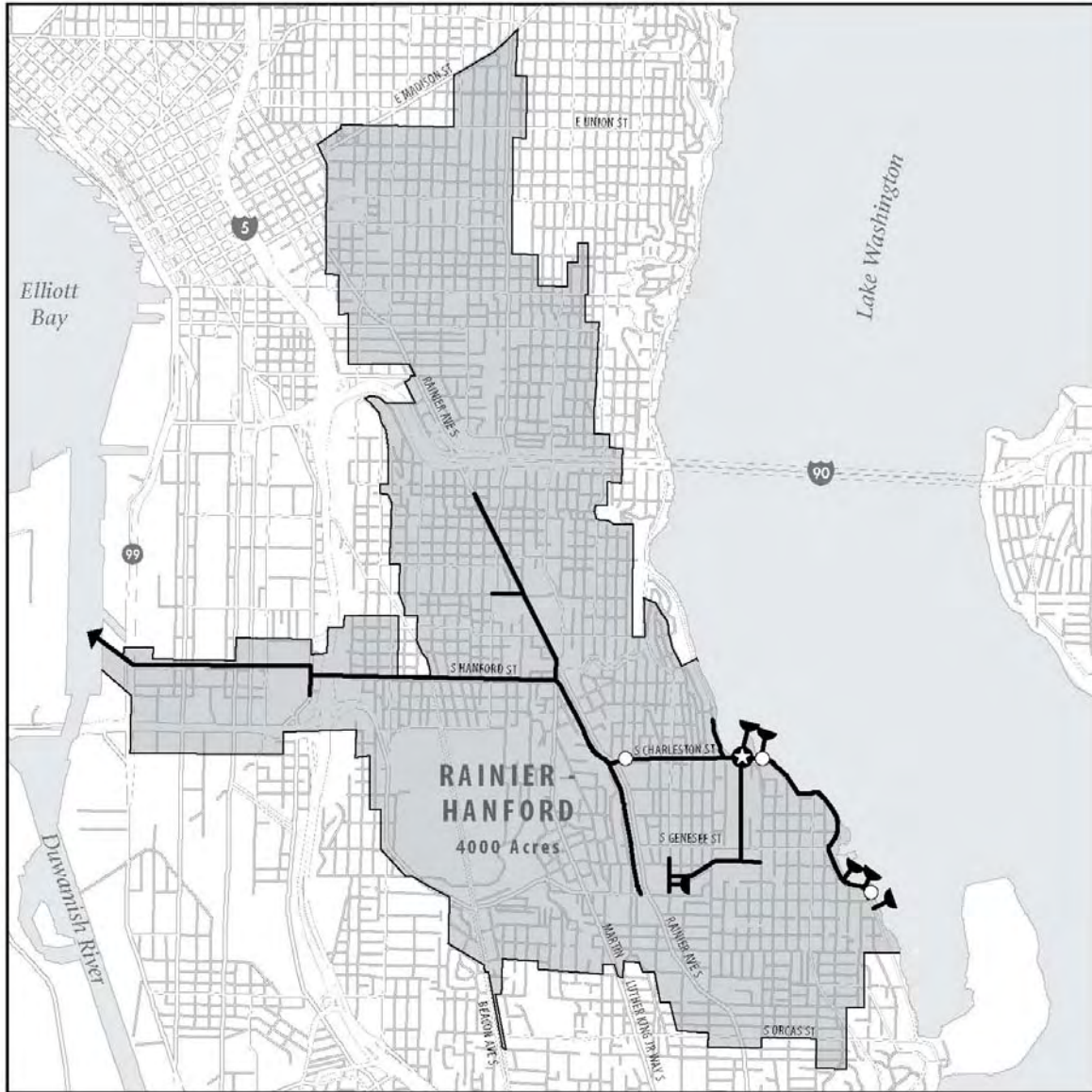
-  Wastewater Treatment Service Area
-  King County Principal Sewer
-  King County CSO
-  City of Seattle CSO
-  CSO Treatment Facility
-  CSO Treatment Facility Outfall
-  King County Pump Station
-  Road


King County
 Department of
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 File name: 091 0c057_Tellottbay.ai wgab



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Figure 1-16. Elliott Bay Area: Current Conditions

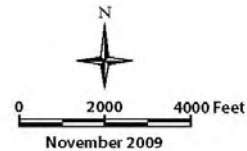


Map 8a
Rainier – Hanford System: 1957 Data

- Service Area Boundary
- ▨ Sewered Area
- Existing Trunk Sewer (1957)
- ◄ Raw Sewage Outfall
- ◄ Overflow
- Pump Station
- ★ Special Structure
- 2009 Street Network (for reference purposes)



Map produced by King County DNRP Visual Communications and WTD GIS
 Data sources: Depictions of Sewer Districts and Conveyance for 1956 were generated from the 1958 Metropolitan Seattle Sewerage and Drainage Survey. All other data come from the King County Spatial Data Warehouse.
 File name: 0910cso57_rainier.ai wgs8



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Figure 1-17. Rainier – Hanford System: 1957 Data



Map 8b
Rainier – Hanford Area: Current Conditions

-  Wastewater Treatment Service Area
-  King County Principal Sewer
-  King County CSO
-  City of Seattle CSO
-  CSO Treatment Facility
-  King County Pump Station
-  Road

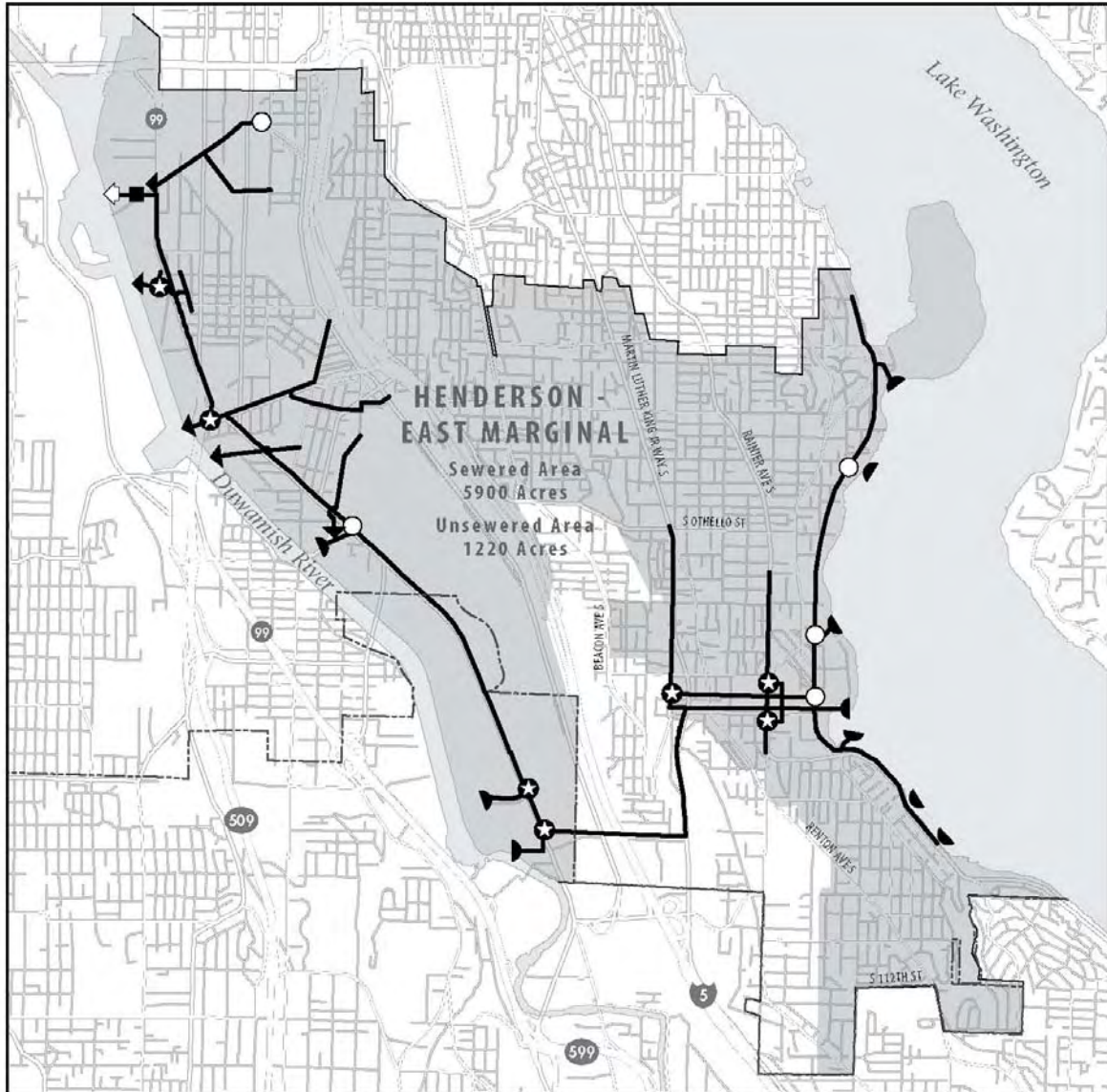


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 File name: 09102609_BrainierAI_wgab



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Figure 1-18. Rainier – Hanford Area: Current Conditions



Map 9a
Henderson – East Marginal Way System: 1957 Data

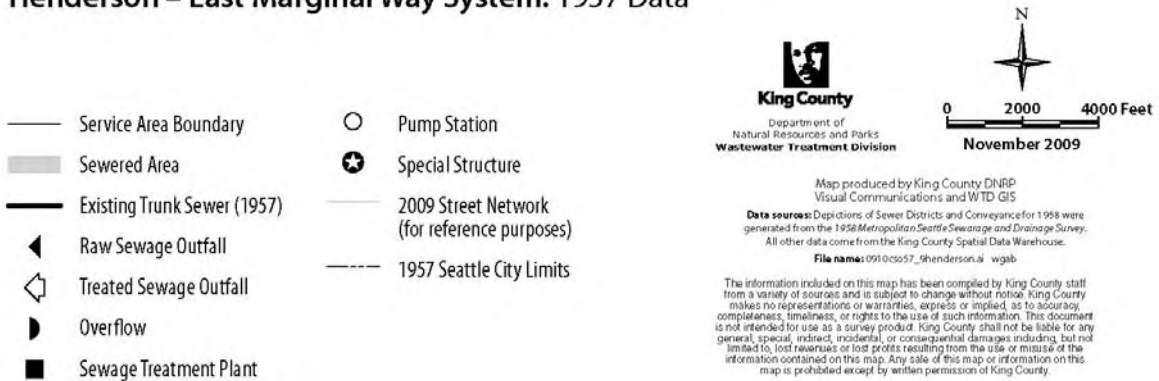
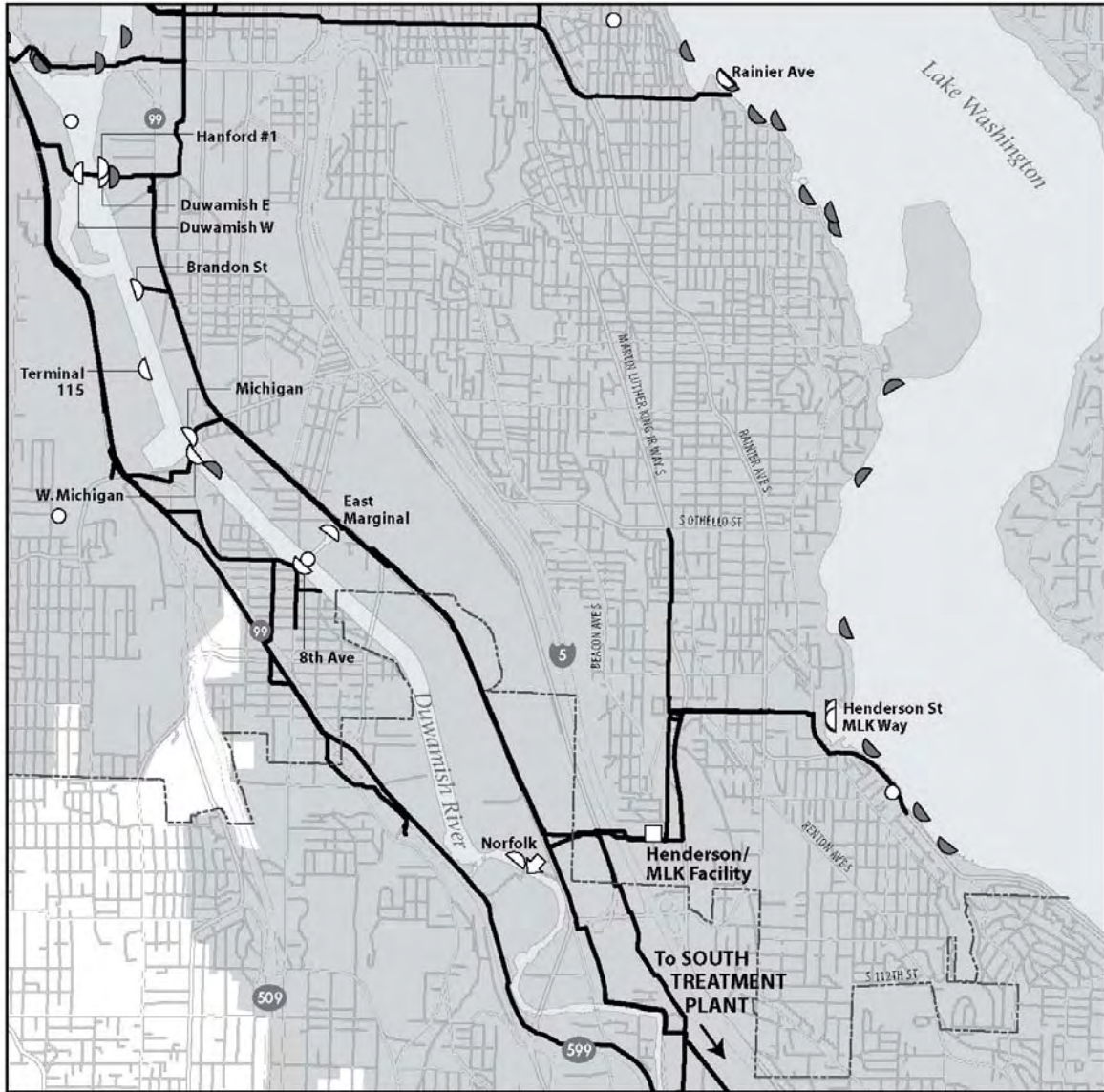


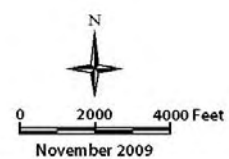
Figure 1-19. Henderson – East Marginal Way System: 1957 Data



Map 9b
Henderson – East Marginal Way Area: Current Conditions

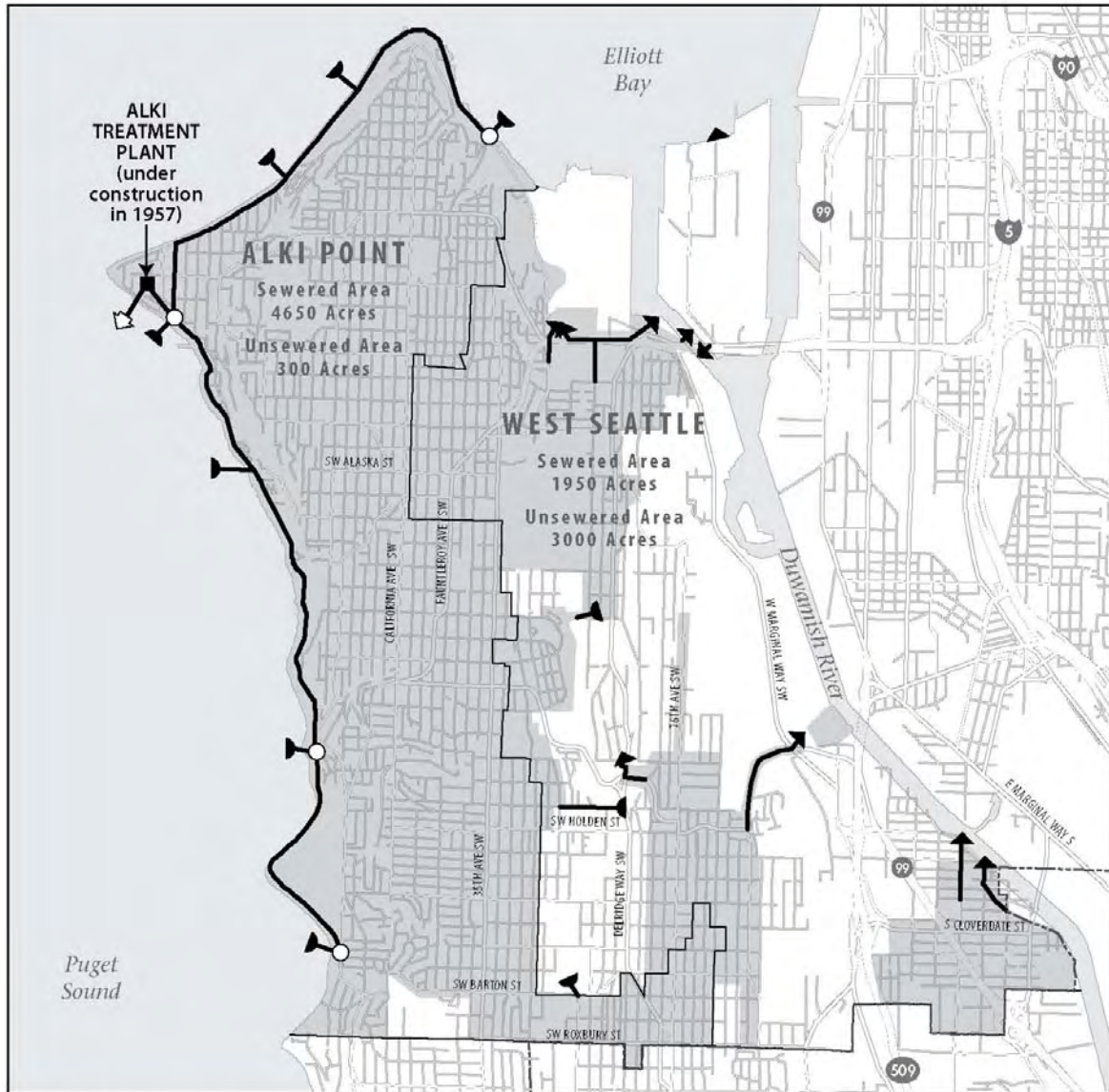
- Wastewater Treatment Service Area
- King County Principal Sewer
- King County CSO
- City of Seattle CSO
- CSO Treatment Facility
- CSO Treatment Facility Outfall
- King County Pump Station
- Road
- Seattle City Limit

King County
 Department of
 Natural Resources and Parks
Wastewater Treatment Division
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Figure 1-20. Henderson – East Marginal Way Area: Current Conditions



Map 10a
West Seattle and Alki Point Systems: 1957 Data

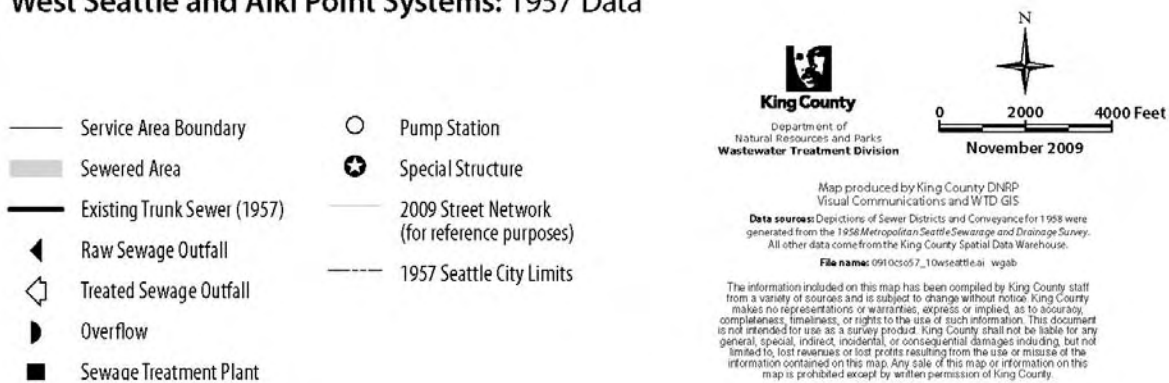
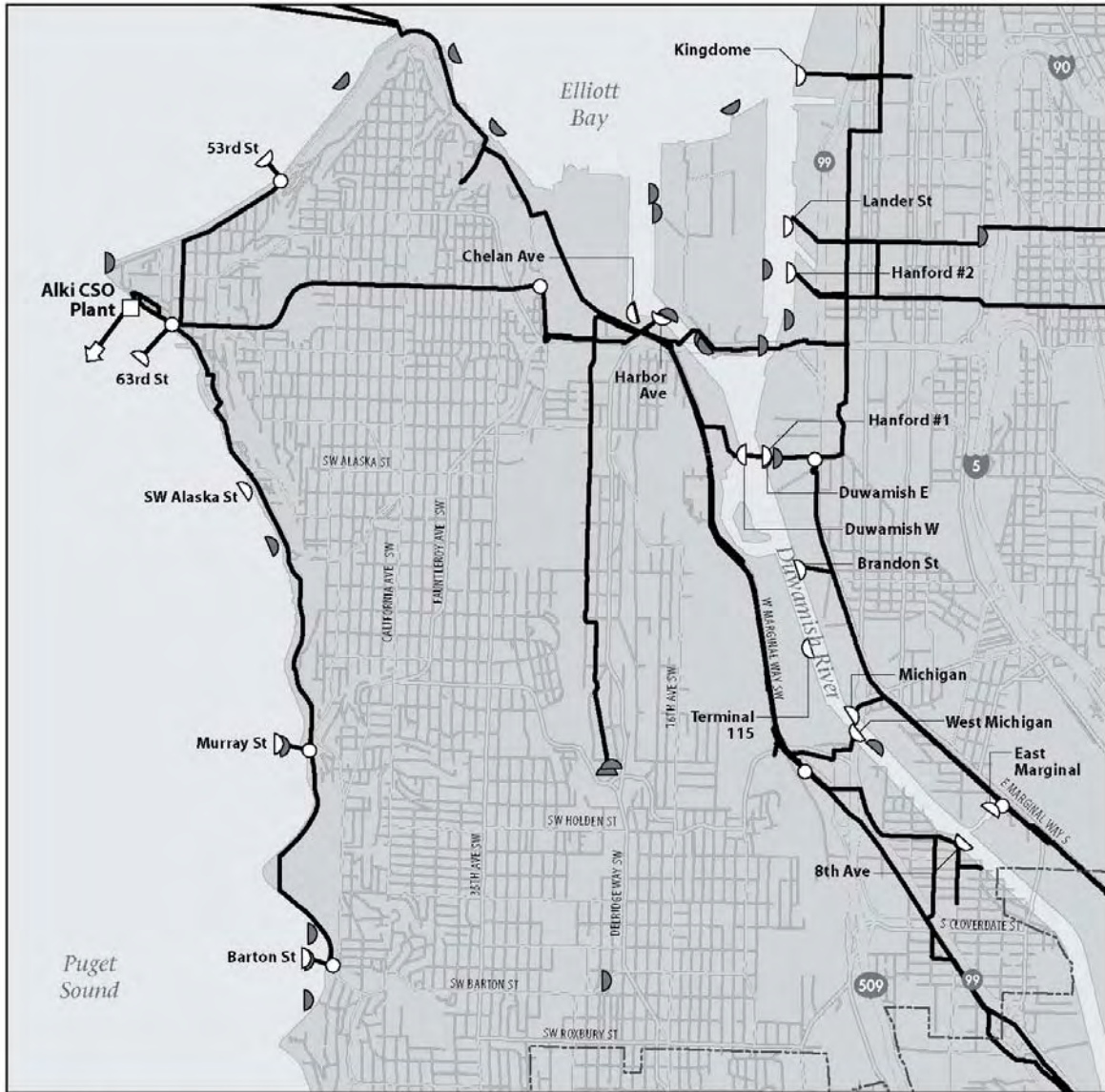


Figure 1-21. West Seattle and Alki Point Systems: 1957 Data

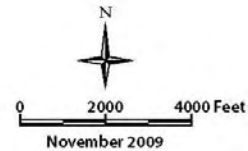


Map 10b
West Seattle and Alki Point Area: Current Conditions

- Wastewater Treatment Service Area
- King County Principal Sewer
- D King County CSO
- ◐ City of Seattle CSO
- CSO Treatment Facility
- ◁ CSO Treatment Facility Outfall
- King County Pump Station
- Road
- - - Seattle City Limit



Department of
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Wastewater Treatment Division
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 Data sources: King County Spatial Data Warehouse
 File name: 0910cc09_10westseattle.wgab



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Figure 1-22. West Seattle and Alki Point Areas: Current Conditions

2.0 CSO OUTFALLS IN THE CENTRAL BASIN OF PUGET SOUND

King County manages nine CSOs that may discharge to the Central Basin of Puget Sound. Five of these CSO are controlled to the Washington State standard: two CSO treatment plants (Carkeek and Alki), two pump station CSO bypasses (53rd and 63rd Avenue), and one overflow (SW Alaska Street). Control projects are in predesign phase for the remaining four CSOs: North Beach Pump Station, South Magnolia, Murray Street Pump Station, and Barton Street Pump Station. The RWSP identified Puget Sound beaches as the highest priority for control in order to protect public health.

2.1 Receiving Water

2.1.1 Overview

Puget Sound is a fjord-like estuary that consists of a series of underwater valleys and ridges (called basins) and submerged hills (called sills). Sills impede the flow of water in and out of the Sound and also induce vertical mixing as water moves over the sill. Puget Sound consists of four major interconnected basins: the Main (Admiralty Inlet and the Central Basin), Whidbey, Southern, and Hood Canal Basins. All of King County's marine CSOs discharge to the Central Basin. The Central Basin has near-oceanic salinity throughout the year and is supplemented with cold, nutrient-rich, low-oxygenated deep oceanic water upwelled off the Washington coast during the late summer months. The Central Basin contains water depths up to 284 meters.

Freshwater flows influence water circulation in the Central Basin as the amount of freshwater input varies seasonally and affects water temperature, salinity, and density, which then determines stratification of the water column. Water column stratification can affect biological populations by trapping nutrients and/or affecting vertical migration through the water column. Freshwater input into rivers is mainly through rainfall; however, snowmelt also contributes a large source in later spring and early summer.

The two main freshwater inputs to the Central Basin are the Green/Duwamish River, which enters Elliott Bay, and the Cedar River (Lake Washington drainage basin), which flows into the Sound primarily through the Lake Washington Ship Canal. Because flows in the Lake Washington drainage basin and the Green River are regulated, snowmelt does not increase the flows in these river systems to the extent that it does in other systems and has little affect on salinity and stratification near the river mouths.

Water circulation in the Central Basin is dominated by tidal currents and generally consists of a two-layered flow, with incoming, saltier oceanic water flowing along the bottom and a fresher, less dense water layer flowing out at the surface. Salty, cold, dense waters enter Puget Sound at depth through Admiralty Inlet. A portion flows south in the Central Basin while the other portion flows northeast through Possession Sound to the Whidbey Basin. Figure 2-1 shows the net circulation pattern in Puget Sound with the deep incoming water flowing beneath the outflowing upper layer. Water tends to flow faster on the eastern side of the Central Basin near Alki Point and Point Wells and along the western side near Point Monroe and north of Kingston, where

major topographic features affect the currents (King County, 2001). The residence time of water in the Central Basin is about 48 days, depending upon the time of year (Babson, 2004).

Amplitudes of tidal currents in the Central Basin are about 50 centimeters per second (cm/s) and estuarine circulation is important for transporting water masses and is typically up to about 10 cm/s but can be higher during storms and bottom-water saltwater intrusion from Admiralty Inlet (King County, 2002).

2.1.2 Receiving Water Characteristics

Unless otherwise noted, the following description applies to receiving waters in the vicinity of all the Central Basin marine CSOs (excluding those in inner Elliott Bay and the Duwamish River, which are discussed separately). The discussion of receiving water characteristics is based on sampling results from the county's long-term marine ambient and point source monitoring program. Data and reports are accessible at <http://green.kingcounty.gov/marine/>.

Surface water temperatures vary seasonally because of differences in air temperatures, wind speed, and solar radiation. The highest temperatures occur during the summer and lowest in January/February. Salinities in the upper 10 meters of the water column generally are lowest during the spring. In waters deeper than 10 meters, such as where the Carkeek and Alki CSO Treatment Plants outfalls discharge, the highest salinities occur in the fall associated with coastal upwelling and input of oceanic water and are at near-oceanic levels (up to 31 PSS) throughout much of the year. Other than seasonally influenced surface waters, a well-mixed water column occurs throughout most of the year. Density is a function of both salinity and temperature and can affect mixing and circulation, as large differences in water column density cause stratification. In general, the periods of the most intense water column stratification occur in the summer and winter and most areas in the Central Basin exhibit a pattern of moderate and infrequent stratification. Fauntleroy Cove, in the vicinity of the Barton Street CSO outfall, exhibits a pattern of weak and infrequent stratification, which is less than in other areas. The water column in Fauntleroy Cove is well-mixed throughout most of the year.

Dissolved oxygen (DO) levels are above 7.0 mg/L (the Washington State water quality standard for extraordinary use of marine surface waters) throughout most of the year. DO levels in Central Basin waters occasionally fall between 4.5 and 5.0 mg/L during the fall months (August through October) because of the input of upwelled oceanic waters that have naturally low DO levels. The exception to this is in Quartermaster Harbor where low DO levels (< 3.5 mg/L) have been documented in the summer months; however, no CSOs are located in this area.

Fecal coliform bacteria levels in Central Basin subtidal waters have always met the state water quality geometric mean and peak standards for primary contact recreation. Most values in subtidal waters were either 1 colony forming unit (CFU)/100 mL or not detected.

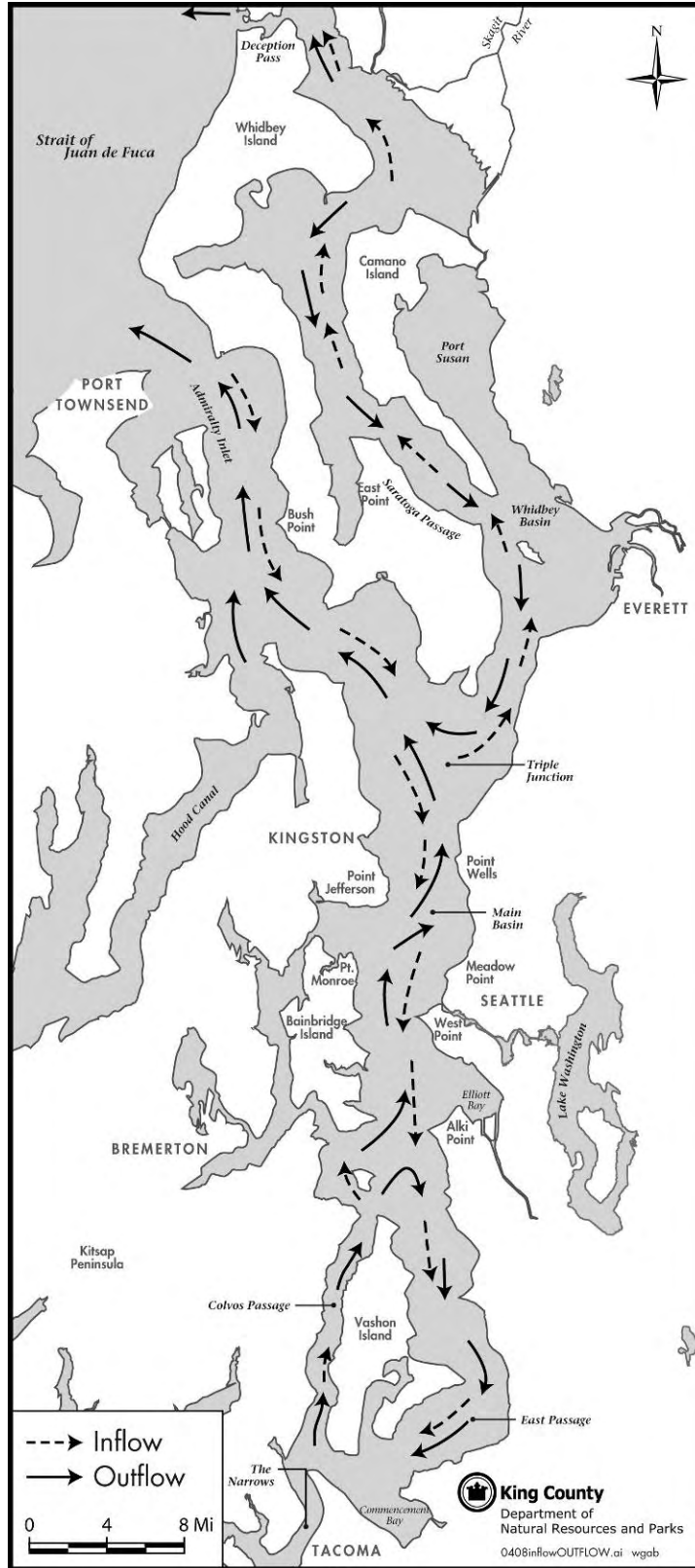


Figure 2-1. Generalized Puget Sound Circulation (from King County, 2002)

2.2 Information on Specific CSO Outfalls

The following pages present outfall and discharge information and sediment chemistry results for the nine CSO outfalls in the Central Basin of Puget Sound. More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx>.

Table 2-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

The accompanying CD provides effluent and sediment quality monitoring data.

Table 2-1. Summary of Sediment and Discharge Information for CSOs in the Central Basin of Puget Sound

DSN	Facility Name	Control Status	Associated Stormwater Outfall	Discharge Quality Data	Last date of Sediment Sample	Number of Stations	Sediment Analysis Performed	Data in EIM	SQS Exceedance
046	Carkeek CSO Treatment Facility Outfall	Treated	Yes	Yes	2000	6	Chemistry	CARKEK00	None
048b	North Beach Pump Station (inlet structure)	Uncontrolled	Yes	Not sampled—no NPDES requirement	1996	6	Chemistry	NB_CS096	Yes
048a	North Beach Pump Station (wet well)	Uncontrolled	Yes	Not sampled—no NPDES requirement	1996	6	Chemistry	NB_CS096	Yes
006	Magnolia Overflow	Uncontrolled	Yes	Not sampled—no NPDES requirement	1996	6	Chemistry	MAGCS096	None
052	53rd Avenue SW Pump Station	Controlled	Yes	Not sampled—controlled CSO	1996	6	Chemistry	53ACSO96	Yes
051	Alki CSO Treatment Facility Outfall	Treated	Yes	Yes	2001	6	Chemistry	ALKI01	None
054	63rd Avenue SW Pump Station	Controlled	Yes	Yes	1997	6	Chemistry	63ACSO97	None
055	SW Alaska Street Overflow	Controlled	No	Not sampled—no NPDES requirement	1997	6	Chemistry	AK_CS097	None
056	Murray Street Pump Station	Uncontrolled	Yes	Not sampled—no NPDES requirement	1997	6	Chemistry	MURCS097	Yes
057	Barton Street Pump Station	Uncontrolled	Yes	Not sampled—no NPDES requirement	1997	6	Chemistry	BRTCS097	Yes

2.2.1 Carkeek CSO Treatment Plant

NPDES Discharge Serial Number 046

1958 Baseline Facility: Built as a private treatment facility to provide floatables removal and chlorination; operated by the City of Seattle after 1954. In 1964, the original private Greenwood plant was upgraded to a 24/7 primary treatment plant; Metro (now King County) assumed responsibility in 1962 and converted the plant to CSO storage and treatment in 1994 when base and stored flows were transferred to West Point for secondary treatment.

Discharge Location: The Carkeek CSO Treatment Plant discharges to Puget Sound through a multi-port diffuser structure at latitude 47° 42' 45.5" N and longitude -122° 23' 16.4" W. The diffuser consists of 13 diffuser ports, varying from 5.5 to 10 inches in diameter. There are four 5.5-inch ports, four 6-inch ports, four 7-inch ports, and one 10-inch end port; all ports are spaced 4 feet apart. The ports discharge horizontally, alternating in direction with the final end port aligned with the outfall pipe. The diffuser terminates at a depth of 200 feet (61 meters) offshore of the Carkeek neighborhood of Seattle, in the Central Basin of Puget Sound (Figure 2-2). The outfall provides 93:1 dilution at the zone of acute criteria exceedance boundary and 146:1 at the chronic mixing zone boundary.

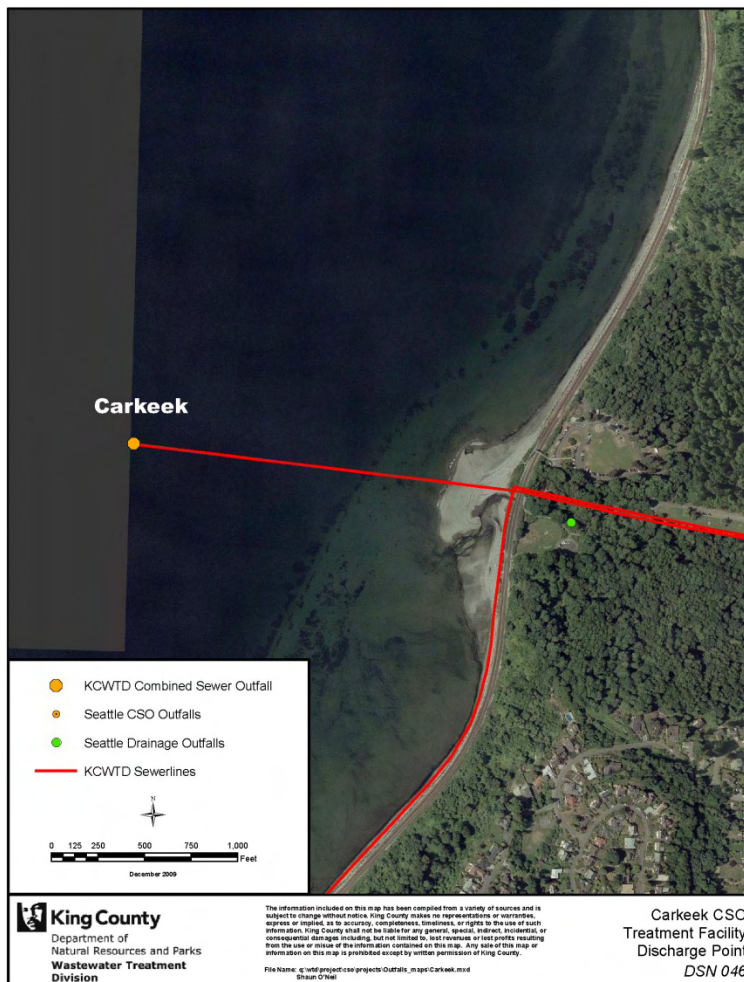


Figure 2-2. Carkeek CSO Treatment Plant Discharge Point

1983 Overflow Baseline: The plant is permitted to discharge up to 46 MG over up to 10 events per year.

Overflow Quantity: No untreated events occur from this facility; controlled to the state standard.

Control Project History: Facility never was an untreated CSO; converted to a CSO treatment facility, with disinfection and dechlorination, from a 24/7 primary treatment plant in 1994 when base flows were routed to West Point; no further projects are needed to meet state standards.

CSO Effluent Quality Monitoring Data: Monitoring is done per event for conventional parameters, and priority pollutants are monitored once per permit cycle under the NPDES permit. Data are available from the Ecology WQ permit program.

Construction-Related Monitoring: Post-construction monitoring was done for after the conversion to CSO treatment.

Sediment Sampling: Sediments in the vicinity of the Carkeek CSO Treatment Plant have been sampled multiple times, most recently in 2000. Sediment samples were collected from six locations proximal to the Carkeek outfall in October 2000. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,500 feet from the outfall in the direction of the prevailing current. Station locations and the outfall discharge point are shown in Figure 2-3. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 909 to 1,810 mg/Kg DW or approximately 0.09 to 0.18 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. All detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID CARKEK00.

Sediment Remediation Activity: Nothing in planning at this time.



Carkeek CSO Treatment Plant Vicinity; Beach Looking Southwest



Carkeek CSO Treatment Plant Sedimentation Tanks



Figure 2-3. Carkeek CSO Treatment Plant (046) Sediment Sampling Locations

2.2.2 North Beach Pump Station

NPDES Discharge Serial Numbers 048a (inlet overflow to storm drain and beach) and 048b (wet well overflow to old plant outfall)

1958 Baseline Facility: Was a 24/7 primary treatment plant operated by City of Seattle after acquired from private North Beach Sewer District in 1954. Converted to a pump station to transfer flows to the Greenwood/Carkeek primary plant by Metro (now King County) in 1962.

Discharge Location: Inlet overflow to storm drain and beach at latitude 47° 42' 7.710" N and longitude -122° 23' 26.735" W; wet well overflow via old plant outfall 1,000 feet offshore at latitude 47° 42' 14.424" N and longitude 122° 23' 33.229" W (Figure 2-4).



Figure 2-4. North Beach Pump Station CSO Discharge Point

1983 Overflow Baseline: 18 events and 6.0 MG per year.

Overflow Quantity: Has overflowed between 0 and 22 times per year since 1991 when monitoring began; 20-year average is 2.31 events per year; 2001–2007 average volume was 9.2 MG.

Control Project History: Control project is currently in predesign; facilities plan is due to Ecology the end of 2010, and the project should be in substantial construction by the end of 2013.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment samples were collected from six locations proximal to the North Beach Pump Station discharge point in October 1996. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-5. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 867 to 1,970 mg/Kg DW or approximately 0.09 to 0.20 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. The phenol concentration of 461 $\mu\text{g/Kg DW}$ detected in the sample collected from Station NB230N exceeded the dry-weight normalized SQS of 420 $\mu\text{g/Kg DW}$. This station is located approximately 230 feet from the end of the outfall. All other detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID NB_CSO96.

Sediment Remediation Activity: Nothing in planning at this time.



North Beach CSO Vicinity; Looking West From Community Park Above Beach



North Beach CSO Wetwell Overflow Outfall; Looking West Across Puget Sound



Figure 2-5. North Beach Pump Station (048a,b) Sediment Sampling Locations

2.2.3 South Magnolia

NPDES Discharge Serial Number 006

1958 Baseline Facility: City of Seattle raw sewage discharge; intercepted by Seattle in 1958 and then acquired by Metro (now King County) in 1962.

Discharge Location: Submerged offshore outfall discharges 780 feet offshore in Puget Sound at latitude 47° 37' 48.663" N and longitude -122° 23' 56.476" W; twin outfalls replaced by a single outfall in 1999 (Figure 2-6).



Figure 2-6. South Magnolia CSO Discharge Point

1983 Overflow Baseline: 25 events and 14 MG per year.

Overflow Quantity: Has overflowed between 0 and 48 times per year since 1991 when monitoring began; 20-year average is 18.9 events per year; 2001–2007 average volume was 30.55 MG; overflows increased significantly after a 2003 Seattle hydrobrake modification.

Control Project History: Control project is currently in predesign; facilities plan is due to Ecology the end of 2010, and the project should be in substantial construction by the end of 2013.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

Construction-related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment samples were collected from six locations proximal to the South Magnolia CSO discharge point in October 1996. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-7. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 1,200 to 1,760 mg/Kg DW or approximately 0.12 to 0.18 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. All detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID MAGCSO96.

Sediment Remediation Activity: Nothing in planning at this time.



South Magnolia CSO Vicinity; Looking Southwest Across Elliott Bay.

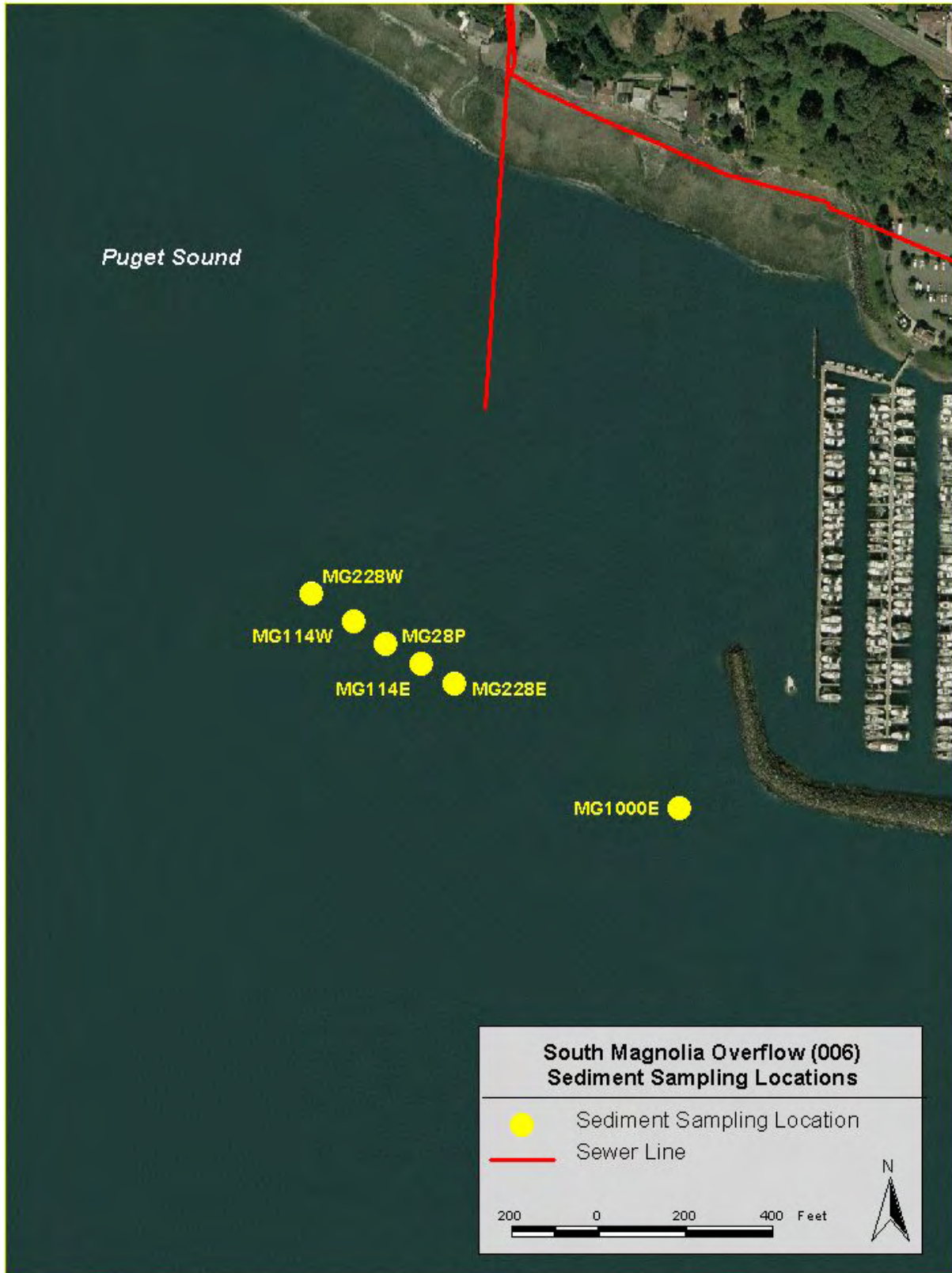


Figure 2-7. South Magnolia Overflow (006) Sediment Sampling Locations

2.2.4 53rd Avenue Pump Station

NPDES Discharge Serial Number 052

1958 Baseline Facility: Seattle Pump Station built by Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

Discharge Location: Submerged 60-inch-diameter outfall, 560 feet offshore to Elliott Bay along North Alki Beach in West Seattle at latitude 47° 35' 5.275" N and longitude -122° 24' 9.186" W (Figure 2-8).



Figure 2-8. 53rd Avenue Pump Station CSO Discharge Point

1983 Overflow Baseline: 0 event and 0 MG per year.

Overflow Quantity: Has overflowed between 0 and 3 times per year since 2000 when monitoring began; 8-year average is 0.3 event year; 2001–2007 average volume was 0.1 MG per year.

Control Project History: No project has been needed or planned; controlled to the state standard

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential with some light commercial in quality.

Construction-Related Monitoring: Not applicable.

Sediment Sampling: Sediment samples were collected from six locations proximal to the 53rd Avenue Pump Station discharge point in October 1996. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-9. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 861 to 3,202 mg/Kg DW or approximately 0.09 to 0.32 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. The Aroclor 1254 concentration of 844 µg/Kg DW detected in the sample collected from Station DH1000S exceeded the LAET of 130 µg/Kg DW. This station is located approximately 1,000 feet from the end of the outfall. The benzyl butyl phthalate concentration of 65.6 detected in the same sample also exceeded the LAET of 63 µg/Kg DW. All other detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID 53ACSO96.

Sediment Remediation Activity: Nothing in planning at this time.



*53rd Avenue Pump Station CSO Vicinity;
Looking West Across Elliott Bay*



*53rd Avenue Pump Station CSO Vicinity;
Looking East Across Elliott Bay*



Figure 2-9. 53rd Avenue Pump Station (052) Sediment Sampling Locations

2.2.5 Alki CSO Treatment Plant

NPDES Discharge Serial Number 050

1958 Baseline Facility: In construction by Seattle as a primary treatment plant; acquired in 1962 by Metro (now King County); converted to CSO treatment in 1998 when the base flows were transferred to West Point for secondary treatment.

Discharge Location: Discharges to Puget Sound south of Duwamish Head in West Seattle/Alki through a multi-port diffuser structure at latitude 47° 34' 12.9" N and longitude -122° 25' 21.0" W. The diffuser consists of eight 12-inch diffuser ports, terminating at a depth of 142.73 feet (43.5 meters) offshore (Figure 2-10). The diffuser provides 17.5:1 dilution at the edge of the zone of acute criteria exceedance and 61:1 dilution at the edge of the chronic mixing zone.

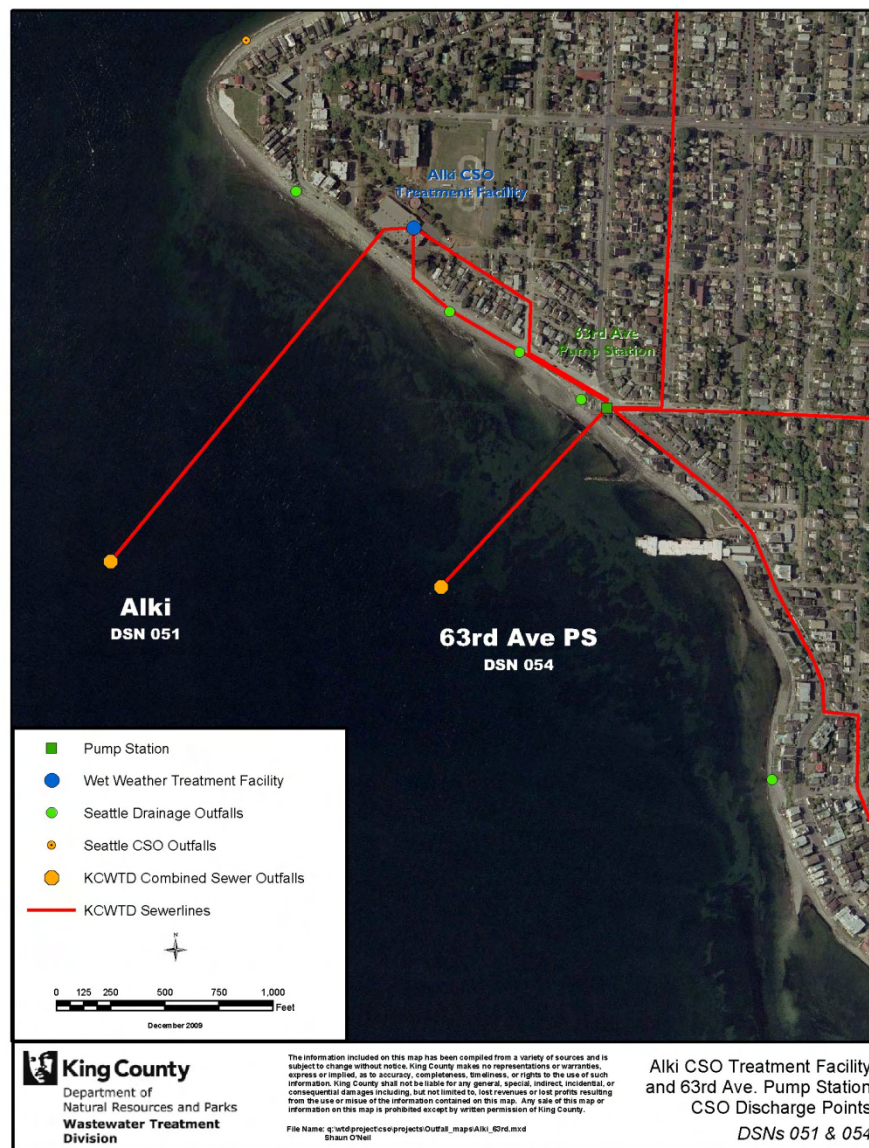


Figure 2-10. Alki CSO Treatment Plant Discharge Point

1983 Overflow Baseline: Not applicable; the plant is permitted to discharge up to 108 MG in 29 events per year.

Overflow Quantity: No untreated events occur from this facility; controlled to the state standard.

Control Project History: Facility never was an untreated CSO; converted to a CSO treatment facility, with disinfection and dechlorination from a 24/7 primary treatment plant in 1998; no further projects are needed.



Alki CSO Treatment Plant Vicinity; Aerial, Looking West into Puget Sound

CSO Effluent Quality Monitoring Data: Monitoring is done per event for conventional parameters, and priority pollutants are monitored once per permit cycle, under the NPDES permit. Data are available from the Ecology WQ permit program.

Construction-Related Monitoring: Post-construction monitoring was not done after the conversion to CSO treatment.

Sediment Sampling: Sediments in the vicinity of the Alki CSO Treatment Plant have been sampled multiple times, most recently in 2001. Sediment samples were collected from six locations proximal to the Alki outfall in October 2001. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,500 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-11. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 2,280 to 3,480 mg/Kg DW or approximately 0.23 to 0.35 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. All detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID ALKI01.

Sediment Remediation Activity: Nothing in planning at this time.



Figure 2-11. Alki CSO Treatment Plant (051) Sediment Sampling Locations

2.2.6 63rd Avenue Pump Station

NPDES Discharge Serial Number 054

1958 Baseline Facility: Pump station built by Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

Discharge Location: Submerged, offshore to Puget Sound; 1,100 feet of 60-inch-diameter outfall at latitude 47° 34' 12.059" N and longitude -122° 24' 58.682" W (Figure 2-12).

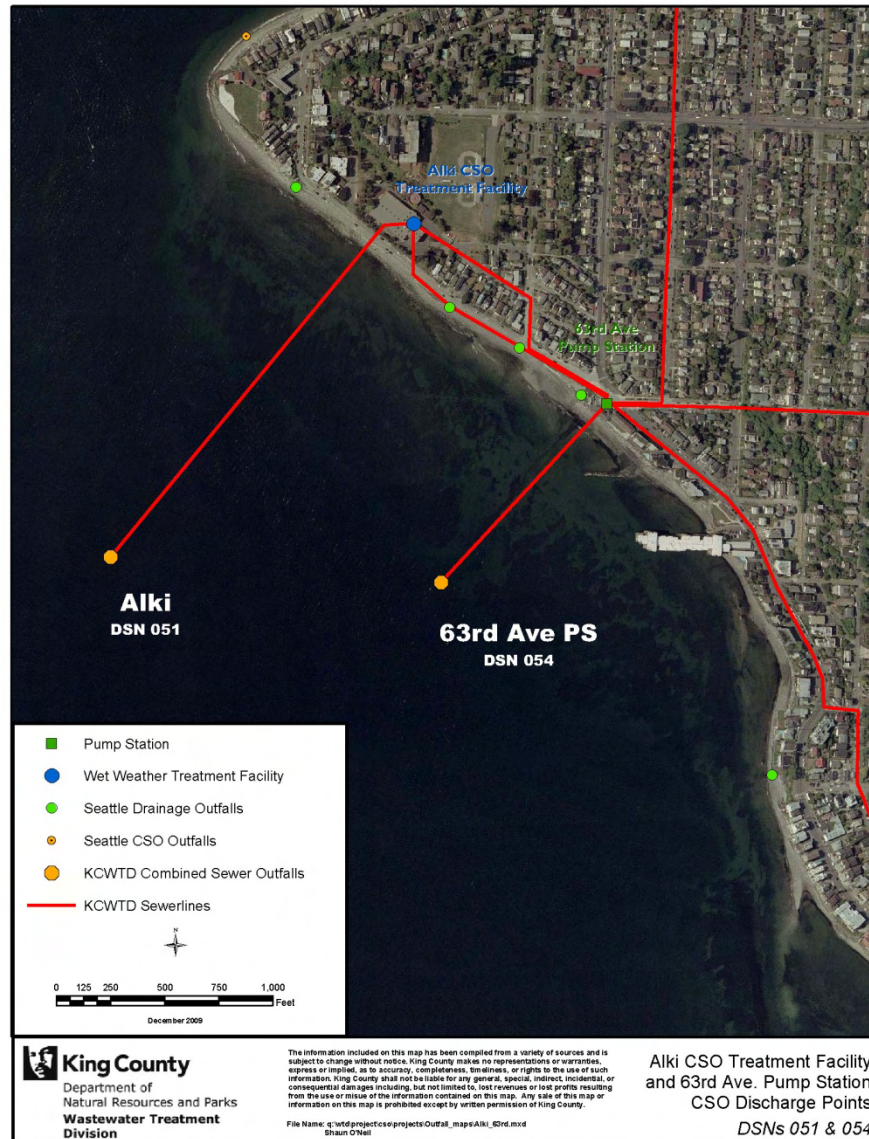


Figure 2-12. 63rd Avenue Pump Station CSO's Discharge Point

1983 Overflow Baseline: 2 events and 10 MG per year.

Overflow Quantity: Has overflowed between 0 and 2 times per year since 2000 when monitoring began; 8-year average is 0.3 event per year; 2001–2007 average volume was 0.54 MG per year.

Control Project History: Controlled in 1998 when converted to be used only when the West Seattle Tunnel is full; now functions to pump excess flow to the Alki CSO Treatment Plant.

CSO Effluent Quality Monitoring Data: No overflow quality monitoring to characterize the CSO was performed; quality will be the same as the influent to the Alki CSO plant, whose data are available from the Ecology WQ permit program.

Construction-Related Monitoring: No post-construction monitoring was done.

Sediment Sampling: Sediment samples were collected from six locations proximal to the 63rd Avenue Pump Station CSO discharge point in October 1997. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-13. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 1,330 to 2,500 mg/Kg DW or approximately 0.13 to 0.25 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. All detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID 63ACSO97.

Sediment Remediation Activity: Nothing in planning at this time.



63rd Avenue Pump Station CSO Vicinity; Looking Northwest across Puget Sound.



Figure 2-13. 63rd Avenue Pump Station (054) Sediment Sampling Locations

2.2.7 SW Alaska Street

NPDES Discharge Serial Number 055

1958 Baseline Facility: Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

Discharge Location: A 54-inch-diameter outfall approximately 300 feet offshore at a depth of 20 feet into Puget Sound at latitude 47° 33' 33.992" N and longitude -122° 24' 25.010" W (Figure 2-14).



Figure 2-14. SW Alaska Street CSO Discharge Point

1983 Overflow Baseline: 1 event and less than 0.1 MG per year.

Overflow Quantity: Has overflowed between 0 and 1 time per year since 1992 when monitoring began; 20-year average is 0.1 event per year; 2001–2007 average volume was 0.01 MG per year. Controlled to state standard.

Control Project History: A project was specified in the RWSP, but is not needed because the site is controlled.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

Construction-Related Monitoring: Not applicable.

Sediment Sampling: Sediment samples were collected from six locations proximal to the SW Alaska Street CSO discharge point in October 1997. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-15. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 2,200 to 3,980 mg/Kg DW or approximately 0.22 to 0.40 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. All detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID AK_CS097.

Sediment Remediation Activity: Nothing in planning at this time.



Alaska Street CSO Vicinity; Looking Northwest Across Puget Sound.



Figure 2-15. SW Alaska Street Overflow (055) Sediment Sampling Locations

2.2.8 Murray Street Pump Station

NPDES Discharge Serial Number 056

1958 Baseline Facility: Pump Station built by Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

Discharge Location: 72-inch-diameter submerged outfall, 800 feet offshore of Lowman Beach Park in West Seattle into Puget Sound at latitude 47° 32' 24.991" N and longitude -122° 24' 0.009" W (Figure 2-16).

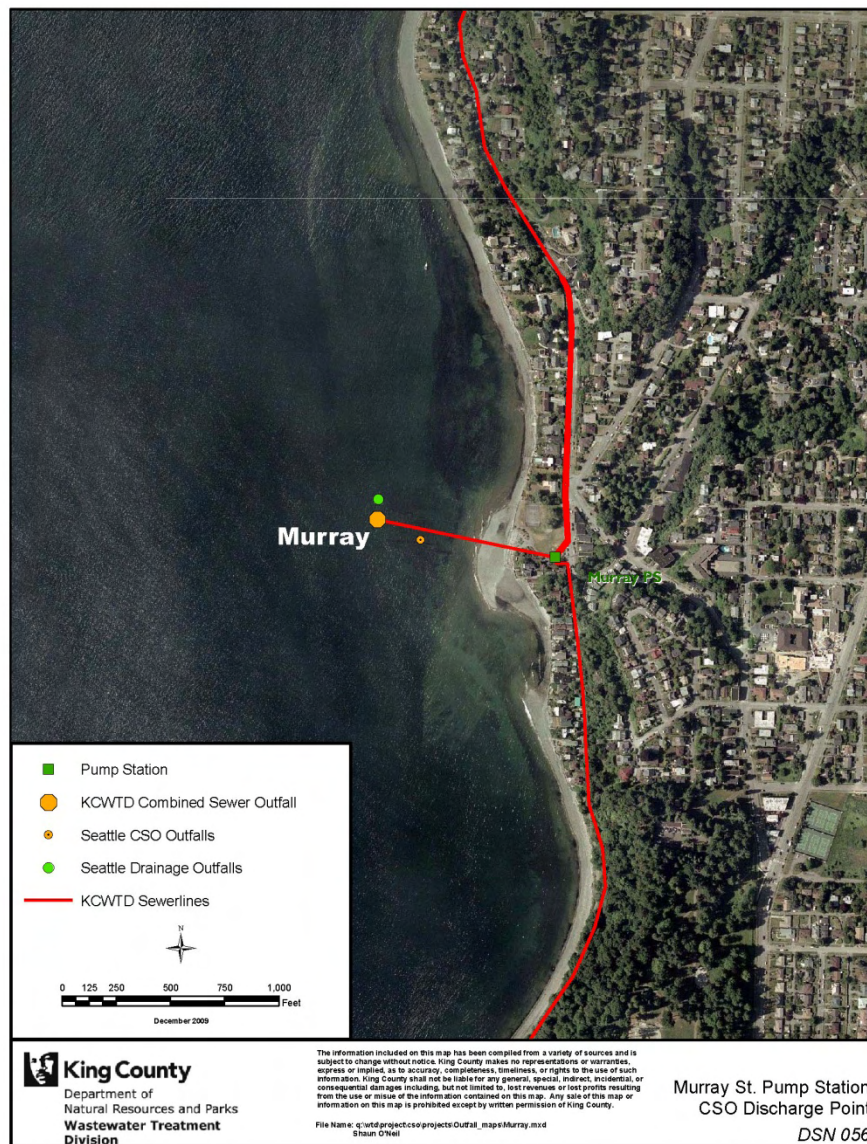


Figure 2-16. Murray Street Pump Station CSO Discharge Point

1983 Overflow Baseline: 5 events and 6 MG per year.

Overflow Quantity: Has overflowed between 0 and 10 times per year since 2000 when monitoring began; 8-year average is 3.6 events per year; 2001–2007 average volume was 5.21 MG per year.

Control Project History: The control project is currently in design; facilities plan is due to Ecology the end of 2010, and the project should be in substantial construction by the end of 2013.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality.

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment samples were collected from six locations proximal to the Murray Street Pump Station CSO discharge point in October 1997. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-17. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 1,620 to 3,610 mg/Kg DW or approximately 0.16 to 0.36 percent DW. Because of these low organic carbon concentrations, organic data from this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. The di-N-octyl phthalate concentration of 278 $\mu\text{g}/\text{Kg DW}$ detected in the sample collected from Station MY106S exceeded the LAET of 61 $\mu\text{g}/\text{Kg DW}$. This station is approximately 106 feet from the end of the outfall. The mercury concentration of 3.05 mg/Kg DW detected in the sample collected from Station MY213S exceeded the CSL of 0.59 mg/Kg DW. This station is located approximately 213 feet from the end of the outfall. Because of the magnitude of this mercury concentration, Station MY213S was resampled, in triplicate, in June 1998 for mercury analysis. Mercury concentrations detected in these three samples ranged from 0.0252 to 0.0427 mg/Kg DW. All other detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID MURCSO97.

Sediment Remediation Activity: Nothing in planning at this time.



Murray Avenue Pump Station CSO Vicinity; Looking West Across Puget Sound.



Figure 2-17. Murray Street Pump Station (056) Sediment Sampling Locations

2.2.9 Barton Street Pump Station

NPDES Discharge Serial Number 057

1958 Baseline Facility: Pump station built by Seattle; Seattle CSO after completion of Alki Sewage Treatment Plant; acquired by Metro (now King County) in 1962.

Discharge Location: 60-inch-diameter submerged outfall, 620 feet offshore of the Fauntleroy ferry terminal in West Seattle into Puget Sound at latitude 47° 31' 25.991" N and longitude - 122° 23' 47.014" W (Figure 2-18).



Figure 2-18. Barton Street Pump Station CSO Discharge Point

1983 Overflow Baseline: 9 events and 8 MG per year.

Overflow Quantity: Has overflowed between 0 and 11 times per year since 2000 when monitoring began; 8-year average is 3 events per year; 2001–2007 average volume was 4.34 MG per year.

Control Project History: The control project is currently in design; facilities Plan is due to Ecology the end of 2010, and the project should be in substantial construction by the end of 2013.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was not required. Estimated to be residential in quality with some light commercial.

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment samples were collected from six locations proximal to the Barton Street Pump Station discharge point in October 1997. Five of the stations formed a transect perpendicular to the end of the outfall and the sixth station was located approximately 1,000 feet from the outfall. Station locations and the outfall discharge point are shown in Figure 2-19. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Organic carbon concentrations in these six samples ranged from 274 to 8,730 mg/Kg DW or approximately 0.03 to 0.87 percent DW. Because of these low organic carbon concentrations, organic data from five stations at this site were compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. The organic carbon concentration of 0.87 percent at the sixth location, Station BT106S, dictates reporting data normalized to organic carbon. The dry-weight normalized benzyl butyl phthalate concentration of 114 $\mu\text{g}/\text{Kg}$ DW detected in the sample collected from Station BT212N exceeded the LAET of 63 $\mu\text{g}/\text{Kg}$ DW. This station is located approximately 212 feet from the end of the outfall. The organic-carbon normalized benzyl butyl phthalate concentration of 16.4 mg/Kg OC detected in the sample collected from Station BT106S exceeded the SQS of 4.9 mg/Kg OC. This station is located approximately 106 feet from the end of the outfall. The dry-weight normalized dimethyl phthalate concentration of 172 $\mu\text{g}/\text{Kg}$ DW detected in the sample collected from Station BT12P exceeded the 2LAET of 71 $\mu\text{g}/\text{Kg}$ DW. This station is located at the end of the outfall. All other detected chemical concentrations were less than their respective SQS criteria or LAET values. Data from this sampling event may be found in EIM under User Study ID BRTCSO97.

Sediment Remediation Activity: Nothing in planning at this time.



*Barton Street Pump Station CSO Vicinity;
Looking West Across Puget Sound.*



Figure 2-19. Barton Street Pump Station (057) Sediment Sampling Locations

3.0 CSO OUTFALLS IN ELLIOTT BAY

King County manages three CSOs that discharge to Elliott Bay. The Denny Way/Elliott West CSO will be controlled after post-control project fine-tuning is completed. The King Street and Connecticut Street (Kingdome) CSOs are not yet controlled.

3.1 Receiving Water

3.1.1 Overview

Elliott Bay is a partially enclosed embayment that is surrounded on the north, east, and south sides by urbanized areas. The eastern shoreline borders downtown Seattle and has been heavily modified from historical conditions. Most of the shoreline is armored, generally with rock, riprap, and/or bulkheads. Much of the southern and eastern waterfront land area was created by filling in what was once intertidal habitat by constructing bulkheads. As a result, the shoreline is much steeper than a natural shoreline. Harbor Island, located in the southern portion of the bay, is a man-made island completed in 1909.

Elliott Bay is an estuarine system that is heavily influenced from outflowing freshwater from the Duwamish River. Freshwater enters Elliott Bay at the surface and mainly follows the eastern shoreline until reaching the outer bay and the Main Basin. The middle and outer area of Elliott Bay is dominated by marine water from the Central Basin with the freshwater layer limited to about the upper five meters (King County, 1999). Circulation in Elliott Bay is density-driven as a result of the dynamic interaction of the high-salinity water of Elliott Bay and the freshwater discharge from the Duwamish River. Surface salinity dynamics depend primarily on the amount of discharge from the Duwamish River, wind stress, and tidal fluctuations.

Other than a few intertidal areas, depths in Elliott Bay range from about 10 meters to slightly over 150 meters near the western portion of the bay. The eastern and western (from Duwamish Head south of Seacrest Park) shorelines have steep slopes, and the middle of the bay has deep, flat areas.

3.1.2 Receiving Water Characteristics

The Duwamish River has a large effect on temperature and salinity in Elliott Bay. During the winter and spring months when runoff from rainfall and snowmelt is high, surface temperatures and salinity in Elliott Bay are lower than in other areas. Winter and early spring water temperatures (from January to April) are typically between 8 and 9°C. Surface salinities from January to March are typically between 25 and 26 PSS, whereas salinities in other parts of the Central Basin are usually above 28 PSS. Although the timing of the snowmelt can vary, the snowmelt signal from the Duwamish River can usually be seen in May and June surface salinities. Salinities in May and June in Elliott Bay surface waters have been measured between 25 and 26 PSS and are typically between 29 and 30 PSS at other locations during this time. Because of the freshwater influence of the Duwamish River, Elliott Bay exhibits strong and intermittent stratification and the water column is stratified throughout much of the summer.

Dissolved oxygen (DO) levels are above 7.0 mg/L throughout much of the year in Elliott Bay. However, DO levels regularly fall between 4.0 and 5.0 mg/L during the fall months (August

through October) because of density stratification, the influence of upwelled oceanic waters that have naturally low DO levels, and decomposition of organic matter. There is no difference in DO levels in waters near the middle of the bay and at the Denny Way CSO outfall.

Fecal coliform bacteria levels in Elliott Bay subtidal waters, including the waters at the Denny Way CSO outfall, have met the state water quality geometric mean and peak standards for primary contact recreation for the last several years.

3.2 Information on Specific CSO Outfalls

The following pages present outfall and discharge information and sediment chemistry results for the three CSO outfalls in Elliott Bay.

More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx>.

Table 3-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

The accompanying CD provides effluent and sediment quality monitoring data.

Table 3-1. Summary of Sediment and Discharge Information for CSOs in Elliott Bay

DSN	Facility Name	Control Status	Associated Stormwater Outfall	Discharge Quality Data*	Last date of Sediment Sample	Number of Stations	Sediment Analysis Performed	Data in EIM	SQS Exceedance
027b	Elliot West CSO Treatment Facility	Treated	No	Yes	2009	16	Chemistry/ Benthic	Pending	Yes
027a	Denny Way Regulator	Post-construction	No	Yes	2009	16	Chemistry/ Benthic	Pending	Yes
028	King Street Regulator	Uncontrolled	Yes	Yes	1989	5	Chemistry	HSSEAT88	Yes
029	Connecticut Street Regulator (Kingdome)	Uncontrolled	Yes	Yes	1996	7	Chemistry/ Bioassay	CONCSO95	Yes

3.2.1 Denny Way CSO and Elliott West CSO Treatment Facility

Denny Way CSO: NPDES Discharge Serial Number 027a

Elliott West CSO Treatment Facility: NPDES Discharge Serial Number 027b

1958 Baseline Facility: Seattle raw sewage outfall; acquired by Metro (now King County) in 1962 and intercepted for treatment at West Point in 1967.

Discharge Location: Untreated overflow on surface at northeast side of Elliott Bay until replaced in 2005 as part of the Denny Way/Lake Union CSO control project with a new submerged outfall 100 feet offshore at 10-foot depth; also as part of the project, the new Elliott West CSO Treatment Facility started discharging treated CSO at latitude 47° 37' 3.18" N and longitude -122° 21' 42.68" W through a 90-inch-diameter submerged outfall 490 feet offshore at 60-foot depth (Figure 3-1). The treated discharge outfall provides 7.8:1 dilution at the zone of acute criteria exceedance and 11:1 dilution at the chronic mixing zone boundary.

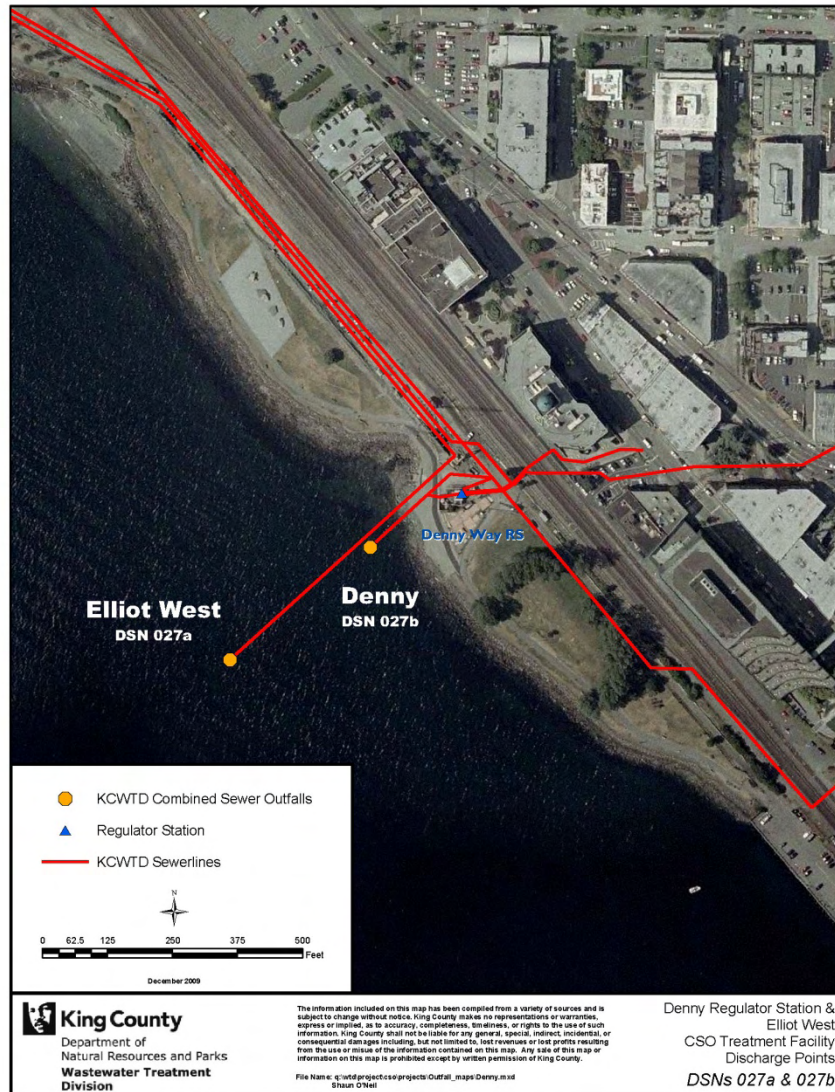


Figure 3-1. Denny Way Regulator Station and Elliott West CSO Treatment Facility CSO Discharge Point

1983 Overflow Baseline: 32 events and 502 MG per year.

Overflow Quantity: The Denny Way outfall has overflowed between 1 and 54 times per year since 1991 (1–9 times per year since the control project was completed); 20-year average is 26.2 events/year (4 per year since control project); 2001–2007 average volume was 221.98 MG per year (includes 2 years after control project). After additional adjustments, facility will meet state standard. Treated discharge will occur intermittently at an average of approximately 8 times per year.

Control Project History: The Elliott West CSO Treatment Facility was completed in 2005 to control the Seattle east Lake Union CSOs and the county's west Lake Union Dexter CSO and Denny Regulator into Elliott Bay. The facility provides CSO (equivalent to primary) treatment, screening, disinfection, and dechlorination of captured CSOs. Additional adjustments are under way to complete control to the state standard.

CSO Effluent Quality Monitoring Data:

Substantial overflow quality monitoring have been done under a variety of studies between 1982 and 1997 to characterize the CSO. Data for these samples are included in the accompanying CD. More current data are available from the Ecology WQ permit program.

Sample Date	Sample #
1/22/1982	CSO027
1/23/1982	CSO027
1/25/1982	CSO027
3/25/1988	8800302
4/11/1982	CSO027
3/5/1992	9200363
3/5/1992	9200364
4/16/1992	9200788
4/16/1992	9200789
4/16/1992	9200790
4/16/1992	9200790
4/16/1992	9200791
8/6/1992	9201566
8/6/1992	9201567
9/3/1992	9201733
9/3/1992	9201734
9/3/1992	9201735
9/3/1992	9201736



Denny Way Original Outfall



Denny Way CSO and Elliott West CSO Treatment Facility Vicinity After New Outfalls; April 2008

Sample Date	Sample #
1/19/1993	L54-1
1/19/1993	L54-2
3/22/1993	L743-1
3/22/1993	L743-2
3/22/1993	L743-3
4/8/1993	L862-1
4/8/1993	L862-2
4/8/1993	L862-3
12/4/1996	L10011-1
12/4/1996	L10011-6
12/6/1996	L10011-5
1/17/1997	L10051-1
1/17/1997	L10051-3
1/18/1997	L10051-5
3/15/1997	L10299-11
3/15/1997	L10299-2
3/15/1997	L10299-7
3/16/1997	L10299-9
3/18/1997	L10663-1
3/18/1997	L10663-9
3/19/1997	L10663-5

Construction-Related Monitoring: Pre-construction effluent and sediment monitoring was completed before the new outfalls were completed. Post-construction monitoring is currently under way.

Sediment Sampling: Sediments in the vicinity of the Denny Way CSO and, later, the Elliott West CSO Treatment Facility discharge points have been sampled extensively in the past. The current sediment monitoring program has been in effect since 2001 as part of the Denny Way/Lake Union CSO Control Project long-term sediment monitoring program. Samples were collected from 16 locations proximal to the two outfalls in 2001, 2003, 2004, 2006, 2007, 2008, and 2009. Station locations and the outfall discharge points are shown in Figure 3-2. Data from the most recent sampling event, which occurred in May 2009, are summarized in the accompanying CD. Data from 15 of the 16 stations have been normalized to organic carbon for comparison with SMS chemical criteria. The 16th station, DWMP-10, has been compared to dry-weight normalized LAET and 2LAET values because of the low organic carbon content at this station (less than the method detection limit of 490 mg/Kg DW). Several chemicals exceed either SQS and/or CSL chemical criteria at one or more locations. These include total PCBs at Stations DWMP-01, DWMP-02, DWMP-03, DWMP-08, DWMP-14, DWMP-15, and DWMP-16; benzo(a)anthracene at Station DWMP-05; benzo(a)pyrene at Station DWMP-01 and DWMP-05; benzo(g,h,i)perylene at Stations DWMP-01 and DWMP-05; benzyl butyl phthalate at Stations DWMP-01 and DWMP-14; bis(2-ethylhexyl) phthalate at Stations DWMP-06, DWMP-08, DWMP-09, DWMP-14, and DWMP-15; chrysene at Station DWMP-05; dibenzo(a,h)anthracene at Stations DWMP-01 and DWMP-05; fluoroanthene at Station DWMP-05; indeno(1,2,3-c,d)pyrene at Stations DWMP-01 and DWMP-05; and mercury at Stations DWMP-01, DWMP-03, DWMP-08, DWMP-09, DWMP-14, and DWMP-15. Data for this sampling event have not yet been submitted to EIM.



Figure 3-2. Denny Way Regulator (027a) and Elliott West CSO Treatment Facility (027b) Sediment Sampling Locations

Sediment Remediation Activity: In 1986, Metro began a trial program to identify and reduce toxicant inputs to the sewer system discharging through the Denny Way CSO. In 1990, King County and the U.S. Army Corps of Engineers (Corps) sponsored the Denny Way CSO capping project to test the feasibility of capping contaminated sediments in Elliott Bay with clean dredged material from the Duwamish Waterway. A 3-foot layer of clean sand, dredged from the upper Duwamish Waterway during routine maintenance, was placed over a 3-acre area in water depths ranging from approximately -25 to -60 feet mean lower low water (MLLW).

King County has monitored the effectiveness of the cap at containing contaminated sediment for the past 17 years. Results show that the cap is stable, is not eroding, and has successfully isolated the underlying contaminated sediments (King County, 2005). However, chemical concentrations on the cap surface layer (offshore of the Denny Way CSO) increased after cap construction, suggesting possible recontamination from the continued CSO discharges from Denny Way or potential redistribution of remaining contaminated sediments from the intertidal area and the inshore edge of the cap.

In 1997, King County characterized the nature and extent of surface and subsurface sediment contamination in the outfall area and in areas inshore and offshore of the existing sediment cap (SEA, 1997). Follow-up sediment sampling conducted by King County in 2005 demonstrated that chemical concentrations in the offshore areas declined over time due to a combination of natural processes, including biodegradation of chemicals, accumulation and mixing of clean sediment, and reduction of contaminant sources (King County, 2005). Thus, monitored natural recovery is a prospective cleanup remedy for the offshore areas. These areas will continue to be evaluated by Ecology and King County to determine if a more active cleanup remedy is required.

In 1997, sediments sampled within inshore areas of the site contained concentrations of cadmium, copper, lead, mercury, silver, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), bis(2-ethylhexyl)phthalate, and butyl benzyl phthalate that exceeded SQS chemical criteria. Contaminant concentrations above SQS chemical criteria were present to a depth of approximately 10 feet below the existing mudline. Unlike offshore areas of the site, natural recovery rates in the inshore sediment areas appeared to be progressing relatively slowly. In order to accelerate cleanup of the site and minimize the risk of future recontamination to other site areas, including the offshore cap, an interim sediment cleanup action plan for the site was developed by King County and Ecology in 2007 that included dredging to the maximum extent practicable to remove contaminated sediments and backfilling to restore the grade to close to pre-project conditions.

The Denny Way CSO interim action remediated contaminated sediment present in two nearshore areas in the immediate vicinity of the former Denny Way CSO outfall (Areas A and B in Figure 3-3). A combination of dredging, backfilling, and armoring was employed to remediate the nearshore areas.

In the initial design, approximately 17,000 cubic yards (cy) of contaminated sediments and associated side slopes were to be dredged from approximately +10 feet MLLW to approximately -35 feet MLLW within the 1.2-acre interim action area. A change order during dredging decreased the overall dredge footprint by over-steepening the side slopes to minimize the disturbance and removal of the riprap seawall. After the change order, approximately 13,700 cy of contaminated sediments and associated side slopes were dredged. The material within the dredge footprint was mechanically dredged using a clamshell bucket deployed from a derrick

barge. Removal of rock armor and concrete from the seawall was performed with a barge-mounted excavator, and 414 tons of recyclable concrete material was recovered from 1,918 tons of mixed concrete, rock, and sediment. The dredged area was backfilled and armored with an average thickness of more than 8 feet of material. Approximately 11,886 cy of well-graded clean sand was armored with approximately 4,821 cy of sandy-gravel habitat mix and with large cobbles and boulders. An additional 1,540 cy of well-graded clean sand was placed in an approximate 6-inch-thick layer around the perimeter of the dredge prism to address any residuals that may have resulted from the dredging.

Post Construction sediment monitoring was done and is documented in the Denny Way CSO Nearshore Interim Sediment Cleanup Project Closure Report (King County, 2008)

(http://your.kingcounty.gov/dnrp/library/wastewater/sedman/Denny/Denny_200810.pdf.)

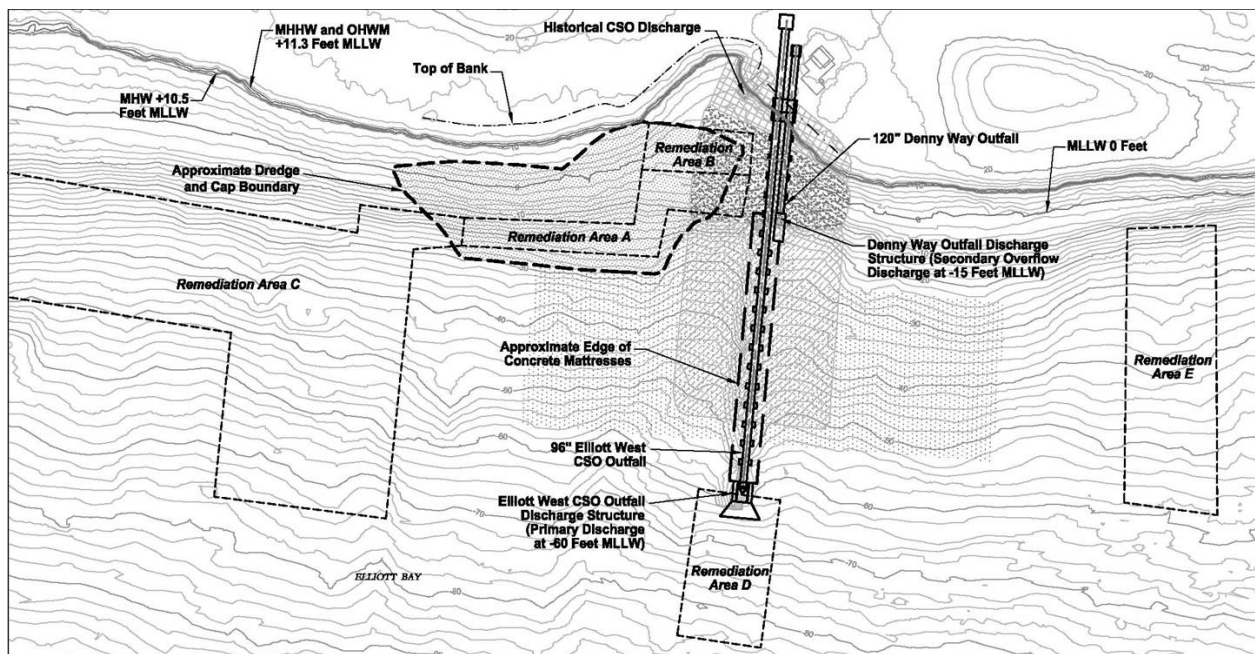


Figure 3-3. Remediation Areas Associated with Denny Way CSO

3.2.2 King Street Regulator

NPDES Discharge Serial Number 028

1958 Baseline Facility: Seattle raw sewage outfall; acquired by Metro (now King County) in 1962 and intercepted for conveyance to West Point in 1971.

Discharge Location: Located next to Terminal 30 at the southeast end of Elliott Bay; Seattle-owned 48-inch-diameter outfall 150 feet offshore at a depth of 20 feet at latitude 47° 37' 56.411" N and longitude -122° 20' 14.730" W (Figure 3-4).

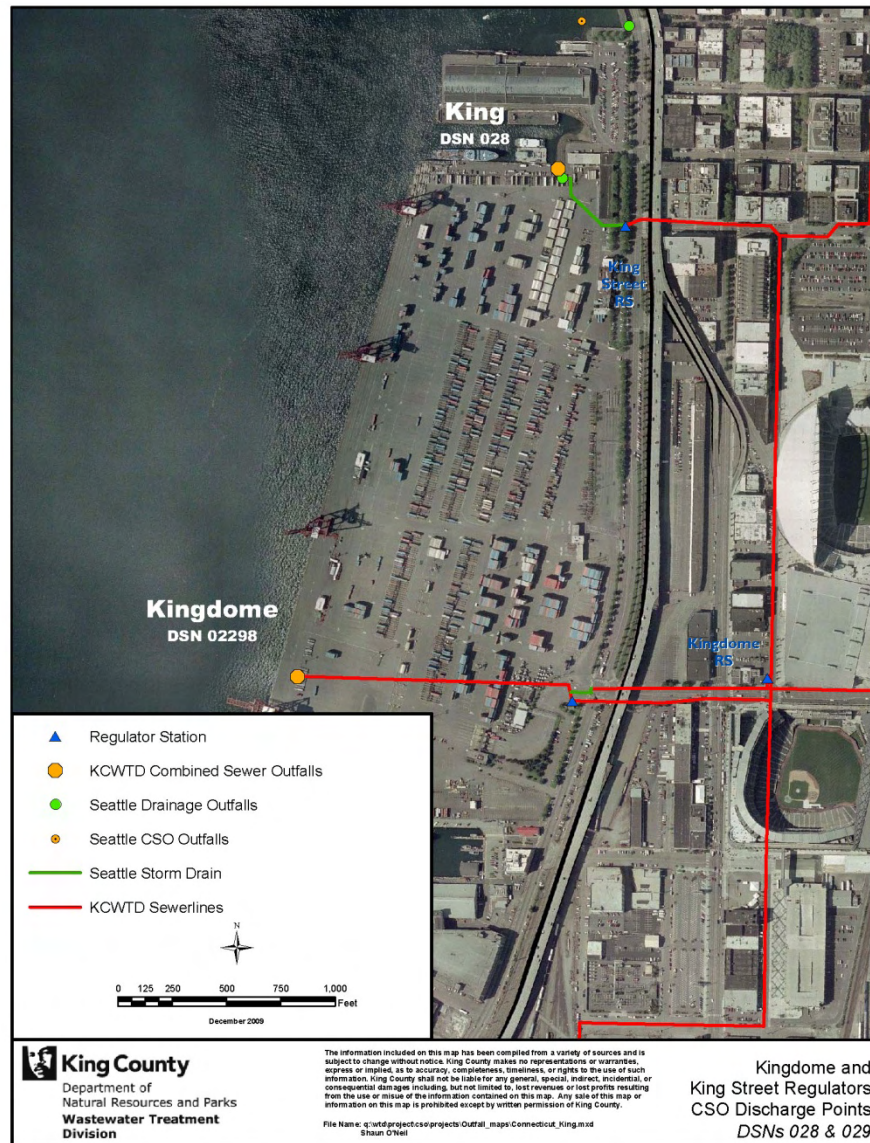


Figure 3-4. King Street Regulator CSO Discharge Point

1983 Overflow Baseline: 16 events and 55 MG per year.

Overflow Quantity: Has overflowed between 3 and 30 times per year since 1991 when monitoring began; 20-year average is 16.8 events/year; 2001–2007 average volume was 25.44 MG per year.

Control Project History: RWSP calls for transferring the CSO to a CSO treatment plant planned for the Connecticut (Kingdome) Regulator to be completed in 2026. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

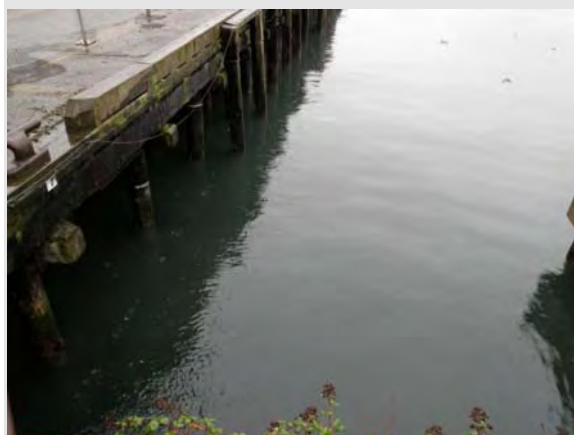
CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed in 1996 and 1997. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
4/23/96	L8386-3
4/23/96	L8386-5
4/23/96	L8389-9
4/23/96	L8389-10
10/17/96	L9742-2
10/17/96	L9742-7
10/17/96	L9742-8
10/17/96	L9742-9
10/17/96	L9742-10
12/4/96	L10025-9
12/4/96	L10025-10
12/4/96	L10029-1
12/4/96	L10029-2
1/27/97	L10292-5
1/27/97	L10292-6
1/30/97	L10322-5
1/30/97	L10322-6
3/1/97	L10524-5
3/1/97	L10524-6
3/7/97	L10588-5
3/7/97	L10588-6
3/15/97	L10645-5
3/15/97	L10645-6
4/19/97	L10939-9
4/19/97	L10939-10
5/31/97	L11233-9



King Street Regulator CSO Outfall at Extreme Low Tide



King Street Regulator CSO Overflowing 10/26/09

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment samples were collected from four locations proximal to the King Street Regulator discharge point in May 1988. A fifth location was sampled in June 1989. Station locations and the outfall discharge point are shown in Figure 3-5. These samples were not analyzed for total organic carbon along with the other constituents of interest; therefore, sediment chemistry results have been normalized to dry weight. Dry-weight normalized sediment chemistry results are summarized in the accompanying CD, where they are compared to LAET and 2LAET values rather than SQS and CSL chemical criteria for those compounds generally normalized to organic carbon. One or more analyte concentrations detected in samples collected from each of the stations exceeded an LAET or 2LAET value. Chemicals that exceeded LAET and/or 2LAET values included acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzofluoranthenes (total), benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoroanthene, fluorene, indeno(1,2,3-c,d)pyrene, phenanthrene, pyrene, bis(2-ethylhexyl) phthalate, total PCBs, arsenic, mercury, silver, and zinc. Data from these sampling events may be found in EIM under User Study HSSEAT88 (Stations LTFH02, LTFH03, LTFH04, LTFH05) and User Study HSSEAT89 (Station LTFH06).

Sediment Remediation Activity: Remediation was defined in King County's sediment management plan (King County, 1999). The remediation will need to be completed as a coordinated multi-agency project that includes the Washington State Department of Transportation (Coleman Dock and Pier 48 projects) and the City of Seattle (Washington Street CSO/storm drain).



Figure 3-5. King Street Regulator (028) Sediment Sampling Locations

3.2.3 Connecticut Street (Kingdome) Regulator

Discharge Serial Number 029

1958 Baseline Facility: A Seattle raw sewage discharge; acquired by Metro (now King County) in 1962. Flows were intercepted in 1971 to be conveyed to West Point for treatment.

Discharge Location: Seattle-owned outfall discharging 150 feet offshore at a depth of 20 feet into the East Waterway of the Duwamish River, near the mouth of the river at latitude 47° 35' 33.114" N and longitude -122° 20' 31.581" W; shared with Connecticut storm drain (Figure 3-6).



Figure 3-6. Connecticut Street (Kingdome) Regulator CSO Discharge Point

1983 Overflow Baseline: 29 events and 50 MG per year.

Overflow Quantity: Has overflowed between 0 and 31 times per year since 1991 when monitoring began; 20-year average is 7.9 events/year; 2001–2007 average volume was 7.13 MG per year.

Control Project History: The Connecticut Street (Kingdome) Regulator was built in 1996 to replace the Connecticut Regulator in anticipation of a sewer separation when Royal Brougham Avenue was widened. In 1998, the Washington State Stadium Authority completed the separation, converting the Connecticut sewer and regulator to a storm-only system. The Connecticut Regulator now functions as a low-flow diversion to allow the first flush of stormwater to enter the Elliott Bay Interceptor for treatment at West Point. The RWSP final control project is defined as 2.1-mgd CSO treatment facilities to control both the King and Kingdome CSOs in 2026. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was performed 1989–1990 and 1996–1997, before the separation project occurred. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
8/21/1989	8900832
10/22/1989	8909689
2/7/1990	9000215
4/23/1990	9000394
3/31/1996	L8211-3
4/23/1996	L8386-1
4/23/1996	L8389-6
5/22/1996	L8679-2
10/17/1996	L9742-1
12/4/1996	L10025-6
4/19/1997	L10939-6
5/31/1997	L11233-6

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment samples were collected from seven locations proximal to the Connecticut Street (Kingdome) regulator discharge point in June 1995. Five of the stations formed a transect perpendicular to the end of the outfall and a sixth station was located approximately 100 feet west of the transect. A seventh station, intended as a nearby reference, is located approximately 400 feet west of the transect. Station locations and the outfall discharge point are shown in Figure 3-7. Sediment chemistry results, normalized to both dry weight and organic carbon, as appropriate, are summarized in the accompanying CD. Organic carbon concentrations at these seven locations ranged from 5,980 to 23,400 mg/Kg DW or approximately 0.60 to 2.3 percent. Concentrations of one more chemicals exceeded SQS and/or CSL criteria in samples collected from five of the seven stations (CN00, CN10N, CN20N, CN10S, and CN10W). Chemicals that exceeded SMS criteria included 1,4-dichlorobenzene, acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(a)fluoranthene(total), benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, dibenzofuran, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, phenanthrene, benzyl butyl phthalate, bis(2-ethylhexyl) phthalate, total

PCBs, and copper. The five stations for which SMS exceedences were reported were resampled in September 1996 for synoptic chemical and toxicity testing. Sediment chemistry data for the 1996 sampling event are also summarized in the accompanying CD. Exceedences of SMS bioassay criteria were shown at three stations—Station CN00 had a SQS bioassay failure and Stations CN10N and CN20N had CSL bioassay failures. Data from this sampling event may be found in EIM under User Study ID CONCSO95.

Sediment Remediation Activity: Nothing in planning at this time. Any need for remediation will be decided under the Harbor Island/East Waterway Superfund action.



Figure 3-7. Connecticut Street (Kingdome) Regulator (029) Sediment Sampling Locations

4.0 CSO OUTFALLS IN THE DUWAMISH RIVER

King County manages 15 CSOs along the Duwamish River. Seven of these CSOs are controlled: Harbor Avenue Regulator, Duwamish Pump Station, East and West Siphons, East Marginal Way Pump Station, 8th Avenue South Regulator, and Norfolk Regulator and Henderson/Norfolk Treatment Facilities. Eight CSOs are not controlled: Lander Street Regulator, Hanford #2 and Hanford #1 Regulators, Chelan Avenue Regulator, Brandon Street Regulator, Terminal 115 CSO, West Michigan Regulator, and Michigan Regulator.

4.1 Receiving Water

4.1.1 Overview

The Duwamish River originates at the confluence of the Green and Black Rivers near Tukwila and flows northwest for approximately 19 kilometers (12 miles), splitting at the southern end of Harbor Island to form the East and West Waterways, prior to discharging into Elliott Bay. The downstream portion of the Duwamish River serves as a major shipping route for bulk and containerized cargo, and the shoreline along the majority of the lower Duwamish (i.e., the reach downstream of the Upper Turning Basin about 8.8 km in length) has been developed for industrial and commercial operations. A portion of the lower Duwamish is maintained as a federal navigation channel by U.S. Army Corps of Engineers (Windward, 2008). Navigation elevations maintained within the lower Duwamish generally range from -30 feet (feet) mean lower low water (MLLW) from Harbor Island to the First Avenue South Bridge to -20 feet MLLW from the First Avenue South Bridge to Slip 4 and -15 feet MLLW from Slip 4 to the Upper Turning Basin (Windward, 2008).

The Green River, which is the main freshwater source for the lower Duwamish, originates in the Cascade Mountains near Stampede Pass and flows by the Howard Hanson Dam and the Tacoma Headworks Dam. The Howard Hanson Dam was installed in 1961 in the upper part of the Green River primarily for flood control and low-flow augmentation to preserve fish life when river flows are low. The dam effectively decreased peak flows, which now rarely exceed 12,000 cfs, but increased moderate flows from 3,920 to 6,460 cfs because of the periodic metered release of water stored behind the dam (Windward, 2008). Between 2000 and 2006, the annual average flow rate measured at the Auburn gauging station was 1,190 cfs (ranging between 851 and 1,549 cfs). Approximately 80 percent of the water in the Duwamish River eventually flows through the West Waterway because of a sill at the south end of the East Waterway. Flow rates are greatest during the winter months because of seasonal precipitation and lowest throughout the late summer dry season (Windward, 2008). Water circulation within the lower Duwamish is driven by tidal actions and river flow; the relative influence of each is highly dependent on seasonal river discharge volumes.

4.1.2 Receiving Water Characteristics

Freshwater moving downstream overlies the tidally influenced saltwater entering the system. Typical of tidally influenced estuaries, the lower Duwamish has a relatively sharp interface between the freshwater outflow at the surface and saltwater inflow (wedge) at depth (Windward, 2008). When freshwater inflow is greater than 1,000 cfs, the saltwater wedge does not extend

upstream beyond the East Marginal Way South Bridge (RM 6.3), regardless of the tide height (Windward, 2008). During high tide stages and periods of low freshwater inflow, the saltwater wedge has been documented as extending as far upstream as the Foster Bridge (RM 8.7). At the river's mouth at the northern end of Harbor Island, a salinity of 25 PSS is typical for the entire water column; salinity decreases toward the upriver portion of the estuary. The thickness of the freshwater layer increases as the river flow rate increases (Windward, 2008). The upstream area of the Duwamish is primarily a freshwater river with tidal influence while the mouth of the river is primarily marine with a variable freshwater layer. The cross-channel salinity distribution is usually uniform for a given location and depth, and the salt wedge up the river is controlled by tides and freshwater flow. The upstream extent of the salt wedge is dependent on freshwater inflow and tidal elevation, except that flows greater than 1,000 cfs will prevent intrusion of the wedge farther than 12.6 km upstream, regardless of tide height (King County, 1999).

Water temperatures vary with time of year and location, but are higher in the late summer months. Surface water temperatures between 12 and 17°C are typical during July and August. Low temperatures, down to just above 3 °C, are seen during the winter months in surface waters. In deeper waters, temperatures are higher during the winter and lower in the summer months than the surface waters. Temperatures at depth are generally between 4.9 and 14.5 °C.

Dissolved oxygen (DO) in the surface freshwater layer typically ranges from 5.9 to 11.9 mg/L dependent upon location and time of year. Lower DO levels typically occur in the summer months when temperatures are highest. DO levels in the saltier, deeper layer typically range between 5.4 and 10.3 mg/L and are also lowest when water temperatures are high.

Fecal coliform concentrations in the Duwamish River vary significantly. Surface values can range from 0 to over 600 CFU/100 mL, whereas values in deeper waters typically range between 0 to a high of 160 CFU/100 mL and have mean values much lower than surface waters. Fecal coliform levels in the southern to middle portion of the East Waterway are substantially lower than in upstream areas of the lower Duwamish.

4.2 Information on Specific CSO Outfalls

The following pages present outfall and discharge information and sediment chemistry results for the 15 CSO outfalls in the Duwamish River. (One outfall is shared by two King County CSOs.) More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx>.

Table 4-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

The accompanying CD provides effluent and sediment quality monitoring data.

Table 4-1. Summary of Sediment and Discharge Information for CSOs in the Duwamish River

DSN	Facility Name	Control Status	Associated Stormwater Outfall	Discharge Quality Data*	Last date of Sediment Sample	Number of Stations	Sediment Analysis Performed	Data in EIM	SQS Exceedance
030	Lander St. Regulator	Uncontrolled	Yes	Yes	Ongoing ^b	—	—	—	—
031	Hanford #1 Overflow	Uncontrolled	Yes	No	Ongoing ^b	—	—	—	—
032	Hanford #2 Regulator	Uncontrolled	Yes	Yes	Ongoing ^c	—	—	—	—
034	E. Duwamish Pump Station	Controlled	Yes	No	Ongoing ^c	—	—	—	—
035	W. Duwamish Pump Station	Controlled	Yes	Yes	Ongoing ^c	—	—	—	—
043	East Marginal Pump Station	Controlled	Yes	No	Ongoing ^c	—	—	—	—
039	Michigan Regulator (South Michigan Regulator)	Uncontrolled	Yes	Yes	Ongoing ^c	—	—	—	—
041	Brandon Street Regulator	Uncontrolled	Yes	Yes	Ongoing ^c	—	—	—	—
044	Norfolk Outfall and Henderson/MLK CSO Treatment Facility	Controlled	Yes	Yes	Ongoing ^c	—	—	—	—
037	Harbor Avenue Regulator ^{a,r}	Uncontrolled	Yes	No	Ongoing ^b	—	—	—	—
036	Chelan Ave Regulator	Uncontrolled	Yes	Yes	Ongoing ^b	—	—	—	—
038	Terminal 115 Overflow	Uncontrolled	Yes	No	Ongoing ^c	—	—	—	—
042	West Michigan Regulator (SW Michigan St regulator)	Uncontrolled	Yes	Yes	Ongoing ^c	—	—	—	—
040	8th Ave South Regulator (West Marginal Way Pump Station)	Controlled	Yes	Yes	Ongoing ^c	—	—	—	—

^a The Harbor Avenue Regulator CSO is still being monitored; at this point, it appears to be controlled.

^b CSO in the Harbor Island Superfund project.

^c CSO in the Lower Duwamish Waterway Superfund project.

4.2.1 Lander Regulator

NPDES Discharge Serial Number 030

1958 Baseline Facility: Seattle raw sewage discharge; acquired by Metro (now King County) in 1962. Regulator #1 built in 1971 to intercept flows for conveyance to West Point for treatment.

Discharge Location: Discharges via Seattle-owned 96-inch-diameter outfall; 150 feet offshore at a depth of 20 feet into the East Waterway of the Duwamish River, under Port of Seattle piers at latitude 47° 34' 53.316" N and longitude -122° 20' 33.320" W; shared with Lander storm drain that resulted from 1992 separation project. Discharge also controlled by an outfall gate (Figure 4-1).

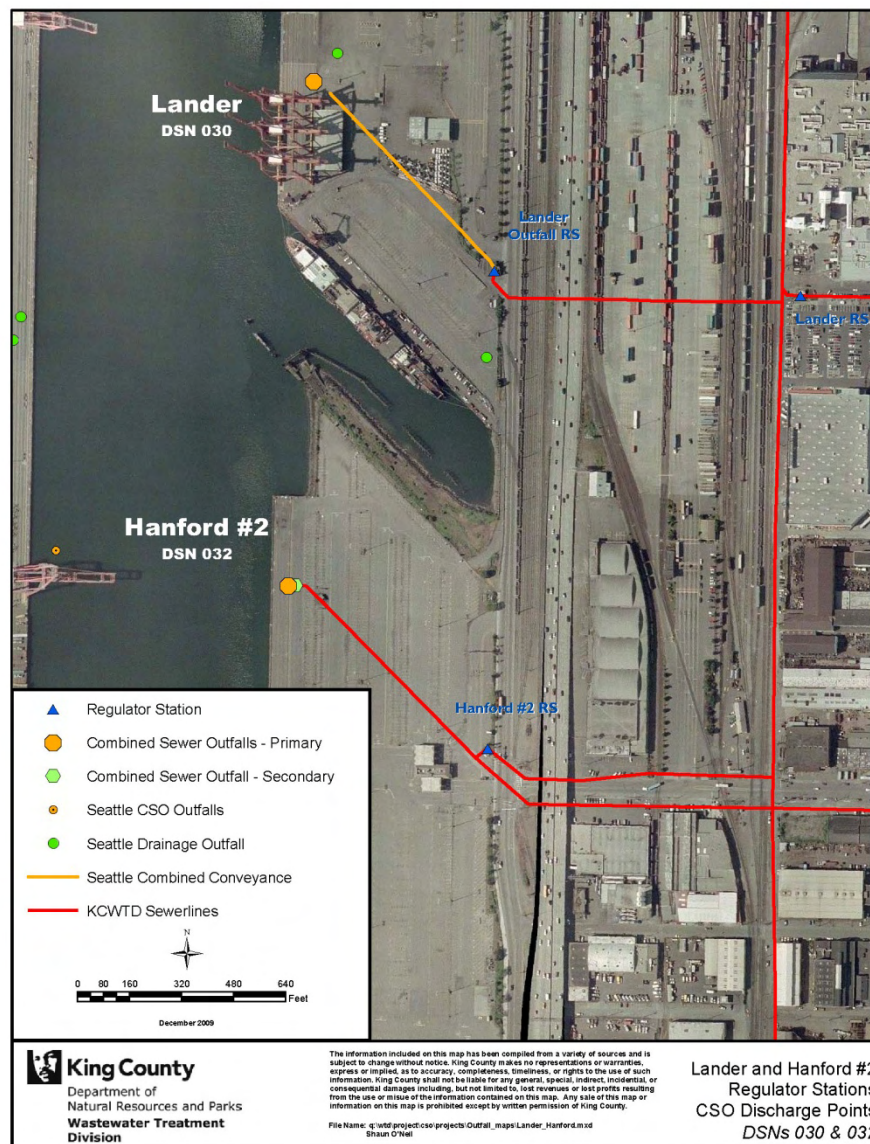


Figure 4-1. Lander Regulator CSO Discharge Point

1983 Overflow Baseline: 26 events and 143 MG per year.

Overflow Quantity: Has overflowed between 0 and 28 times per year since 1991 when monitoring began; 20-year average is 10.9 events per year; 2001–2007 average volume was 110 MG per year.

Control Project History: Regulator #2 built in 1992 for Bayview/Hanford/Lander separation project; resulted in annual reduction of 43 MG. Regulator #1 provides a low-flow diversion to capture the stormwater first flush for treatment at West Point. Current Phase II control project in RWSP calls for a joint 4.8-MG CSO treatment facility for Lander and Hanford to be complete in 2019. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was performed between 1982 and 1988, before the first separation project occurred, and recently in 2008 and 2009. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
1/23/1982	1625
1/25/1982	1638
4/11/1982	1872
3/26/1988	8800301
6/3/2008	L44912-6
8/20/2008	L45811-6
11/4/2008	L46418-6
11/6/2008	L46918-1
4/12/2009	L47834-3

Construction-Related Monitoring: Pre-construction baseline sediment monitoring was done under the Harbor Island/East Waterway Superfund action. Post-construction monitoring will be defined in the Plan to be submitted to Ecology 7/1/10.

Sediment Sampling: EPA has launched a comprehensive study of the East Waterway of the Harbor Island Superfund site in Seattle's Elliott Bay. The Port of Seattle is leading the work under a legal agreement with EPA. The City of Seattle and King County are supporting the Port's efforts. The purpose of the study is to learn about the contaminated sediment, including the following:

- Chemicals of concern in the sediment.
- Extent of the chemical contamination.
- Sources of the contamination.
- Risks that exposure to the sediment may pose to people and the environment.

Work will include sampling in areas not studied before. The study will also include research on cleanup methods for the entire East Waterway (<http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/HI>).

Sediment Remediation Activity: Sediment remediations are being determined by the Port of Seattle under the Harbor Island/East Waterway Superfund action.

4.2.2 Hanford #2 Regulator

NPDES Discharge Serial Number 032

1958 Baseline Facility: Seattle raw sewage outfall, acquired by Metro (now King County) in 1962. Regulator built in 1971 to intercept flows for conveyance to West Point for treatment.

Discharge Location: A 48-inch-diameter, 150-foot long outfall under Port of Seattle piers at latitude 47° 34' 38.004" N and longitude -122° 20' 34.009" W. Discharge also controlled by an outfall gate (Figure 4-2).

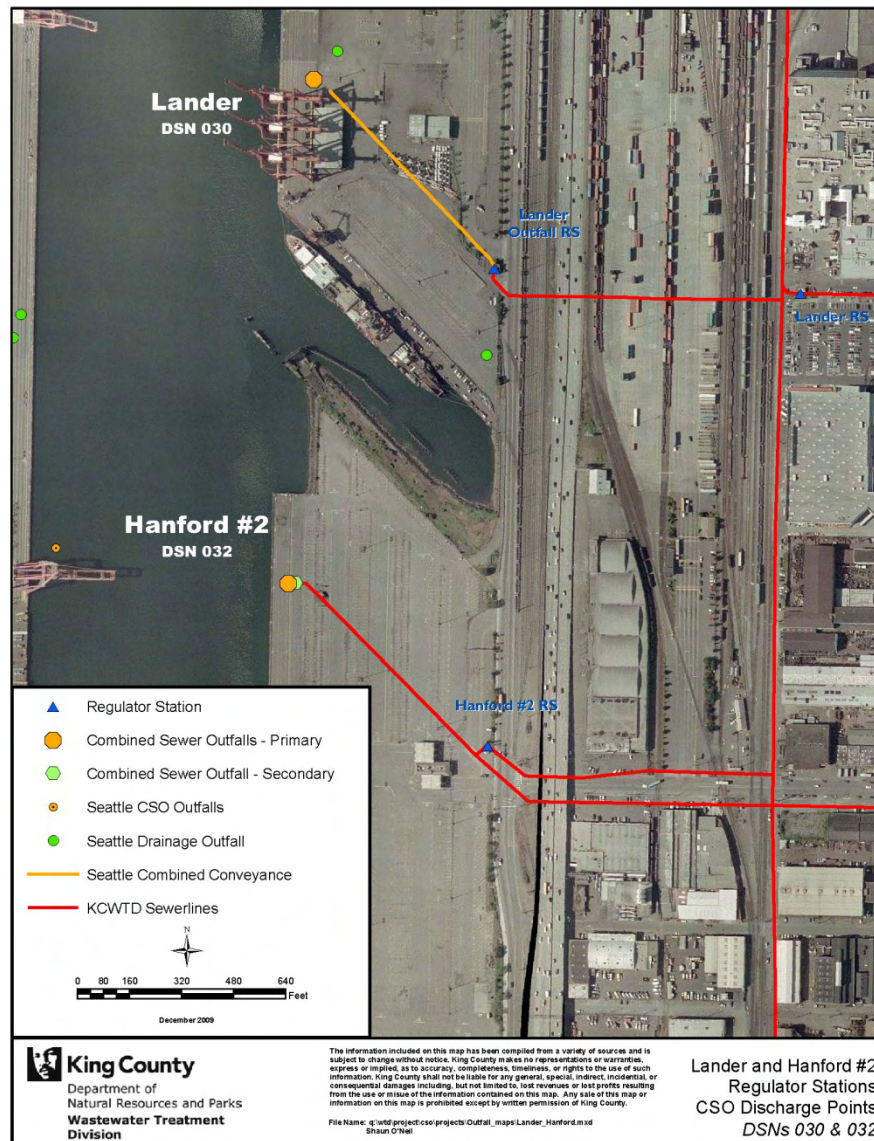
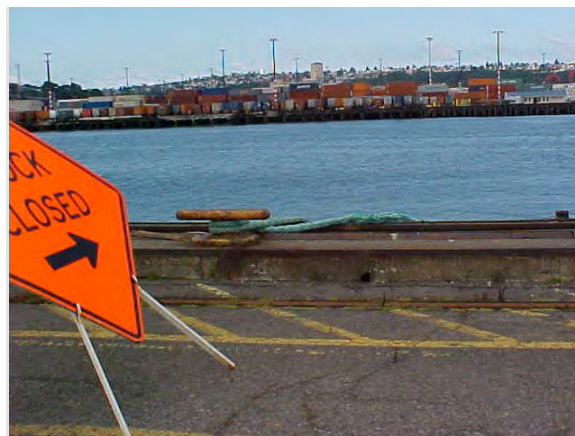


Figure 4-2. Hanford #2 Regulator CSO Discharge Point

1983 Overflow Baseline: 28 events and 266 MG per year.

Overflow Quantity: Has overflowed between 8 and 32 times per year since 1991 when monitoring began; 20-year average is 15.6 events per year; 2001–2007 average volume was 87 MG per year.

Control Project History: 1992 Phase I project—Hanford/Lander/Bayview separation—reduced the overflow volume by 56 MG. RWSP Phase II control project is defined as a joint 4.8-MG CSO treatment facility for Hanford and Lander to be completed in 2019. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.



Hanford #2 Regulator CSO Vicinity; Discharge is Under this Pier; Looking West Across East Waterway

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was performed between 1996 and 2009. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
3/31/1996	L8206-3
4/16/1996	L8309-3
5/22/1996	L8679-3
10/21/1996	L9764-3
10/28/1996	L9820-1
12/4/1996	L10025-7
1/27/1997	L10292-3
1/30/1997	L10322-3
3/1/1997	L10524-3
3/7/1997	L10588-3
3/15/1997	L10645-3
4/19/1997	L10939-7
1/29/2004	L30881-2
12/2/2007	L44133-3
12/2/2007	L44133-4
8/20/2008	L45811-3
11/4/2008	L46418-3
11/6/2008	L46918-3
4/2/2009	L47597-3
4/2/2009	L47597-4
4/12/2009	L47834-1
4/12/2009	L47834-2

Construction-Related Monitoring: Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: EPA has launched a comprehensive study of the East Waterway of the Harbor Island Superfund site in Seattle's Elliott Bay. The Port of Seattle is leading the work under a legal agreement with EPA. The City of Seattle and King County are supporting the Port's efforts. The purpose of the study is to learn about the contaminated sediment, including the following:

- Chemicals of concern in the sediment.
- Extent of the chemical contamination.
- Sources of the contamination.
- Risks that exposure to the sediment may pose to people and the environment.

Work will include sampling in areas not studied before. The study will also include research on cleanup methods for the entire East Waterway (<http://yosemite.epa.gov/R10/CLEANUP.NSF/sites/HI>).

Sediment Remediation Activity: Sediment remediations are being determined by the Port of Seattle under the Harbor Island/East Waterway Superfund action.

4.2.3 Hanford #1 Regulator

NPDES Discharge Serial Number 031

1958 Baseline Facility: Seattle raw sewage discharge, acquired by Metro (now King County) in 1962. Regulator #1 built in 1971 to intercept flows for conveyance to West Point for treatment.

Discharge Location: Discharges into the Seattle Diagonal storm drain, which is a 144-inch-diameter culvert that discharges at the shoreline just north of the Duwamish East Siphon overflow and the Duwamish Pump Station emergency overflow at latitude 47° 33' 47.187" N and longitude -122° 20' 43.135" W (Figure 4-3).



Figure 4-3. Hanford #1 Regulator CSO Discharge Point

1983 Overflow Baseline: 30 events and 378 MG per year.

Overflow Quantity: Has overflowed between 0 and 20 times per year since 1996 when monitoring began; 20-year average is 8.3 events per year; 2001–2007 average volume was 19 MG per year.

Control Project History: 1992

Hanford/Lander/Bayview separation project was believed to have controlled the overflow. In 1995, three small overflows (Hanford at Rainier, Bayview North and Bayview South) far upstream into the Diagonal storm drain were discovered. The RWSP includes a Phase II control project—a 0.6-MG storage tank—is to be completed in 2026. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.



Diagonal Storm Drain Outfall at Low Tide; Grate Is Now Gone.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was not performed because it was thought that the CSO was controlled.

Construction-Related Monitoring: Post-remediation monitoring has been completed. Any additional post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Superfund action. Sediment sampling off the Diagonal storm drain was conducted over three rounds from 1994 through 1996 under the Elliott Bay/Duwamish Restoration Program (King County et al., 2005). Both surface and subsurface sampling was extensively conducted in several hundred feet of the outfall to determine the remediation boundaries. Results are presented in King County et al. (2005). SMS exceedances included mercury, cadmium, chromium, lead, silver, zinc, total PCBs, 1,2, dichlorobenzene, 1, 4 dichlorobenzene, 1,2,4 trichlorobenzene, bis(2-ethylhexyl)phthalate and butly benzy phthalate. Bioassay testing to confirm SMS exceedances were used to set the remediation boundaries. Data from this study may be found in EIM under User Study ID DUDI9496.

Sediment Remediation Activity: A remediation of the Diagonal/Duwamish site was completed in 2004 under the Elliott Bay/Duwamish Restoration Program and as an early-action project for the Lower Duwamish Waterway Superfund action.

4.2.4 Duwamish Pump Station, East Siphon

NPDES Discharge Serial Number 034

1958 Baseline Facility: Associated with Seattle Diagonal Treatment Plant overflow; pump station built by Metro (now King County) in 1969 to convey flows to West Point for treatment from the East Marginal Trunk that went to the Diagonal plant or overflowed raw. Siphon built in 1976. The Diagonal plant was then decommissioned.

Discharge Location: Discharges from a 36-inch-diameter, 50-foot-long line from siphon aftbay at latitude 47° 33' 47.605" N and longitude -122° 20' 53.720" W (Figure 4-4).



Figure 4-4. Duwamish Pump Station, East Siphon, CSO Discharge Point

1983 Overflow Baseline: 0 event and 0 MG per year.

Overflow Quantity: Has overflowed between 0 and 1 time per year since 1991 when monitoring began; 20-year average is 0.1 event per year; 2001–2007 average volume was 0.51 MG per year; controlled to state standard.

Control Project History: controlled to the state standard; no project has been needed or planned.

CSO Effluent Quality Monitoring Data:

Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable because the site is controlled to the state standard.

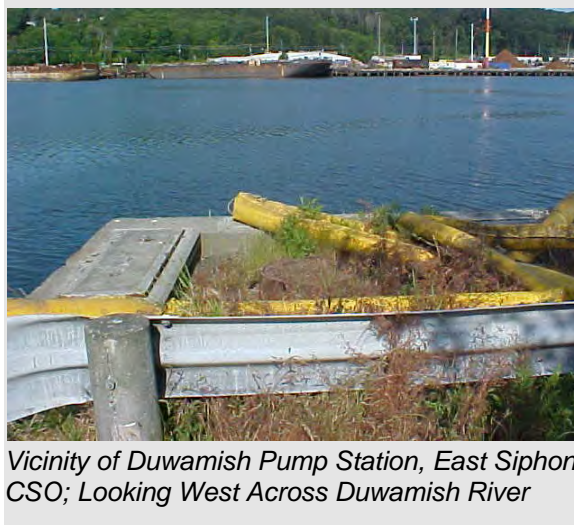
Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action. Sediment sampling off the Diagonal storm drain was conducted over three rounds from 1994 through 1996 under the Elliott Bay/Duwamish Restoration Program (King County et al., 2005). Both surface and subsurface sampling was extensively conducted in several hundred feet of the outfall to determine the remediation

boundaries. Results are presented in King County et al. (2005). SMS exceedances included mercury, cadmium, chromium, lead, silver, zinc, total PCBs, 1,2, dichlorobenzene, 1, 4 dichlorobenzene, 1,2,4 trichlorobenzene, bis(2-ethylhexyl)phthalate and butly benzy phthalate. Bioassay testing to confirm SMS exceedances were used to set the remediation boundaries. Data from this study may be found in EIM under User Study ID DUDI9496.

Sediment Remediation Activity: To implement the requirements of a 1991 Consent Decree (United States District Court 1991) defining the terms of a natural resources damage agreement, the Elliott Bay/Duwamish Restoration Program (EBDRP) was established. Program oversight is provided by the EBDRP Panel, which is composed of federal, state, and tribal natural resource trustees, the Municipality of Metropolitan Seattle (which subsequently became part of King County government and is now the King County Department of Natural Resources and Parks (KCDNRP), and the City of Seattle (City). The goals of the EBDRP include remediation of contaminated sediments associated with KCDNRP and City CSOs and storm drains, restoration of habitat in Elliott Bay and the Duwamish River, and control of potential sources of contaminants from the outfalls.



Diagonal Storm Drain Looking East; Includes Discharge From Hanford #1 and Duwamish Pump Station



Vicinity of Duwamish Pump Station, East Siphon, CSO; Looking West Across Duwamish River

In 1992, a Sediment Remediation Technical Working Group (SRTWG) was established by the EBD RP Panel to address contaminated sediment issues. The SRTWG identified 24 potential sediment remediation sites associated with KCDNRP and City CSOs and storm drains. These sites were evaluated against several criteria, which included extent of contamination, degree of source control near sites, and public input, as reported in the Final Concept Document. Ultimately, the SRTWG selected three sites (the Duwamish Pump Station CSO and Diagonal Way CSO/storm drain, the Norfolk CSO, and the Seattle Waterfront) for further investigation. The Duwamish Pump Station CSO and the Diagonal Way CSO/storm drain outfalls were combined into one site because of their proximity (the Duwamish/Diagonal outfalls).

KCDNRP implemented field collection activities between August 1994 and September 1996. The primary goal was to determine the extent of sediment contamination around the Duwamish/Diagonal outfalls based on comparison to SMS criteria. Sediment chemistry data collected by EPA in 1998 for a National Priority List evaluation were also used to define areas exceeding SMS for four specific chemicals, PCBs, mercury, and two phthalate compounds.

The site was remediated in 2003–2004. The plan called for installation of an engineered sediment cap to isolate contaminated sediment while maintaining existing bottom elevations for navigation and fisheries in a 7-acre area in front of the outfalls. The remedial action included mechanical dredging of 68,250 cubic yards of contaminated sediment. All dredged material was placed on barges, and the contaminated sediments were transported to an offloading facility in the East Waterway for transport and disposal at a permitted Subtitle D landfill. Capping the site with clean material to produce final bottom elevations that were approximately equal to pre-dredge bottom elevations required different layers of capping material for isolation and armoring to prevent erosion from tug boats using an adjacent mooring pier.

A follow-up action was conducted in February 2005. A thin layer of sand was placed around a portion of the dredged area to reduce the level of contaminants from the previous dredging activity.

<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/DuDi/Library.aspx>

4.2.5 Duwamish West Siphon

NPDES Discharge Serial Number 035

1958 Baseline Facility: Did not exist in 1958. Siphon and forebay built by Metro (King County) in 1976 with West Marginal Interceptor.

Discharge Location: Discharges through a 36-inch-diameter line from siphon forebay to west side of Duwamish River at latitude 47° 33' 46.748" N and longitude -122° 20' 42.979" W (Figure 4-5).



Figure 4-5. Duwamish West Siphon CSO Discharge Point

1983 Overflow Baseline: Not modeled. It was believed this site was not hydraulically capable of overflowing; later it was determined that the forebay could surcharge and result in overflow.

Overflow Quantity: Has overflowed between 0 and 1 time per year since 2005 when monitoring began; 4-year average is 0.5 event per year; 2005–2008 average volume was 0.6 MG per year; controlled to state standard.

Control Project History: No project has been needed or planned; is controlled to the state standard

CSO Effluent Quality Monitoring Data: Not CSO. Samples were collected in 2007 and 2009 from the forebay at high flows as representative of any overflow that might occur.

Date	Lab ID.
9/30/2007	L43913-2
12/2/2007	L44133-2
4/2/2009	L47597-2



Vicinity of Duwamish West Siphon CSO; Looking West Across Duwamish River to Site

Construction-Related Monitoring: Not applicable as is controlled to the state standard.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediation will be identified under the Lower Duwamish Waterway Superfund action.

4.2.6 East Marginal Way Pump Station

NPDES Discharge Serial Number 043

1958 Baseline Facility: Seattle raw sewage discharge; part of Diagonal Treatment Plant collection system; acquired by Metro in 1962; pump station built by Metro (now King County) in 1964 to convey flows to West Point for treatment from the East Marginal Trunk that went to the Diagonal plant or overflowed raw.

Discharge Location: Discharges through a 36-inch-diameter overflow line at end of Slip 4 at latitude 47° 32' 13.372" N and longitude -122° 19' 6.563" W (Figure 4-6).

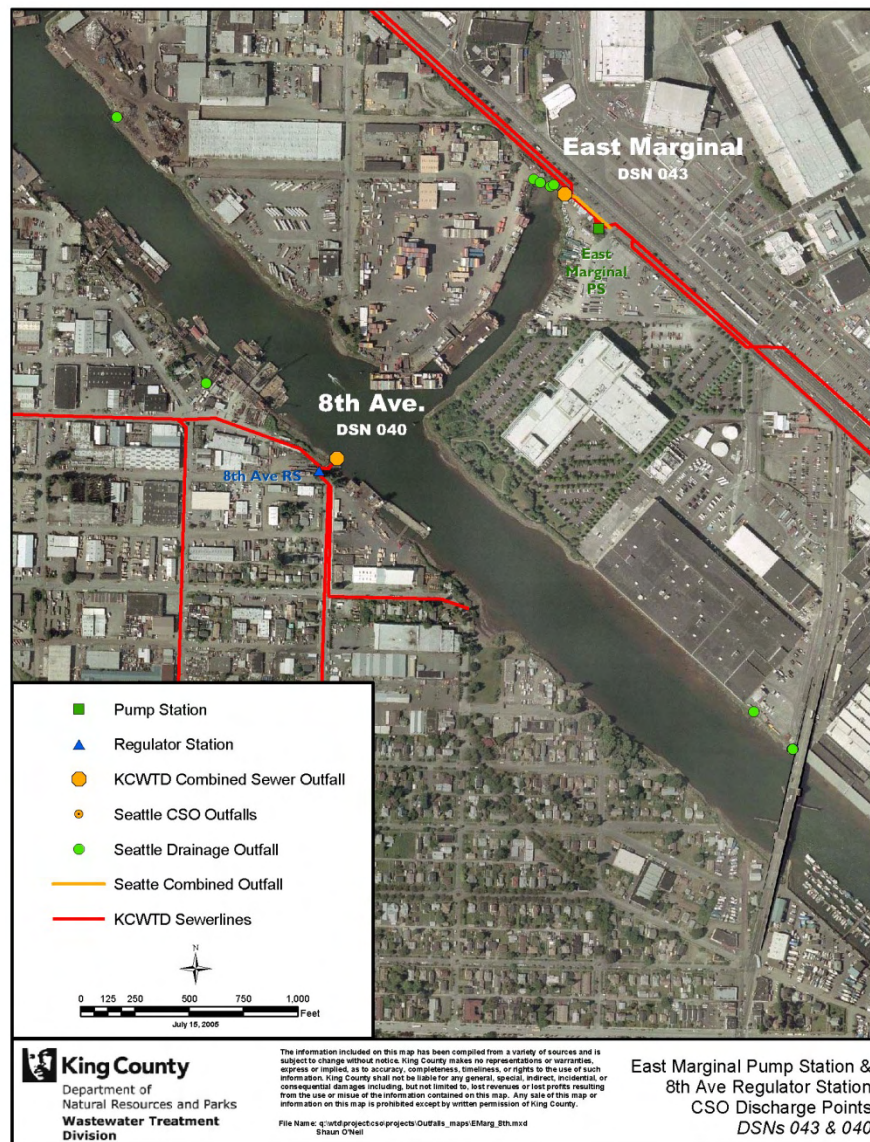


Figure 4-6. East Marginal Way Pump Station CSO Discharge Point

1983 Overflow Baseline: 0 event and 0 MG per year.

Overflow Quantity: Has not overflowed since 1991 when monitoring began.

Control Project History: Controlled to the state standard; no project has been needed or is planned.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring has not been done because the CSO is controlled to the state standard.

Construction-Related Monitoring: Not applicable because the CSO is controlled to the state standard.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action. Sediment sampling in Slip 4 was conducted in 2004 as part of an early action in the Lower Duwamish Waterway Superfund site. Both surface and subsurface sampling was extensively conducted in several hundred feet of the outfall to determine the remediation boundaries. Results are presented in Intergal (2006). SMS exceedances included several metals, total PCBs, several PAHs, and bis(2-ethylhexyl)phthalate.

Sediment Remediation Activity: A remediation of Slip 4 is being planned under the Lower Duwamish Waterway Superfund action.



Vicinity of East Marginal Way Pump Station CSO; Looking North Across Slip 4



Vicinity of East Marginal Way Pump Station CSO; Looking South Across Slip 4

4.2.7 Michigan Regulator

NPDES Discharge Serial Number 039

1958 Baseline Facility: Seattle raw sewage discharge; part of Diagonal Treatment Plant collection system; acquired by Metro in 1962; regulator built by Metro (now King County) in 1964 to convey flows to West Point for treatment that went to the Diagonal plant or overflowed raw.

Discharge Location: Outfall station discharges at east bank of Duwamish River at latitude 47° 32' 36.709" N and longitude -122° 20' 5.880" W (Figure 4-7).

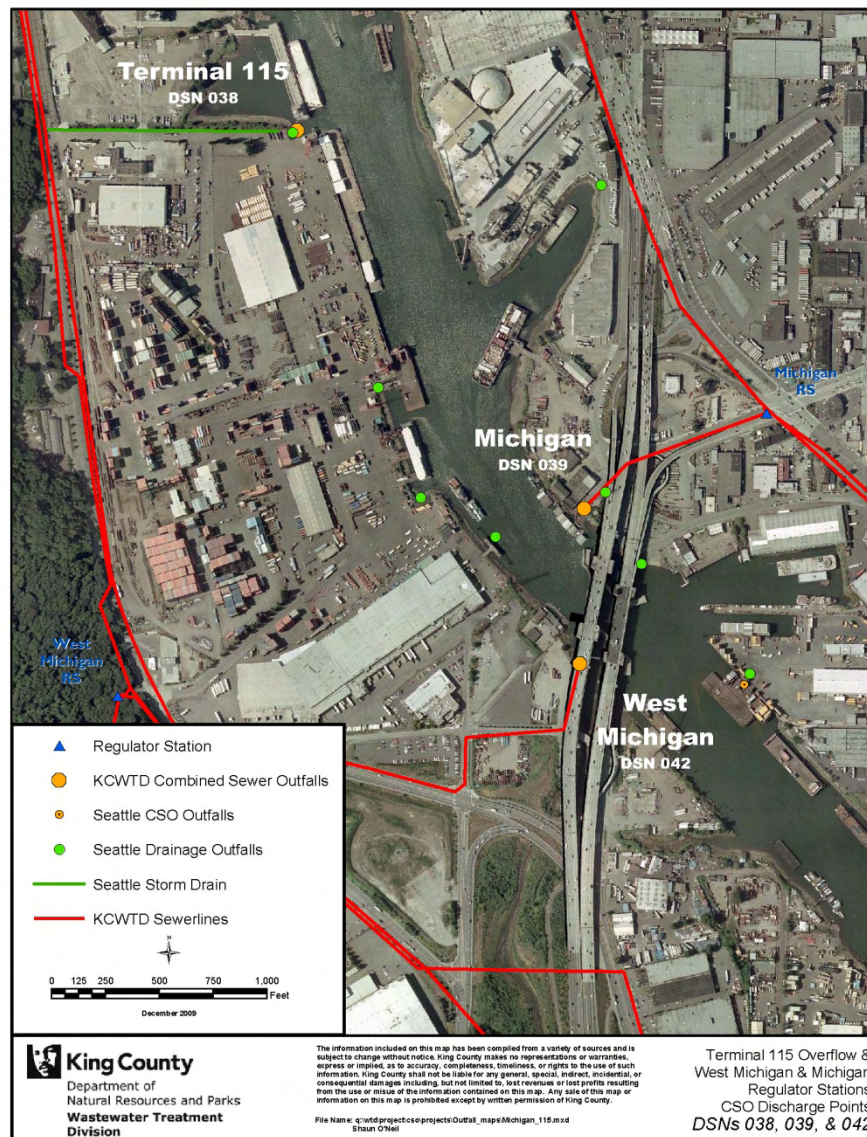


Figure 4-7. Michigan Regulator CSO Discharge Point

1983 Overflow Baseline: 34 events and 190 MG per year.

Overflow Quantity: Has overflowed between 0 and 13 times per year since 1991 when monitoring began; 20-year average is 6.8 events per year; 2001–2007 average volume was 18 MG per year.

Control Project History: RWSP includes a 2.2-MG CSO treatment facility to be completed in 2022. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed between 1982, 1988, 2007, and 2008. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
1/22/1982	
1/23/1982	
1/25/1982	
3/26/1988	8800300
09/04/2007	L43790-1
09/30/2007	L43913-1
12/02/07	L44133-1
08/19/2008	L45811-1
11/06/2008	L46918-1

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action. Sediment was previously collected from four stations in front of the Michigan outfall in 1992. Data from this sampling event may be found in EIM under User Study ID DUWCSO92.

Sediment Remediation Activity: Nothing in planning at this time. Any need for remediation will be decided under the Lower Duwamish Waterway Superfund action.



Michigan Regulator CSO at Extreme Low Tide



Michigan Regulator CSO Overflowing 10/26/09



Michigan Regulator CSO Overflowing 10/26/09

4.2.8 Brandon Regulator

NPDES Discharge Serial Number 041

1958 Baseline Facility: Seattle raw sewage discharge; part of Diagonal Treatment Plant collection system; acquired by Metro in 1962; regulator built by Metro (now King County) in 1964 to convey flows to West Point for treatment that went to the Diagonal plant or overflowed raw.

Discharge Location: Outfall station discharges at east bank of Duwamish at latitude 47° 33' 16.781" N and longitude -122° 20' 26.996" W (Figure 4-8).

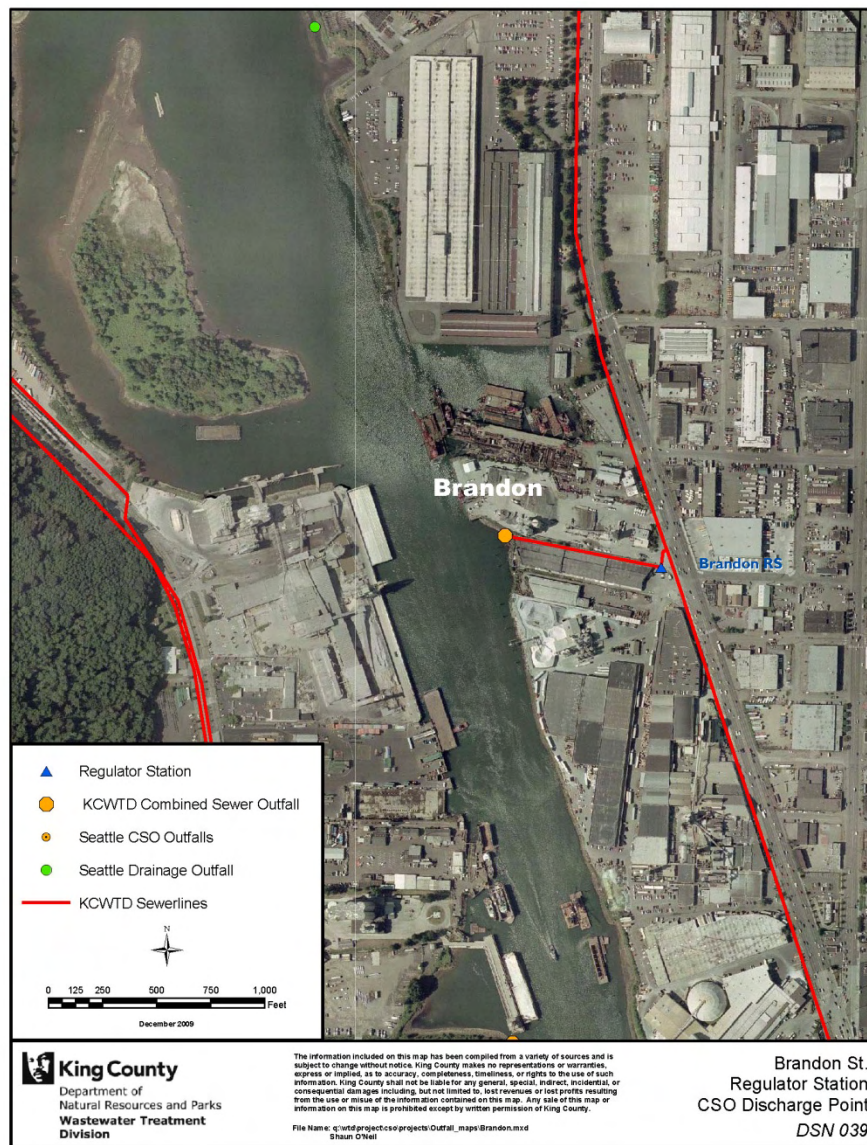


Figure 4-8. Brandon Regulator CSO Discharge Point

1983 Overflow Baseline: 36 events and 64 MG per year.

Overflow Quantity: Has overflowed between 0 and 55 times per year since 1991 when monitoring began; 20-year average is 30.9 events per year; 2001–2007 average volume was 32 MG per year.

Control Project History: A project to increase the size of the pipe from the regulator to the Elliott Bay Interceptor, and so decrease the small and frequent overflows, was completed in 2006. RWSP includes an 0.8-MG CSO treatment facility to be completed in 2022. This project definition and schedule will reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Extensive overflow quality monitoring to characterize the CSO was performed in 1990 and 1996–1997 for the Water Quality Assessment study (King County, 1999). Additional monitoring was done in 2008 and 2009. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
14-Mar-90	9000289
03-Jun-90	9000510
04-Oct-90	9000881
04-Dec-90	9010003
2/6/1996	L7718-3
29-Mar-96	L8206-1
29-Mar-96	L8206-2
01-Apr-96	L8211-1
15-Apr-96	L8309-1
15-Apr-96	L8309-2
22-Apr-96	L8386-6
22-Apr-96	L8386-7
22-Apr-96	L8389-1
23-Apr-96	L8389-2
22-May-96	L8679-1
22-May-96	L8680-1
22-May-96	L8680-2
22-May-96	L8680-3
02-Aug-96	L9214-1
02-Aug-96	L9214-2
02-Aug-96	L9215-1
13-Oct-96	L9704-1



Brandon Regulator CSO Overflow at Extreme Low Tide



Brandon Regulator CSO Vicinity; Looking West Across Duwamish River



Brandon Regulator CSO Overflowing 10/17/09

Sample Date	Sample #
13-Oct-96	L9704-2
13-Oct-96	L9704-3
12-Nov-96	L9904-1
12-Nov-96	L9905-1
12-Nov-96	L9905-2
12-Nov-96	L9905-3
12-Nov-96	L9905-4
04-Dec-96	L10025-1
04-Dec-96	L10025-2
27-Jan-97	L10292-1
27-Jan-97	L10292-2
30-Jan-97	L10322-1
30-Jan-97	L10322-2
01-Mar-97	L10524-1
01-Mar-97	L10524-2
06-Mar-97	L10588-1
06-Mar-97	L10588-2
15-Mar-97	L10645-1
15-Mar-97	L10645-2
19-Apr-97	L10939-1
19-Apr-97	L10939-2
4/26/1997	L10995-1
4/26/1997	L10995-2
31-May-97	L11233-1
31-May-97	L11233-2
31-May-97	L11234-2
10/1/1997	L11603-1
10/1/1997	L11603-2
10/1/1997	L11603-3
10/1/1997	L11606-1
10/30/1997	L12176-1
10/30/1997	L12176-10
10/30/1997	L12176-3
10/30/1997	L12176-4
10/30/1997	L12176-5
10/30/1997	L12176-6
10/30/1997	L12176-7
10/30/1997	L12176-8
10/30/1997	L12176-9
11/6/2008	L46918-5
1/7/2009	L47190-2

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action. Sediment was previously collected from four stations in front of the Brandon outfall in 1992. Data from this sampling event may be found in EIM under User Study ID DUWCSO92.

Sediment Remediation Activity: Nothing in planning at this time. Any need for remediation will be decided under the Lower Duwamish Waterway Superfund action.

4.2.9 Norfolk Regulator and Henderson/Norfolk CSO Treatment Facilities

Norfolk Regulator: NPDES Discharge Serial Number 044a

Henderson/Norfolk CSO Treatment Facilities: NPDES Discharge Serial Number 044b

1958 Baseline Facility: Seattle CSO; part of Diagonal Treatment Plant collection system.

Discharge Location: East side of Duwamish River by turning basin at latitude 47° 30' 42.98" N and longitude -122° 17' 50.48" W (Figure 4-9). The untreated Norfolk discharge and the treated Henderson/Martin Luther King Jr. Way/Norfolk discharge share the Norfolk outfall, but each is monitored independently. The outfall does not have a diffuser. It provides 1.9:1 dilution at the edge of the zone of acute criteria exceedance and 10.3:1 dilution at the edge of the chronic mixing zone.

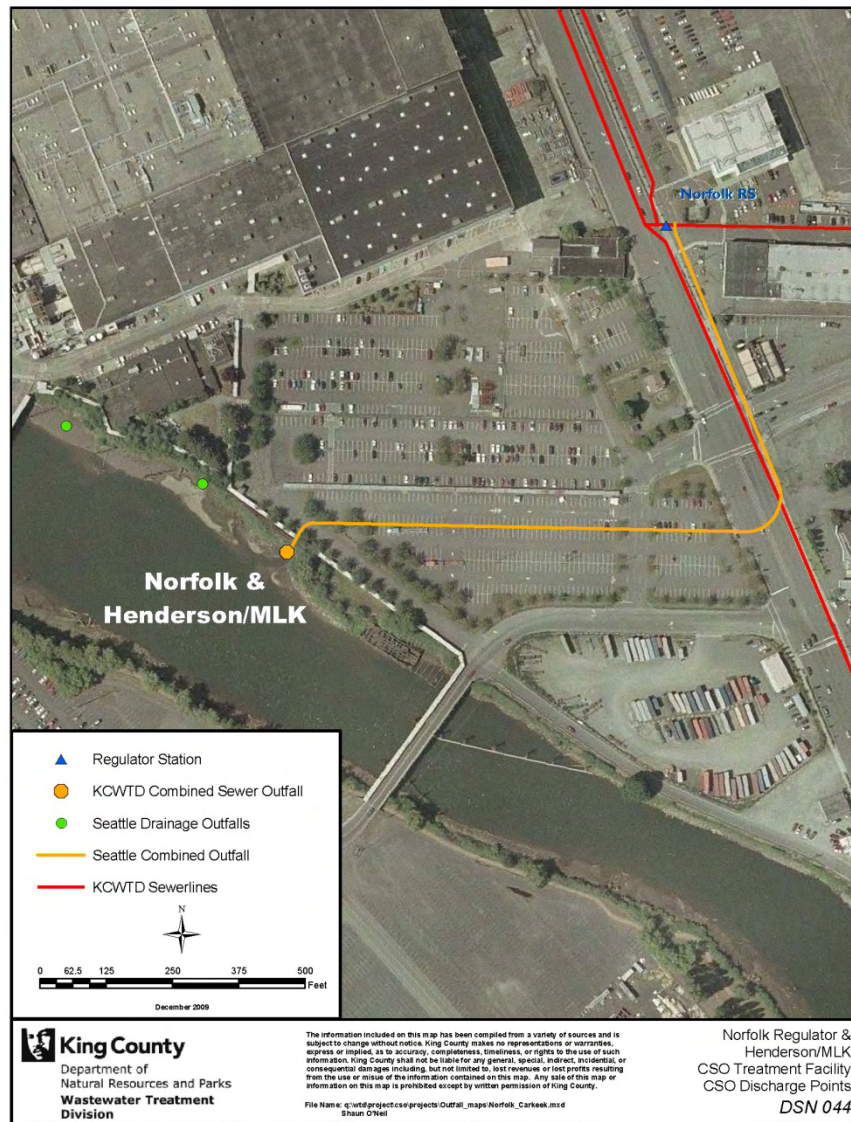


Figure 4-9. Norfolk Regulator CSO Discharge Point

1983 Overflow Baseline: 20 events and 39 MG per year.

Overflow Quantity: Has overflowed between 0 and 32 times per year since 1991 when monitoring began; average since control was achieved in 2005 is 0 events per year; 2001–2007 average volume was 0.28 MG per year. The treated discharge occurs about 4 times per year and meets limits under the NPDES permit.

Control Project History: The Allentown Diversion, completed in 1995, removed Henderson/Martin Luther King Jr. Way area flows from the Elliott Bay Interceptor, creating capacity for the Norfolk CSO flows (reducing them by about 34 MG per year) and introducing Alki area flows to the Elliott Bay Interceptor further downstream. Control was completed in 2005 with the construction of the Henderson/Norfolk CSO treatment and storage facilities. This project also controlled the Martin Luther King and Henderson overflows into Lake Washington. The treatment facility provides CSO treatment (equivalent to primary treatment), screening, disinfection, and dechlorination.

CSO Effluent Quality Monitoring Data: Extensive overflow quality monitoring to characterize the CSO was performed 1990–1991 and 1995–1997. Data for these samples are included in the accompanying CD.



Vicinity of Norfolk Regulator CSO; Looking East Across River Toward Outfall Site

Sample Date	Sample #
06-Jun-90	9000524
14-Oct-90	9000887
04-Dec-90	9010006
03-Apr-91	9100612
14-Dec-95	L7536-2
30-Apr-97	L11002-1
30-Apr-97	L11002-33
5/2/1997	L11002-15
5/2/1997	L11002-16
5/2/1997	L11002-17
5/2/1997	L11002-18
5/2/1997	L11002-19
5/2/1997	L11002-30
31-May-97	L11044-1
31-May-97	L11044-22
31-May-97	L11044-26
31-May-97	L11044-29
6/1/1997	L11044-19
6/1/1997	L11044-4
6/1/1997	L11044-5
6/1/1997	L11044-6
6/1/1997	L11044-7
6/1/1997	L11044-8
17-Sep-97	L11428-1

Sample Date	Sample #
17-Sep-97	L11428-22
9/19/1997	L11428-19
9/19/1997	L11428-25
9/19/1997	L11428-4
9/19/1997	L11428-5
9/19/1997	L11428-6
9/19/1997	L11428-7
9/19/1997	L11428-8
30-Oct-97	L11971-1
30-Oct-97	L11971-22
30-Oct-97	L11971-29
11/1/1997	L11971-19
11/1/1997	L11971-4
11/1/1997	L11971-5
11/1/1997	L11971-6
11/1/1997	L11971-7
11/1/1997	L11971-8
12/16/1997	L12456-27
12/16/1997	L12456-28

Construction-Related Monitoring: Post-construction monitoring was completed in conjunction with the post-remediation monitoring done under the Elliott Bay/Duwamish Restoration Panel.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action. Sediment sampling off the Norfolk CSO/storm drain was conducted over three rounds from 1994 through 1995 under the Elliott Bay/Duwamish Restoration Program (King County, 1996). Both surface and subsurface sampling was extensively conducted in several hundred feet of the outfall to determine the remediation boundaries. Results are presented in King County (1996). SMS exceedances included mercury, total PCBs, 1, 4 dichlorobenzene, and bis(2-ethylhexyl)phthalate. The SQS was used to set the remediation boundaries. Data from this study may be found in EIM under User Study ID NRFK9495.

Sediment Remediation Activity: To implement the requirements of a 1991 Consent Decree (United States District Court 1991) defining the terms of a natural resources damage agreement, the Elliott Bay/Duwamish Restoration Program (EBDRP) was established. Program oversight is provided by the EBDRP Panel, which is composed of federal, state, and tribal natural resource trustees, the Municipality of Metropolitan Seattle (which subsequently became part of King County government and is now the King County Department of Natural Resources and Parks (KCDNRP), and the City of Seattle (City). The goals of the EBDRP include remediation of contaminated sediments associated with KCDNRP and City CSOs and storm drains, restoration of habitat in Elliott Bay and the Duwamish River, and control of potential sources of contaminants from the outfalls.

In 1992, a Sediment Remediation Technical Working Group (SRTWG) was established by the EBDRP Panel to address contaminated sediment issues. The SRTWG identified 24 potential sediment remediation sites associated with KCDNRP and City CSOs and storm drains. These sites were evaluated against several criteria, which included extent of contamination, degree of source control near sites, and public input, as reported in the Final Concept Document.

Ultimately, the SRTWG selected three sites (the Duwamish Pump Station CSO and Diagonal Way CSO/storm drain, the Norfolk CSO, and the Seattle Waterfront) for further investigation. The Duwamish Pump Station CSO and the Diagonal Way CSO/storm drain outfalls were combined into one site because of their proximity (the Duwamish/Diagonal outfalls).

In 1994, a plan to investigate the extent of contamination at the Norfolk CSO was prepared by KCDNRP (then Metro) on behalf of the EBDRP Panel. KCDNRP implemented field data collection activities between August 1994 and December 1995. The primary goals were to determine the extent of sediment contamination around the Norfolk CSO outfall, based on comparison to Sediment Management Standards (SMS) criteria and to determine a preferred remedial alternative for the site.

Site remediation began in February 1999 and was completed in March 1999. Activities consisted of dredging contaminated sediment and backfilling the dredged area to original grade with clean sediment. Contaminated sediments were removed from the site by mechanical dredging and dewatered onshore in a containment area. Sediments with a PCB concentration greater than 45 parts per million (ppm) were transported to a Subtitle C landfill for disposal. Sediments with a PCB concentration less than 45 ppm were transported to a Subtitle D landfill for disposal. A total of 5,190 cubic yards of sediment was removed during the dredging; approximately 1,900 cubic yards were transported to a Subtitle D landfill as hazardous waste. Sediment was generally removed to a depth of 3 feet.

The project was monitored for a period of five years to evaluate possible recontamination of the backfill sediment as a result of continuing CSO discharges. The monitoring was completed in 2005. The site is now under evaluation as part of the early action sites in the Superfund area.

In 2003, The Boeing Company conducted a cleanup of river sediments near the Norfolk CSO site using a specialized vacuum excavator; approximately 100 cubic yards of sediment was removed.

<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/Norfolk/Library.aspx>

4.2.10 Harbor Avenue Regulator

NPDES Discharge Serial Number 037

1958 Baseline Facility: Seattle raw sewage outfall; acquired by Metro (now King County) in 1962; Metro built the regulator in 1967.

Discharge Location: Duwamish West Waterway via a 96-inch-diameter Seattle storm drain that also carries Seattle CSOs and Longfellow Creek at latitude 47° 34' 25.341" N and longitude - 122° 21' 40.174" W (Figure 4-10).



Figure 4-10. Harbor Avenue Regulator CSO Discharge Point

1983 Overflow Baseline: 30 events and 36 MG per year.

Overflow Quantity: Has overflowed between 0 and 56 times per year since 1991; 20-year average is 14.6 events per year; 2001–2007 average volume was 6 MG per year.

Control Project History: A 2000 project diverted flows to the West Seattle Tunnel to achieve control. Additional control adjustments have been required to ensure control level is maintained.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was provided to Ecology before the 1986 sampling plan. The Ecology-approved 1988 NPDES CSO monitoring plan referenced data that had been previously submitted in reports to Ecology. Those older data are not available from the current Laboratory Information Management System (LIMS).

Construction-Related Monitoring: The Harbor Island Superfund action will determine if any further monitoring is needed.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by EPA (2003) as part of the ongoing Harbor Island Superfund action.

Sediment Remediation Activity: The Harbor Avenue and Chelan Avenue outfalls are located within the Harbor Island Superfund West Waterway Operable Unit (OU). The Harbor Island site (EPA ID Number WAD980722839) was listed on the National Priorities List (NPL) in 1983. The Harbor Island Superfund site is composed of upland portions and marine portions, with a total of seven OUs. The West Waterway OU was addressed by a Record of Decision (ROD) in 2003.

The ROD presented the basis for the determination that no remedial action is necessary in the West Waterway OU, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Ecology concurred that the no-action decision for the West Waterway is consistent with CERCLA requirements. Ecology also recognizes that the no-action decision is based on Superfund risk assessment that is similar to the requirements of the Model Toxics Control Act (MTCA), but not entirely consistent with the state cleanup regulation. The determination was made in accordance with an interagency agreement between EPA and Ecology dated February 23, 2000.

For the West Waterway OU, EPA has determined that no further action is necessary under CERCLA because environmental investigations and site-specific risk assessments found that concentrations in marine sediments in the operable unit do not pose unacceptable risks to human



Harbor Avenue Regulator CSO/Seattle Storm Drain Outfall at Extreme Low Tide



Vicinity of Harbor Avenue Regulator CSO; Looking Northeast Across West Waterway

health and the environment. EPA will conduct a five-year review to verify that the sediment continues to pose no unacceptable risks to human health and the environment.

4.2.11 Chelan Avenue Regulator

NPDES Discharge Serial Number 036

1958 Baseline Facility: Seattle raw sewage outfall; acquired by Metro (now King County) in 1962; Metro built the regulator in 1967.

Discharge Location: West side of Duwamish West Waterway below Port of Seattle facilities via parallel submerged 30- and 48-inch outfalls at latitude 47° 34' 25.201" N and longitude -122° 21' 28.004" W (Figure 4-11).



Figure 4-11. Chelan Avenue Regulator CSO Discharge Point

1983 Overflow Baseline: 7 events and 61 MG per year.

Overflow Quantity: Has overflowed between 0 and 15 times per year since 1991; 20-year average is 5.3 events per year; 2001–2007 average volume was 1.28 MG per year.

Control Project History: RWSP includes a 4 MG-deep caisson-type storage tank to be completed in 2024. This project definition and schedule will reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was performed in 1989, 1990, 1994, 1996, and 1997. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
8/21/1989	8900832
10/22/1989	8909689
2/7/1990	9000215
4/23/1990	9000394
11/30/1994	L5032-1
1/31/1995	L5357-1
3/31/1996	L8211-3
4/23/1996	L8386-1
4/23/1996	L8386-8
4/23/1996	L8386-9
4/23/1996	L8386-10
4/23/1996	L8389-3
4/23/1996	L8389-4
4/23/1996	L8389-5
4/23/1996	L8389-6
5/22/1996	L8679-2
10/17/1996	L9742-1
10/21/1996	L9764-1
10/21/1996	L9764-2
12/4/1996	L10025-3
12/4/1996	L10025-4
12/4/1996	L10025-5
12/4/1996	L10025-6
3/18/1997	L10681-1
3/18/1997	L10681-2
3/18/1997	L10681-3
3/18/1997	L10692-1
3/18/1997	L10692-2
3/18/1997	L10692-3
4/19/1997	L10939-3
4/19/1997	L10939-4
4/19/1997	L10939-5
4/19/1997	L10939-6
5/31/1997	L11233-3
5/31/1997	L11233-4
5/31/1997	L11233-5
5/31/1997	L11233-6

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by EPA (2003) as part of the ongoing Harbor Island Superfund action.

Sediment Remediation Activity: The Harbor Avenue and Chelan Avenue outfalls are located within the Harbor Island Superfund West Waterway Operable Unit (OU). The Harbor Island site (EPA ID Number WAD980722839) was listed on the National Priorities List (NPL) in 1983. The Harbor Island Superfund site is composed of upland portions and marine portions, with a total of seven OUs. The West Waterway OU was addressed by a Record of Decision (ROD) in 2003.

The ROD presented the basis for the determination that no remedial action is necessary in the West Waterway OU, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Ecology concurred that the no-action decision for the West Waterway is consistent with CERCLA requirements. Ecology also recognizes that the no-action decision is based on Superfund risk assessment that is similar to the requirements of the Model Toxics Control Act (MTCA), but not entirely consistent with the state cleanup regulation. The determination was made in accordance with an interagency agreement between EPA and Ecology dated February 23, 2000.

For the West Waterway OU, EPA has determined that no further action is necessary under CERCLA because environmental investigations and site-specific risk assessments found that concentrations in marine sediments in the operable unit do not pose unacceptable risks to human health and the environment. EPA will conduct a five-year review process to verify that the sediment continues to pose no unacceptable risks to human health and the environment.

4.2.12 Terminal 115 CSO

NPDES Discharge Serial Number 038

1958 Baseline Facility: Seattle raw sewage outfall built in 1958; acquired by Metro (now King County) in 1962. Intercepted for treatment in 1976 when West Marginal Interceptor and Duwamish Siphon were built.

Discharge Location: Overflows into a 48-inch-diameter Seattle storm drain that discharges into the west side of the Duwamish River at latitude 47° 32' 53.737" N and longitude -122° 20' 25.810" W (Figure 4-12).

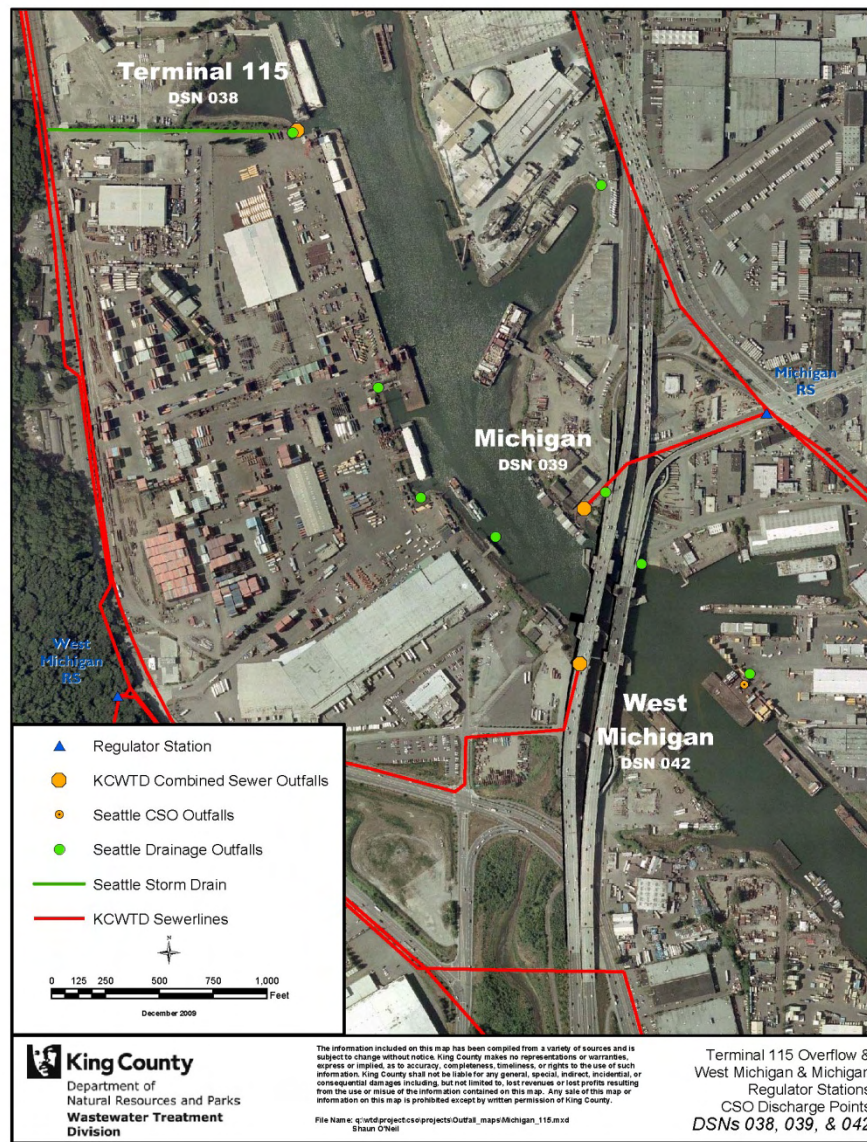


Figure 4-12. Terminal 115 CSO Discharge Point

1983 Overflow Baseline: 4 events and 2.0 MG per year.

Overflow Quantity: Has overflowed between 0 and 7 times per year since 2003 when monitors were installed (improved monitoring techniques allowed for safe installation); 6-year average is 2.5 events per year; 2003–2007 average volume was 3.52 MG per year.

Control Project History: The RWSP includes a 0.5-MG storage tank to be completed in 2027. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data: No overflow quality monitoring to characterize the CSO has been performed. The quality is expected to be similar to that of the West Michigan CSO because of similar land use and industries.

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action.

Sediment Remediation Activity: Nothing in planning at this time. Any need for remediation will be decided under the Lower Duwamish Waterway Superfund action.

4.2.13 West Michigan Regulator

NPDES Discharge Serial Number 042

1958 Baseline Facility: Seattle raw sewage outfall; acquired by Metro (now King County) in 1962. Regulator built in 1967, and flows intercepted for treatment in 1976 when the West Marginal Interceptor and Duwamish Siphon were built.

Discharge Location: Overflows through a submerged 36-inch-diameter outfall to west side of Duwamish River under the First Avenue South bridge at latitude 47° 32' 29.621" N and longitude -122° 20' 5.978" W (Figure 4-13).

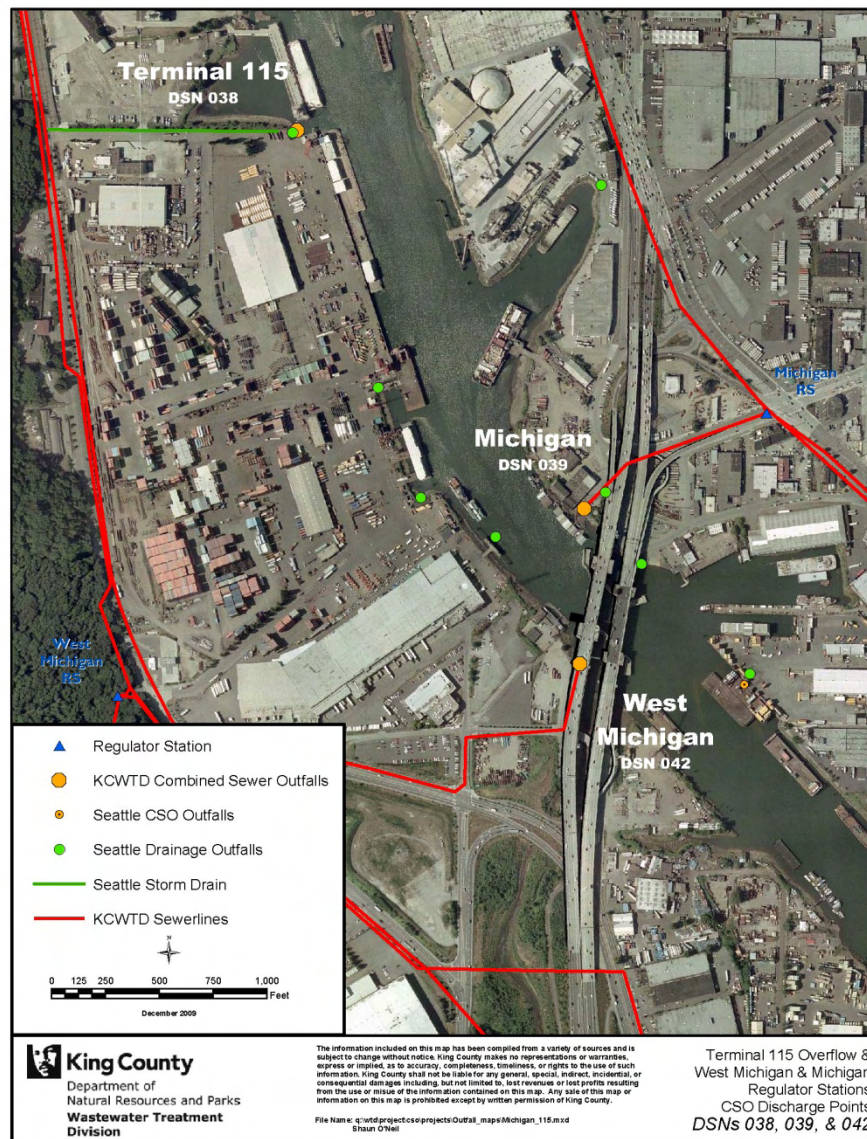


Figure 4-13. West Michigan Regulator CSO Discharge Point

1983 Overflow Baseline: 5 events and 2.0 MG per year.

Overflow Quantity: Has overflowed between 0 and 12 times per year since 1991 when monitoring began; 20-year average is 4.8 events per year; 2001–2007 average volume was 1.23 MG per year.

Control Project History: No specific control project has been done; some improvement may have resulted from installation of supervisory control and data acquisition system. The RWSP includes a conveyance upgrade to be completed in 2027. This project definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed in 1991, 1992, 1993, and 2009. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
1/12/1991	9100012
4/3/1991	9100613
1/28/1992	9200134
10/31/1992	9202111
10/6/1993	L2224-1
4/12/2009	L47834-4



West Michigan Regulator CSO Vicinity; Looking North at the First Avenue South Bridge Footing



West Michigan Regulator CSO Overflowing 10/17/2009

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediation will be identified under the Lower Duwamish Waterway Superfund action.

4.2.14 8th Avenue South Regulator

NPDES Discharge Serial Number 040

1958 Baseline Facility: Seattle raw sewage outfall; acquired by Metro (now King County) in 1962. Regulator built in 1967, and flows intercepted for treatment in 1976 when West Marginal Interceptor and Duwamish Siphon were built.

Discharge Location: Submerged discharge to west side of Duwamish River via a 36-inch-diameter outfall line at latitude 47° 32' 1.131" N and longitude -122° 19' 21.501" W (Figure 4-14).

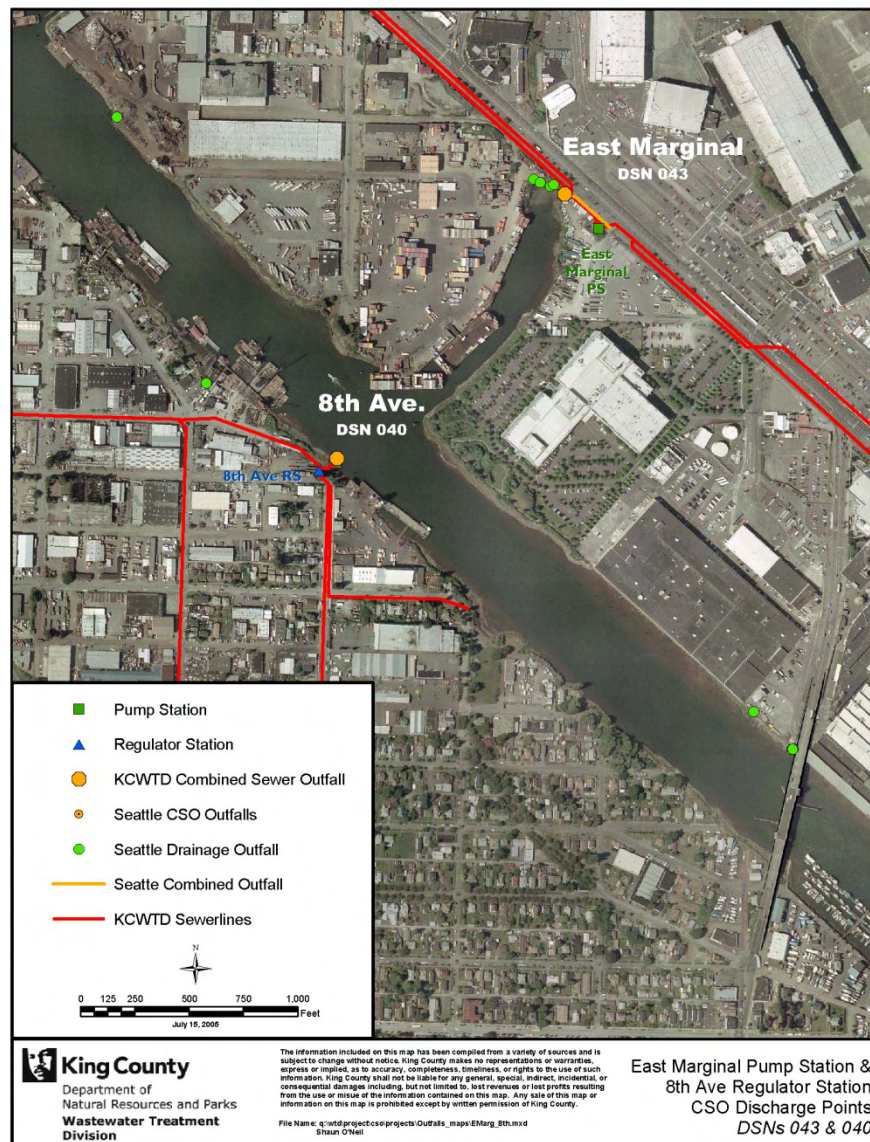


Figure 4-14. 8th Ave South Regulator CSO Discharge Point

1983 Overflow Baseline: 6 events and 8.0 MG per year.

Overflow Quantity: Has overflowed between 0 and 6 times per year since 1991 when monitoring began; has not overflowed since 1996; 20-year average is 0.8 event per year; 2001–2007 average volume was 0.0 MG per year. May be controlled. Its status to be confirmed in the hydraulic model recalibration.

Control Project History: No specific control project has been done; some improvement may have resulted from installation of a supervisory control and data acquisition system. The RWSP includes a 1.0-MG storage tank to be completed in 2027. This CSO may be controlled. The need for this project and its definition and schedule will be reassessed during development of the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed in 1994. Only one sample could be collected because of the infrequency of overflow. Data for this sample are included in the accompanying CD.

Sample Date	Sample #
12/27/1994	L5152-1



*8th Avenue South Regulator CSO Vicinity;
Looking Northwest Across Duwamish River*



*8th Avenue South Regulator CSO Vicinity;
Looking East Along Duwamish River*

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: Sediment sampling in this part of the Duwamish River has been characterized by Windward (2008) as part of the ongoing Lower Duwamish Waterway Superfund action.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediation will be identified under the Lower Duwamish Waterway Superfund action.

5.0 CSO OUTFALLS IN LAKE WASHINGTON SHIP CANAL/LAKE UNION/PORTAGE BAY

King County manages seven CSOs in Lake Washington Ship Canal/Lake Union/Portage Bay. The Canal Street CSO is controlled. A control project has been completed for the Dexter Avenue Regulator; fine-tuning of the facilities should achieve control. Five CSOs are not controlled: Ballard Siphon Regulator, 11th Avenue NW, 3rd Avenue West University Regulator, and Montlake.

5.1 Receiving Water

5.1.1 Overview

Lake Union is a freshwater lake with depths ranging from 35 to 52 feet. The lake receives most of its inflow from Lake Washington via the Montlake Cut and Portage Bay. Lake Union discharges to the Puget Sound Central Basin via the Hiram Chittenden Locks. At certain times of the year the lake has a significant amount of salt water near the bottom because of saltwater intrusion entering from the Locks.

Water circulation patterns in Lake Union are complex and affected by several factors, such as saltwater intrusion, freshwater flows from Lake Washington, wind, and temperature and density stratification. Lake Union exhibits a general pattern of summer stratification and winter flushing. During the dry summer months, water movement from Lake Washington into Lake Union decreases by over 90 percent compared to peak winter flows (Herrera, 1993). As the flow from Lake Washington decreases, the water temperature in Lake Union rises and saltwater moves into the lake from the Locks. This results in a stratified water column with colder, saltier water on the bottom and warmer fresh water at the surface.

The saltwater intrusion begins around May and continues through the summer until around November, when rainfall increases freshwater flow into the lake and flushes out salt water. The northern portion of Lake Union has more flushing than the southern portion because of the proximity to the Lake Washington flow, which directs flow toward the Locks and Puget Sound (Herrera, 1993).

Density stratification during the summer and fall creates two distinct sections of Lake Union. Circulation during the winter and spring months is mainly dominated by water inflow from Lake Washington, which creates a high flushing rate. Weather factors, such as wind speed and direction, can have a significant effect on water circulation.

5.1.2 Receiving Water Characteristics

The following description applies to receiving waters in the vicinity of the Lake Washington Ship Canal CSOs. The discussion of receiving water characteristics is based on 2001 to 2008 sampling results from the County's freshwater monitoring program. Data and reports are accessible at <http://green.kingcounty.gov/lakes/LakeUnion.aspx>.

Temperatures in the Ship Canal vary seasonally, with a typical minimum of about 5.5°C in the winter and summer maximums greater than 22°C at the surface and 19°C at the bottom. The lowest temperatures are typically measured in January and February and the highest (up to 23°C) in the summer months. There is little difference between surface and bottom temperatures in the western portion of the Ship Canal (west of Lake Union), but differences between surface and bottom waters were evident near the Montlake Cut.

Dissolved oxygen concentrations exhibit a seasonal pattern, with the highest concentrations (up to 13.7 mg/L) typically in April and the lowest (2.2 mg/L) in August and September. Near the Locks, there was little difference between surface and bottom waters, but in other areas, concentrations were lower in deeper waters.

Fecal coliform bacteria are measured in surface waters and most values were below 50 CFU/100 mL, with higher values seen in winter months associated with large precipitation events. The area of the Ship Canal just east of the Locks had more values over 50 CFU/100mls than in other areas of the Ship Canal. At the sampling location near the Fremont Bridge, only 11 values between 2001 and 2008 were over 50 CFU/100 mL.

5.2 Information on Specific CSO Outfalls

The following pages present outfall and discharge information and sediment chemistry results for the seven CSO outfalls in Lake Washington Ship Canal/Lake Union/Portage Bay. More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx>.

Table 5-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

The accompanying CD provides effluent and sediment quality monitoring data.

Table 5-1. Summary of Sediment and Discharge Information for CSOs in Lake Washington Ship Canal/Lake Union/Portage Bay

DSN	Facility Name	Control Status	Associated Stormwater Outfall	Discharge Quality Data*	Last date of Sediment Sample	Number of Stations	Sediment Analysis Performed	Data in EIM	SQS Exceedance
003	Ballard Siphon Regulator via Seattle Storm Drain	Uncontrolled	Yes	Yes	1989	1	Chemistry	No	No freshwater standard
004	East Ballard (AKA 11th Ave NW)	Uncontrolled	Yes	Yes	1989	1	Chemistry	No	No freshwater standard
008	3rd Ave W and Ewing St.	Uncontrolled	Yes	Yes	1989	1	Chemistry	No	No freshwater standard
007	Canal Street Overflow	Controlled	Yes	No	Not sampled—controlled CSO	—	—	—	No freshwater standard
009	Dexter Ave Regulator	Post-construction	Yes	Yes	2001	1	Chemistry	No	No freshwater standard
015	University Regulator	Uncontrolled	Yes	Yes	1986	1	Chemistry	No	No freshwater standard
014	Montlake Overflow	Uncontrolled	Yes	Yes	1989	1	Chemistry	No	No freshwater standard

5.2.1 Ballard Siphon Regulator

NPDES Discharge Serial Number 003

1958 Baseline Facility: City of Seattle CSO on the North Trunk; acquired by Metro (now King County) in 1962

Discharge Location: North side of Ship Canal at Salmon Bay through a Seattle storm drain at latitude 47° 39' 50.096" N and longitude -122° 22' 56.400" W (Figure 5-1).



Figure 5-1. Ballard Siphon Regulator CSO Discharge Point

1983 Overflow Baseline: 13 events and 95 MG per year.

Overflow Quantity: Has overflowed between 0 and 12 times per year since 1991 when monitoring began; 20-year average is 4.3 events per year; 2001–2007 average volume was 0.27 MG per year.

Control Project History: Significant control was achieved through building of the Parallel Ft. Lawton tunnel in 1992 to transfer captured CSO to West Point for treatment. The RWSP defined a control project concept of a 1.0-MG storage tank to be completed in 2030. The current siphon replacement project is being sized to bring early control to the CSO by 2010.



Ballard Siphon Regulator CSO Vicinity; Looking South Across Ship Canal

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was performed 1989–1990. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
02-Dec-89	8909776
06-Jan-90	9000002
09-Mar-90	9000286
04-Oct-90	9000880

Construction-Related Monitoring: Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: King County collected a sediment sample from one location proximal to the Ballard Siphon Regulator CSO discharge point in May 1989. The station location and the overflow discharge point are shown in Figure 5-2. One sample was collected from Station KSSY01. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. These data have never been submitted to EIM.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediations should be undertaken as a coordinated multi-agency approach for the Lake Washington Ship Canal, perhaps under the Lake Union Action Team.



Figure 5-2. Ballard Siphon Regulator (003) Sediment Sampling Location

5.2.2 11th Avenue NW CSO

NPDES Discharge Serial Number 004

1958 Baseline Facility: City of Seattle CSO on the North Trunk; acquired by Metro (now King County) in 1962.

Discharge Location: from a side weir to a submerged 72-inch-diameter outfall that discharges at a depth of approximately 20 feet to north side of Ship Canal at latitude 47° 39' 34.169" N and longitude -122° 22' 56.400" W (Figure 5-3).



Figure 5-3. 11th Avenue NW CSO Discharge Point

1983 Overflow Baseline: 16 events and 16 MG per year.

Overflow Quantity: Has overflowed between 6 and 30 times per year since 1991 when monitoring began; 20-year average is 13.4 events per year; 2001–2007 average volume was 6.3 MG per year.

Control Project History: RWSP plans a 2.0-MG storage tank to be completed in 2030. Definition and schedule will be reassessed in 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed 1988–1989. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
14-Jan-88	8800052
06-Apr-88	8800352
25-Sep-88	8801793
02-Nov-88	8802026
22-Feb-89	8900177

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: King County collected a sediment sample from one location proximal to the 11th Avenue NW CSO discharge point in May 1989. The station location and the overflow discharge point are shown in Figure 5-4. One sample was collected from Station KTTB01. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. These data have never been submitted to EIM.

Sediment Remediation: Nothing in planning at this time. Any needed remediations should be undertaken as a coordinated multi-agency approach for the Lake Washington Ship Canal, perhaps under the Lake Union Action Team.



11th Avenue NW CSO Vicinity; Looking South Across Ship Canal



11th Avenue NW CSO Overflowing 10/26/09



Figure 5-4. 11th Avenue NW CSO (004) Sediment Sampling Location

5.2.3 3rd Avenue West CSO

NPDES Discharge Serial Number 008

1958 Baseline Facility: Seattle CSO, sand-catcher and 30-foot-long side overflow weir built in 1958; acquired by Metro (now King County) in 1962.

Discharge Location: To south Ship Canal seawall via a 5-foot-square opening in the quay wall at a depth of 3 feet at latitude 47° 39' 34.169" N and longitude -122° 22' 56.400" W (Figure 5-5).



Figure 5-5. 3rd Avenue West CSO Discharge Point

1983 Overflow Baseline: 17 events and 106 MG per year.

Overflow Quantity: Has overflowed between 0 and 15 times per year since 1991 when monitoring began; 20-year average is 6.3 events per year; 2001–2007 average volume was 4.7 MG per year.

Control Project History: 64-MG reduction was achieved through building of the Parallel Ft. Lawton tunnel in 1992 to transfer captured CSO to West Point for treatment. RWSP plans a 5.5-MG storage tank to be complete in 2029. This schedule will be reassessed under the 2013 NPDES CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed in 1988–1989. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
14-Jan-88	8800053
27-Mar-88	8800303
25-Sep-88	8801792
02-Nov-88	8802027
22-Feb-89	8900174



3rd Avenue West CSO Vicinity; Looking Northwest Across Ship Canal



3rd Avenue West Overflowing 10/26/09

Construction-Related Monitoring: Pre-construction baseline sediment monitoring will be done before the start of construction. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling King County collected a sediment sample from one location proximal to the 3rd Avenue West CSO discharge point in May 1989. The station location and the overflow discharge point are shown in Figure 5-6. One sample was collected from Station KTUD02. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. These data have never been submitted to EIM.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediations should be undertaken as a multi-agency approach for the Lake Washington Ship Canal, perhaps under the Lake Union Action Team.



Figure 5-6. 3rd Avenue West CSO (008) Sediment Sampling Location

5.2.4 Canal Street CSO

NPDES Discharge Serial Number 007

1958 Baseline Facility: Seattle built the relief and sand-catcher in 1958 to control flows across the Fremont Siphon; Metro (now King County) acquired it in 1962.

Discharge Location: From the sand-catcher to the Ship Canal seawall through north quay wall at a depth of 3 feet at latitude 47° 39' 6.683" N and longitude -122° 21' 29.208" W (Figure 5-7).



Figure 5-7. Canal Street CSO Discharge Point

1983 Overflow Baseline: Less than 1 event and 1 MG per year.

Overflow Quantity: Has overflowed between 0 and 5 times per year since 1991 when monitoring began; 20-year average is 0.9 event per year; 2001–2007 average volume was 0 MG per year; controlled to the state standard.

Control Project History: No project has been needed and none is planned because the CSO is controlled.

CSO Effluent Quality Monitoring Data:

Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable; the CSO is controlled.

Sediment Sampling: King County has not sampled Lake Washington Ship Canal sediments in the vicinity of the Canal Street CSO discharge point. Data would be similar to that from 3rd Avenue West.

Sediment Remediation Activity: Nothing in planning at this time.



Canal Street CSO Vicinity; Looking South Across Ship Canal

5.2.5 Dexter Avenue Regulator

NPDES Discharge Serial Number 009

1958 Baseline Facility: Seattle CSO; 30-foot-long side weir overflow; acquired by Metro (now King County) in 1962; regulator station built by Metro in 1972.

Discharge Location: Lake Union via a 48-inch-diameter and 414-foot-long submarine outfall at latitude 47° 37' 56.298" N and longitude -122° 20' 19.506" W (Figure 5-8).

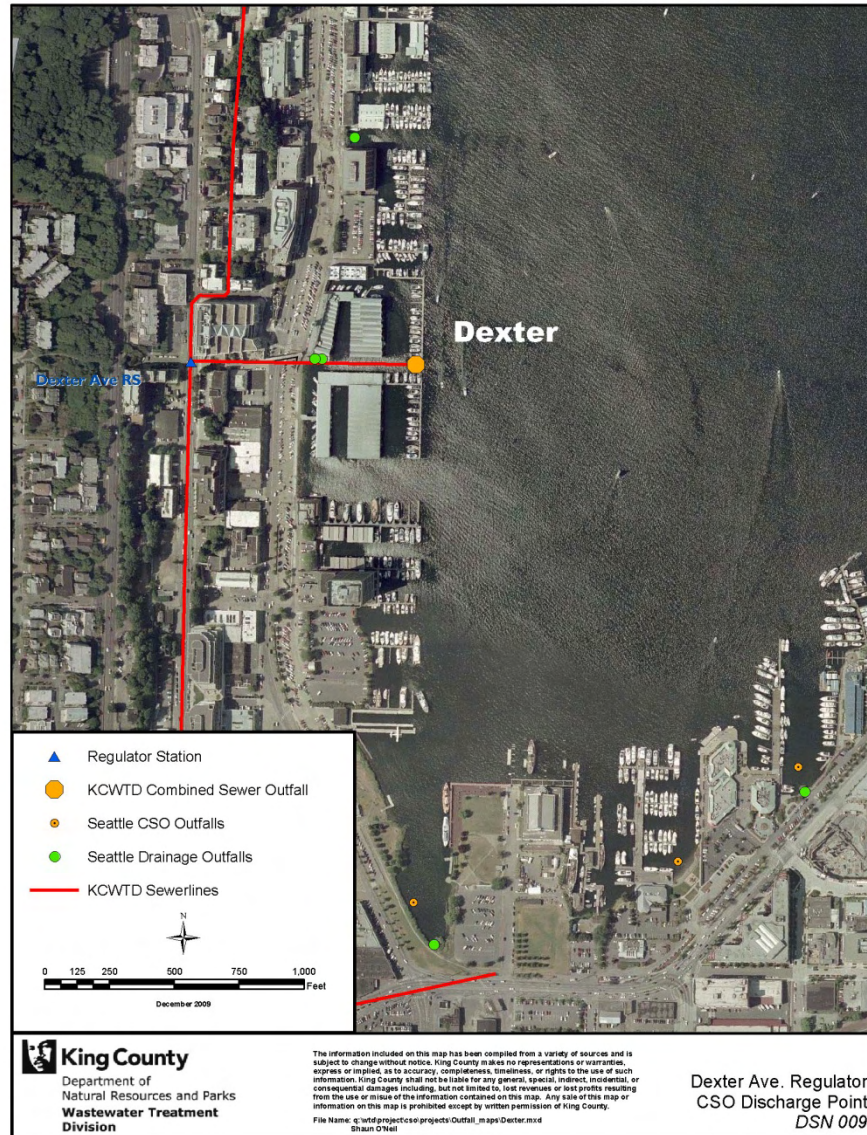


Figure 5-8. Dexter Avenue Regulator CSO Discharge Point

1983 Overflow Baseline: 15 events and 24 MG per year.

Overflow Quantity: Has overflowed between 2 and 23 times per year since 1991 when monitoring began; 20-year average is 12.1 events per year; 2001–2007 average volume was 6.3 MG per year.

Control Project History: Substantial control achieved from Denny Lake Union project, online May 2005; additional control modifications are under way to complete control.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed in 1994 and 1995; Ecology released King County from the requirement to capture remaining two samples because the county was unable to capture additional overflows (all were short duration). Data for these samples are included in the accompanying CD.

Sample Date	Sample #
19-Dec-94	L5122-1
18-Feb-95	L5494-1



Dexter Avenue Regulator CSO Vicinity, Looking South, Parallel to Westlake Avenue

Construction-Related Monitoring: Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: King County collected a sediment sample from one location proximal to the Dexter Avenue Regulator CSO discharge point in May 1989. The station location and the overflow discharge point are shown in Figure 5-9. One sample was collected from Station KTHY01. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Sediments in the vicinity of this discharge point were sampled again in August 2001. One sample was collected from Station 0569. Sediment chemistry results from this sampling event are also summarized in the accompanying CD. Data from these sampling events have not been submitted to EIM.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediations should be undertaken as a multi-agency approach for the Lake Washington Ship Canal, perhaps under the Lake Union Action Team.



Figure 5-9. Dexter Avenue Regulator (009) Sediment Sampling Locations

5.2.6 University Regulator

NPDES Discharge Serial Number 015

1958 Baseline Facility: Originally a City of Seattle CSO; acquired by Metro (now King County) in 1962; regulator built by Metro in 1976.

Discharge Location: Discharges at surface through seawall at latitude 47° 38' 56.299" N and longitude -122° 18' 40.281" W (Figure 5-10).

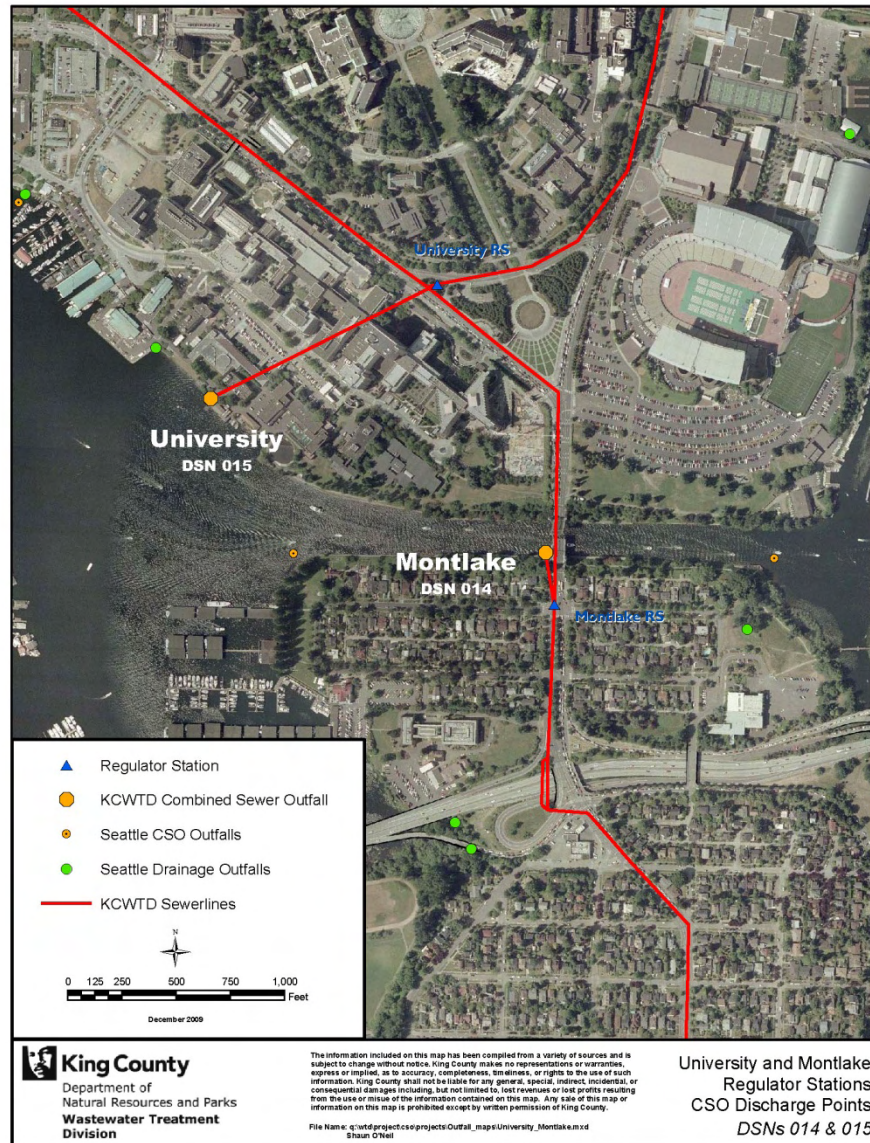


Figure 5-10. University Regulator CSO Discharge Point

1983 Overflow Baseline: 13 events and 126 MG per year.

Overflow Quantity: Has overflowed between 2 and 15 times per year since 1991 when monitoring began; 20-year average is 6.6 events per year; 2001–2007 average volume was 41 MG per year.

Control Project History: A Phase I partial separation project was completed in 1994 creating a new stormwater outfall under the I-5/University Bridge, called the Densmore Drain. Project volume reduction was approximately 36 MG per year.

Current Phase II planned control project: RWSP plans a 7.5-MG storage tank to control the Montlake and University CSOs to be completed in 2017. This schedule will be reassessed during development of the 2013 CSO Control Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed in 1986. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
26-Oct-86	8611852
21-Nov-86	8611855
29-Dec-86	8611858
30-Dec- 86	8611851



University Regulator CSO Vicinity; Looking South Across Ship Canal



University Regulator Overflowing 10/26/09

Construction-Related monitoring: Phase 1 post-construction monitoring will serve as Phase II pre-construction baseline sediment monitoring. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: King County collected a sediment sample from one location proximal to the University Regulator CSO discharge point in November 1986. The station location and the overflow discharge point are shown in Figure 5-11. One sample was collected from Station 0545. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. These data have never been submitted to EIM.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediations should be undertaken as a multi-agency approach for the Lake Washington Ship Canal, perhaps under the Lake Union Action Team.



Figure 5-11. University Regulator (015) Sediment Sampling Location

5.2.7 Montlake CSO

NPDES Discharge Serial Number 014

1958 Baseline Facility: Originally a City of Seattle CSO: acquired by Metro (now King County) in 1962; regulator built by Metro in 1978,

Discharge Location: Discharges at the surface on the south seawall at latitude 47° 38' 49.597" N and longitude -122° 18' 17.498" W (Figure 5-12).

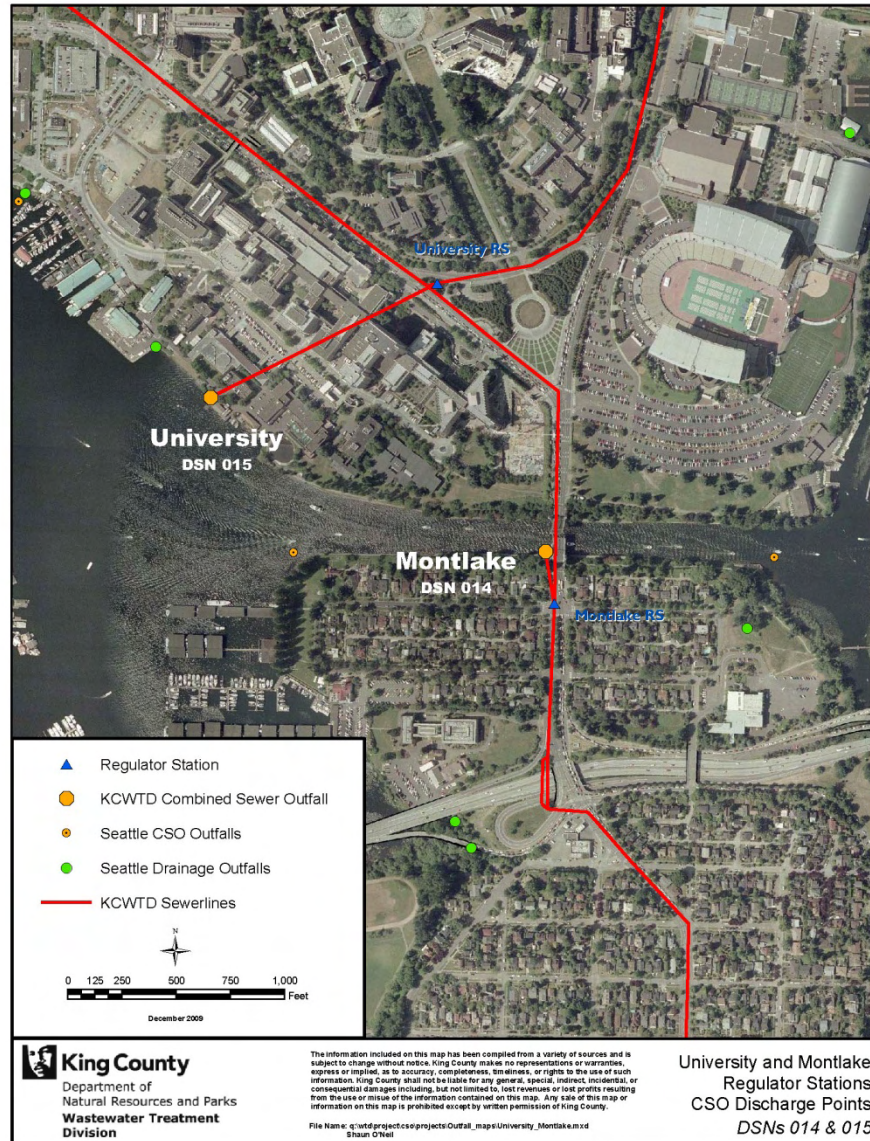


Figure 5-12. University and Montlake CSOs Discharge Point

1983 Overflow Baseline: 6 events and 32 MG per year.

Overflow Quantity: Has overflowed between 0 and 13 times per year since 1991 when monitoring began; 20-year average is 5.2 events per year; 2001–2007 average volume was 10 MG per year.

Control Project History: RWSP plans a 7.5-MG storage tank to control the Montlake and University CSOs to be completed in 2017. This schedule will be reassessed in the 2013 NPDES CSO Plan Update.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was performed between 1990 and 1995. Data for these samples are included in the accompanying CD.

Sample Date	Sample #
04-Dec-90	9010009
03-Apr-91	9100609
21-Feb-92	9200258
23-Mar-95	L5766-1

Construction-Related Sediment Monitoring:

Pre-construction baseline sediment monitoring will be done before the control project begins. Post-construction monitoring will be defined in the CSO Post Construction Monitoring Plan to be submitted to Ecology July 1, 2010.

Sediment Sampling: King County collected a sediment sample from one location proximal to the Montlake CSO discharge point in May 1989. The station location and the overflow discharge point are shown in Figure 5-13. One sample was collected from Station KTVP01. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. These data have never been submitted to EIM.

Sediment Remediation Activity: Nothing in planning at this time. Any needed remediations should be undertaken as a multi-agency approach for the Lake Washington Ship Canal, perhaps under the Lake Union Action Team.



Montlake CSO Vicinity Looking East



Montlake CSO Vicinity Looking West



Montlake CSO Overflowing 10/26/09



Figure 5-13. Montlake CSO (014) Sediment Sampling Location

6.0 CSO OUTFALLS IN LAKE WASHINGTON

King County manages six CSOs in Lake Washington: Matthews Park, 30th Avenue NE, Belvoir, East Pine, Rainier Avenue, and Henderson (including the Martin Luther King Jr. Way CSO) Pump Stations. All CSOs are controlled.

6.1 Receiving Water

6.1.1 Overview

Lake Washington is the largest of the three major lakes in King County. Lake Washington's two major influent streams are the Cedar River at the southern end, which contributes about 57 percent of the annual hydraulic load and 25 percent of the phosphorus load, and Lake Sammamish via the Sammamish River from the north, which contributes 27 percent of the hydraulic load and 41 percent of the phosphorus load. Most of the lake shoreline is highly developed with 63 percent fully developed (King County, 2009). The lake received raw, primary, and secondary treated wastewater between 1941 and 1963, which resulted in eutrophication and declined water quality of the lake. Wastewater was diverted from the lake, and discharge of untreated effluent, except for CSOs, was reduced to zero by 1968.

The basin of Lake Washington is a deep, narrow, glacial trough with steeply sloping sides. The lake is 20.6 feet above MLLW in Puget Sound and is connected to the Puget Sound Central Basin via Lake Union and the Lake Washington Ship Canal. Mercer Island lies in the southern half of the lake, separated from the east shore by a relatively shallow and narrow channel and from the west shore by a much wider and deeper channel. The mean depth of the lake is 108 feet with a maximum depth of 214 feet (King County, 2009).

6.1.2 Receiving Water Characteristics

The following description applies to receiving waters in the vicinity of all the Lake Washington CSOs unless otherwise noted. The discussion of receiving water characteristics is based on 1990 to 2001 sampling results from the County's freshwater monitoring program. Data and reports are accessible at <http://green.kingcounty.gov/lakes/LakeWashington.aspx>.

Lake Washington has one mixing and one stratification event per year and undergoes a complete mixing from the surface to the bottom during December through March. The water column is stratified the remainder of the year. The lake begins to stratify in April and by June, strong stratification occurs until October. Surface water starts to cool in October and the stratification weakens until the thermal stratification that separates the surface and deep waters breaks down.

Lake Washington temperatures were generally from 6–9°C from December through March with maximum temperatures between 21.5 and 24.5°C during July and August. Temperatures in nearshore areas, such as those near the county CSOs, generally exceeded 17.8°C from mid-July through early October (King County, 2003).

Dissolved oxygen concentrations in deep waters ranged were typically over 9.0 mg/L during months where the water column was mixed down to a low of 2.5 mg/L when the lake was stratified (King County, 2003).

Mean summer transparencies in pelagic (deep) areas of the lake ranged between 3.5 to 5.6 meters. Mean transparencies in nearshore areas was slightly less, by 0.1 to 0.5 meter, than those in pelagic areas. Transparencies in the fall were usually higher than other seasons (King County, 2003).

6.2 Information on Specific CSO Outfalls

The following pages present outfall and discharge information and sediment chemistry results for the six CSO outfalls in Lake Washington. More information on the volume of CSO discharged yearly from each location can be found in the annual reports on King County's CSO program at <http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx>.

Table 6-1 presents a summary of sediment and discharge monitoring information for these CSOs. It also indicates whether there is a stormwater outfall associated with a CSO site.

The accompanying CD provides effluent and sediment quality monitoring data.

Table 6-1. Summary of Sediment and Discharge Information for CSOs in Lake Washington

DSN	Facility Name	Control Status	Associated Stormwater Outfall	Discharge Quality Data*	Last date of Sediment Sample	Number of Stations	Sediment Analysis Performed	Data in EIM	SQS Exceedance
018	Matthews Park Pump Station Emergency Overflows	Controlled	Yes	No	Not sampled—controlled CSO	—	—	—	No freshwater standard
049	30th Avenue NE Pump Station	Controlled	Yes	No	Not sampled—controlled CSO	—	—	—	No freshwater standard
012	Belvoir Pump Station Emergency Overflow	Controlled	Yes	No	Not sampled—controlled CSO	—	—	—	No freshwater standard
011	E Pine St. Pump Station Emergency Overflow	Controlled	Yes	No	2000	2	Chemistry	LKWA00SD007B	No freshwater standard
033	Rainier Ave Pump Station	Controlled	Yes	No	2000	2	Chemistry	LKWA00864A & LKWA00864B	No freshwater standard
045	Henderson Pump Station	Controlled	Yes	Yes	2000	2	Chemistry	LKWA004903A & LKWA004903B	No freshwater standard
013	Martin Luther King Way Trunk Line Overflow	Controlled	Yes	Yes	2000	2	Chemistry	LKWA004903A & LKWA004903B	No freshwater standard

6.2.1 Mathews Park Pump Station

NPDES Discharge Serial Number 018; northeastern start of King County combined system

1958 Baseline Facility: Did not exist in 1958. Built by Metro (now King County) in 1967 to divert flow from the service area of City of Seattle’s 2.5-mgd Lake City secondary treatment plant (allowing it to be decommissioned) and from the north end of the system to the new West Point treatment plant. Separated flows, but highly influenced by infiltration and inflow, arrive from upstream.

Discharge Location: Any overflow occurs from a series of seven flapgates along the Kenmore Lakeline, starting from the southernmost flapgate (Flapgate 01Aa) at latitude 47° 37’ 3.108” N and longitude -122° 16’ 21.54” W (Figure 6-1).



Figure 6-1. Matthew’s Park Pump Station CSO Discharge Point (Flapgate 01Aa)

1983 Overflow Baseline: 0 events and 0 MG per year.

Overflow Quantity: Has rarely overflowed since 1991 when monitoring began; 20-year average is less than 1 event per year; 2001–2007 average volume was less than 1 MG per year; overflows only during 100-year-type storms.

Control Project History: No project has been needed or planned; controlled to the state standard.

CSO Effluent Quality Monitoring Data: Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable; no control project is needed.

Sediment Sampling: King County has not sampled Lake Washington sediments in the vicinity of the Matthews Park Pump Station CSO discharge point.

Sediment Remediation Activity: Nothing in planning at this time.



*Matthews Park Pump Station CSO Vicinity;
Looking Northeast*



*Matthews Park Pump Station CSO Vicinity;
Looking Southeast*

6.2.2 30th Avenue NE Pump Station

NPDES Discharge Serial Number 049

1958 Baseline Facility: Seattle Pump Station 1; replaced with new pump station by Metro (now King County) in 1971.

Discharge Location: Shares outfall with Belvoir Pump Station; discharges to Union Bay Slough through a 36-inch-diameter outfall that discharges 40 feet offshore at a depth of 10 feet at latitude 47° 39' 24.111" N and longitude -122° 17' 15.321" W (Figure 6-2).



Figure 6-2. 30th Avenue NE Pump Station CSO Discharge Point

1983 Overflow Baseline: 0 events and 0 MG per year.

Overflow Quantity: Has not overflowed since monitoring began in 1992; controlled to the state standard.

Control Project History: No project has been needed or planned; controlled to the state standard.

CSO Effluent Quality Monitoring Data: Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable; no control project is needed.

Sediment Sampling: King County has not sampled Lake Washington sediments in the vicinity of the 30th Avenue NE Pump Station CSO discharge point.

Sediment Remediation Activity: Nothing in planning at this time.



30th Avenue NE and Belvoir Place Pump Stations CSO Vicinity; Looking Southwest, No Warning Signage Because No Public Access



30th Avenue NE and Belvoir Place Pump Stations CSO from Shore Looking Southwest

6.2.3 Belvoir Place Pump Station

NPDES Discharge Serial Number 012

1958 Baseline Facility: Originally Seattle Pump Station 2; replaced with a new pump station by Metro (now King County) in 1971.

Discharge Location: Shared outfall with 30th Avenue NE Pump Station; discharges to Union Bay Slough through a 36-inch-diameter outfall that discharges 40 feet offshore at a depth of 10 feet at latitude 47° 39' 24.111" N and longitude -122° 17' 15.321" W (Figure 6-3).



Figure 6-3. Belvoir Place Pump Station CSO Discharge Point

1983 Overflow Baseline: 0 events and 0 MG per year.

Overflow Quantity: Has overflowed between 0 and 2 times per year since 1992 when monitoring began; 20-year average is 0.6 event per year; 2001–2007 average volume was 0.21 MG per year. This overflow is considered controlled.

Control Project History: No project has been needed or is planned because the CSO is controlled to the state standard.

CSO Effluent Quality Monitoring Data: Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable; CSO is controlled.

Sediment Sampling King County has not sampled Lake Washington sediments in the vicinity of the Belvoir Pump Station CSO discharge point.

Sediment Remediation Activity: Nothing in planning at this time.

6.2.4 East Pine Street Pump Station

NPDES Discharge Serial Number 011

1958 Baseline Facility: Originally Seattle Pump Station 5; Metro (now King County) replaced the pump station in 1976.

Discharge Location: 24-inch diameter 300-foot-long outfall into Lake Washington at latitude 47° 36' 53.732" N and longitude -122° 16' 15.321" W (Figure 6-4).



Figure 6-4. East Pine Street Pump Station CSO Discharge Point

1983 Overflow Baseline: 0 events and 0 MG per year.

Overflow Quantity: Has not overflowed since 1992 when monitoring began.

Control Project History: No project has been needed or planned; controlled to the state standard.

CSO Effluent Quality Monitoring Data: Overflow quality and sediment monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable; CSO is controlled.

Sediment Sampling: King County collected sediment samples from two locations proximal to the East Pine Street Pump Station CSO discharge point in September 2000. Station locations and the discharge point are shown in Figure 6-5. Triplicate samples were collected from Station SD007A, and a single sample was collected from Station SD007B. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Data from this sampling event may be found in EIM under User Study ID LKWA00 and User Location IDs LKWA00SD007A and LKWA00SD007B.

Sediment Remediation Activity: Nothing in planning at this time.



East Pine Street Pump Station Vicinity; Looking Southeast Over Lake Washington



Figure 6-5. East Pine Street Pump Station (011) Sediment Sampling Locations

6.2.5 Rainier Avenue Pump Station

NPDES Discharge Serial Number 033

1958 Baseline Facility: Emergency Relief Overflow for Seattle pump station that transferred flows from the Lake Washington shoreline into the Rainier/Hanford sewer system where they were discharged raw into the East Waterway of the Duwamish River at today’s Hanford CSO site; Metro (now King County) assumed control in 1962; the sewage was intercepted for treatment at West Point in 1967; pump station modified by Metro in 1973.

Discharge Location: Discharges into Lake Washington near an active boating and hydroplane racing area at Stan Sayers Pits via a 36-inch-diameter and 400-foot-long outfall at a depth of 30 feet at latitude 47° 34’ 16.946’’ N and longitude -122° 16’ 31.909’’ W (Figure 6-6).

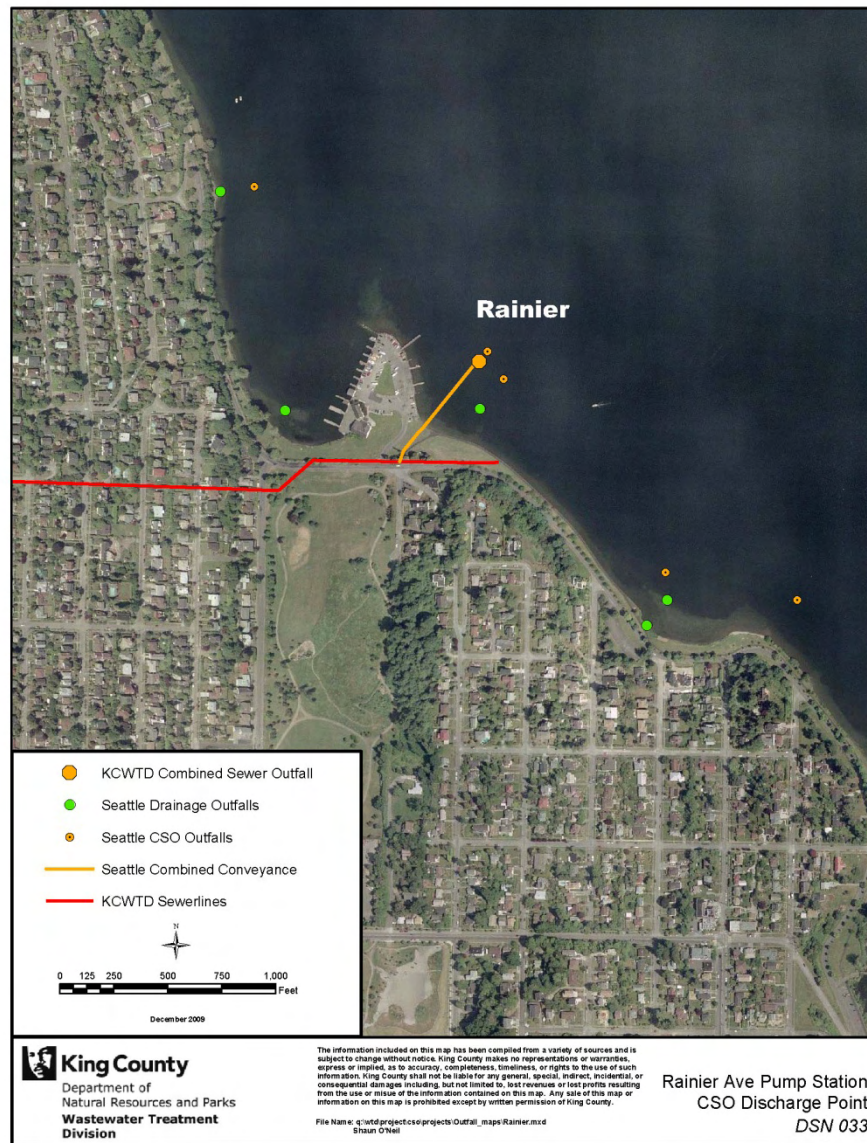


Figure 6-6. Rainier Avenue Pump Station CSO Discharge Point

1983 Overflow Baseline: 0 events and 0 MG per year.

Overflow Quantity: 20-year average is 0 event per year; 2001–2007 average volume was 0 MG per year.

Control Project History: No project has been needed or planned; controlled to the state standard.

CSO Effluent Quality Monitoring Data: Overflow quality monitoring to characterize the CSO was not done because the CSO is controlled.

Construction-Related Monitoring: Not applicable; no control project needed.

Sediment Sampling: King County collected sediment samples from two locations proximal to the Rainier Avenue Pump Station CSO discharge point in September 2000. Station locations and the overflow discharge point are shown in Figure 6-7. A single sample was collected both from Station 0864A and Station 0864B. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Data from this sampling event may be found in EIM under User Study ID LKWA00 and User Location IDs LKWA000864A and LKWA000864B.

Sediment Remediation Activity: Nothing in planning at this time.



Rainier Avenue Pump Station CSO Vicinity, Looking North Along Lake Washington



Figure 6-7. Rainier Avenue Pump Station (033) Sediment Sampling Locations

6.2.6 Henderson Pump Station and Martin Luther King Jr. Way CSO

Henderson Pump Station CSO NPDES Discharge Serial Number 045

1958 Baseline Facility: Seattle pump station that transferred flows from the Lake Washington shoreline into the Henderson/East Marginal sewer system and on to the Diagonal primary treatment plant; Metro (now King County) assumed responsibility in 1962 and replaced the pump station in 1976 and again in 2005 as part of the CSO control project; flows were conveyed to West Point for secondary treatment beginning in 1969.

Discharge Location: Lake Washington via an 84-inch-diameter Seattle storm drain that discharges 50 feet offshore at a depth of 12 feet at latitude 47° 31' 23.827" N and longitude - 122° 15' 46.619" W. Storm sewer also carries overflow from the Martin Luther King Jr. Way CSO (Figure 6-8).



Figure 6-8. Henderson Street/Martin Luther King Jr. Way CSOs Discharge Point

1983 Overflow Baseline: 12 events and 15 MG per year.

Overflow Quantity: Has not overflowed since control project completed in 2005; 20-year average is 9.7 events per year; 2001–2007 average volume was 5.9 MG per year.

Control Project History: The project to control this CSO, along with the Martin Luther King Jr. Way CSO and Norfolk CSO, was completed in 2005. With fine-tuning that is under way it is expected to be controlled to the state standard. Flows are now conveyed to the South Treatment Plant for secondary treatment. Flows in excess of plant capacity are stored in the new Henderson Tunnel. Flows exceeding the capacity of the storage are discharged in an outfall shared with the Norfolk CSO to the Duwamish River after receiving primary treatment, screening, disinfection, and dechlorination. After the storm passes stored flows drain to South plant.

CSO Effluent Quality Monitoring Data:

Overflow quality monitoring to characterize the CSO was not done as part of the NPDES characterization because the CSO was believed to be controlled. Overflow monitoring was done concurrently with Martin Luther King Jr. Way and Norfolk CSOs for pre-control project characterization. Data are provided on the accompanying CD.

Sample Date	Sample #
27-Apr-97	L10901-3
31-May-97	L11044-3
17-Sep-97	L11428-3
30-Oct-97	L11971-3

Construction-Related Monitoring: Post-construction monitoring off the Henderson outfall has not been done because of the ongoing shared stormwater discharge.

Sediment Sampling: King County collected sediment samples in September 2000 from two locations proximal to the discharge point that serves both the Martin Luther King Jr. Way CSO and the Henderson Street Pump Station CSO. Station locations and the overflow discharge point are shown in Figure 6-9. Triplicate samples were collected from Station 4903A, and a single sample was collected from Station 4903B. Sediment chemistry results, normalized to dry weight, are summarized in the accompanying CD. Data from this sampling event may be found in EIM under User Study ID LKWA00 and User Location IDs LKWA004903A and LKWA004903B. One sediment sample was collected from a third location – Station 4903 – in July 1995. Data from this sample are included in the accompanying CD; however, these have never been submitted to EIM.

Sediment Remediation Activity: Nothing in planning at this time.



Henderson Pump Station CSO Vicinity, Looking South Along Lake Washington



Henderson Pump Station CSO Vicinity, Looking East Along Lake Washington



Figure 6-9. Martin Luther King Jr. Way CSO (013) and Henderson Street Pump Station (045) Sediment Sampling Locations

7.0 REFERENCES

- Babson, A. 2004. Personal communication from Amanda Babson at the University of Washington to Kimberle Stark, King County Department of Natural Resources and Parks. August 14, 2004.
- Brown & Caldwell. 1958. Metropolitan Seattle sewerage and drainage study: A report for the City of Seattle, King County and the State of Washington on the collection, treatment and disposal of sewage and the collection and disposal of storm water in the Metropolitan Seattle area. Seattle, WA.
- EPA. 2003. *Record of Decision – Harbor Island Superfund Site West Waterway Operable Unit, Seattle, Washington*. EPA Region 10, Seattle, WA.
<http://yosemite.epa.gov/r10/cleanup.nsf/346a4822da38ae7088256da6005fc923/5a64831b6521f46b8825650200836f1c!OpenDocument#West%20Waterway>.
- Herrera Environmental Consultants. 1993. *Memorandum: Lake Union circulation patterns and implications for CSO and storm drain outfalls*. Prepared by Kent Easthouse.
- Integral. 2006. *Lower Duwamish Waterway Slip 4 early action area: Engineering evaluation/cost analysis*. Prepared for City of Seattle and King County. Integral Consulting, Inc., Mercer Island, WA.
[http://yosemite.epa.gov/R10/CLEANUP.NSF/ddea47a33877982f88256db8007e8049/f7b826ca8a5733d688257044008228ef/\\$FILE/EECA%20Slip%204%20Main%20Document%20February%2010,%202006-.pdf](http://yosemite.epa.gov/R10/CLEANUP.NSF/ddea47a33877982f88256db8007e8049/f7b826ca8a5733d688257044008228ef/$FILE/EECA%20Slip%204%20Main%20Document%20February%2010,%202006-.pdf).
- King County. 1996. *Norfolk CSO cleanup study report*. Prepared for Elliott Bay/Duwamish Restoration Program Panel. Panel Publication 13. King County Department of Natural Resources, Seattle, WA.
<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/Norfolk/Library.aspx>.
- King County. 1999. *King County combined sewer overflow water quality assessment for the Duwamish River and Elliott Bay*. Appendix B1: Hydrodynamic and fate and transport numerical model for the Duwamish River and Elliott Bay. Prepared by the Duwamish River and Elliott Bay Water Quality Assessment Team for the King County Department of Natural Resources.
- King County. 1999. *Sediment management plan*. Task 1400, Technical Memorandum. Prepared by Anchor Environmental and Herrera Environmental Consultants in collaboration with the King County Department of Natural Resources. Year 2000 CSO Plan Update Project, Sediment Management Program.
- King County. 2001. *Review: Puget Sound physical oceanography related to the Triple Junction region*. Prepared by Ebbesmeyer, C., and G. Cannon for the King County Department of Natural Resources and Parks. Seattle, WA.
- King County. 2002. *Puget Sound physical oceanography related to the Triple Junction region, Brightwater Marine Outfall*. Prepared by Ebbesmeyer, C., G. Cannon, B. Nairn, B. Fox, and M. Kawase for the King County Department of Natural Resources and Parks. Seattle, WA.

- King County. 2003. *Sammamish/Washington analysis and modeling program: Lake Washington existing conditions report*. Prepared by Tetra Tech ISG and Parametrix for the King County Department of Natural Resources and Parks. Seattle, WA.
- King County. 2005. *The Denny Way sediment cap – 2000 data – final monitoring report*. King County Department of Natural Resources. Seattle, Washington.
- King County. 2008. *Denny Way CSO nearshore interim sediment cleanup project closure report*. King County Department of Natural Resources. Seattle, Washington.
- King County. 2009. Major Lakes Monitoring Program Web site.
<http://green.kingcounty.gov/lakes/LakeWashington.aspx>
- King County, Anchor, EcoChem. 2005. *Duwamish/Diagonal CSO/SD cleanup study report*. Prepared for Elliott Bay/Duwamish Restoration Program Panel. Panel Publication 30. King County Department of Natural Resources, Anchor Environmental, L.L.C., and EcoChem, Inc., Seattle, WA.
<http://www.kingcounty.gov/environment/wastewater/SedimentManagement/Projects/DuDi/Library.aspx>.
- Municipality of Metropolitan Seattle (Metro). 1984. *Toxicant pretreatment planning study*. Prepared by Romberg, G.P., JRB Associates, Battelle Marine Research Laboratory, and Science Applications, Inc.
- Municipality of Metropolitan Seattle (Metro). 1983. *Water quality assessment of the Duwamish Estuary*.
- SEA. 1999. *Sediment remediation plan, Denny Way/Lake Union CSO Control Project*. Prepared for King County and Black and Veatch. Seattle, Washington.
- Washington State Department of Ecology. 1978. *Areawide Section 208 water quality plan*.
- Washington State Department of Ecology. 1988. *Elliott Bay action plan*.
- Windward Environmental LLC. 2008. *Lower Duwamish Waterway remedial investigation, remedial investigation report, draft final (internal)*. Prepared for submittal to the U.S. Environmental Protection Agency and the Washington State Department of Ecology. Bellevue, WA.
[http://yosemite.epa.gov/r10/CLEANUP.NSF/LDW/Lower+Duwamish+Waterway+Draft+Phase+II+Remedial+Investigation+Report/\\$FILE/draft_riII.pdf](http://yosemite.epa.gov/r10/CLEANUP.NSF/LDW/Lower+Duwamish+Waterway+Draft+Phase+II+Remedial+Investigation+Report/$FILE/draft_riII.pdf)

Appendix A

Foundational Studies

King County, and its predecessor agency Metro, have consistently considered scientific information in making wastewater management decisions. When information has not been available, they have initiated or participated in special studies to develop the needed information. This appendix describes the foundational studies that have shaped King County's decisions on CSO control through submittal of the 2000 CSO control plan update. Studies conducted since the 2000 update are described in the body of the report.

1958 Metropolitan Seattle Wastewater and Drainage Study

Beginning with the 1958 *Metropolitan Seattle Wastewater and Drainage Study*, regional agencies have collaborated on studies to identify major environmental protection needs and to identify and prioritize corrective actions. This study recognized that providing better wastewater management would result in the most environmental improvement. As a result, the regional wastewater agency, Metro, was formed to put the new wastewater system in place.

CSO Implication: As part of the larger three-stage schedule of projects, the study recommended a program of sewer separation and storage, as needed, to control overflows in the City of Seattle.

1978 Areawide Section 208 Water Quality Plan

As early as 1974, Metro recognized the need to consider the presence and fate of toxic chemicals in its planning and management activities. The initial focus was on characterizing treatment plant and combined sewer discharges for heavy metals. Investigation of sediment conditions near Metro outfalls was a component of these first efforts. The scope of later studies was expanded to assess organic compounds (notably pesticides and PCBs) and the complex interaction of chemical contamination, biological impairment, and source identification and control strategies.

Two years of investigation was done under Section 208 of the federal Clean Water Act. Toxic chemicals were identified as one of the five main water quality problems facing the Seattle–King County region. The plan recommended public and private actions to control pollutants entering regional waters.

CSO Implication: The plan recommended CSO control as part of improved wastewater management and identified the need for more understanding of the toxic impacts of CSOs.

1979–1984 *Toxicant Pretreatment Planning Study*

In 1979, Metro, with the support of the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), initiated a 5-year, \$7 million (1979 dollars) study—the *Toxicant Pretreatment Planning Study* (TPPS)—to develop a better understanding of toxic chemicals in the environment and in wastewater, and of their impacts and treatability. A scientific advisory panel provided advice, oversight, and review during the study.

Recommendations of the study included the following:

- Develop an action plan to clean up toxicants in Elliott Bay.
- Strengthen Metro's industrial pretreatment program to meet increasing emphasis on toxicant control at the source.
- Continue source control programs and promote a general “source control attitude.”
- Implement Metro's adopted facilities plans.
- Focus on continued toxicant research.

Table 1 lists the reports produced as a part of the *Toxicant Pretreatment Planning Study*. Information from the TPPS and from two complementary studies, *Household Hazardous Waste Disposal* and *Toxicants in Urban Runoff*, became a basis for the policy decisions in the 1980s.

CSO Implication: The TPPS recommended that CSO control should be part of a coordinated Elliott Bay Action Plan and that source control, including enhancing Metro’s pretreatment program, should be a priority.

**Table 1. Documents Produced as Part of the
*Toxicant Pretreatment Planning Study***

Title	Topics
TPPS Summary Report	Synthesis of all TPPS and related project information, problem definition, conclusions and recommendations.
A1: Treatment Plant Evaluation	Occurrence of toxicants in wastewater treatment plants, removals, mass loadings, and balances. Alum addition and the impacts of Renton sludge.
A2: Collection System Evaluation	Occurrence of toxicants in various land use types, estimates of total loadings by land use types, toxicants in CSO's, and evaluation of a Duwamish satellite treatment plant.
A3: Industrial Waste	Occurrence of toxicants at selected industrial locations, identification of total industrial loads of toxicants to West

Characterization	Point and Renton (South plant).
A4: Source Controls— Pretreatment Evaluation	Industrial pretreatment program review and recommendations plus other toxicant control options.
Technical Report B: Pilot Plant Studies	Occurrence of toxicants, mass loadings, and balances of pilot-scale studies on alum-assisted primary treatment, secondary treatment of West Point wastewater, and anaerobic digestion. Bench-scale alum and powdered activated carbon studies.
C1: Evaluation of Toxicant Transport and Fate	Occurrence of toxicants in receiving waters, sources of toxicants, transport, and deposition.
C2: Puget Sound Benthic Studies and Ecological Implications	Analysis of biological testing of bottom sediments in Puget Sound and correlation with toxicant loadings.
C3: Lake Washington Benthic Studies and Ecological Implications	Analysis of biological testing of bottom sediments in Lake Washington and correlation with toxicant loadings.

1983 *The Water Quality Assessment of the Duwamish Estuary*

Because of the potential conflict between uses of the Duwamish Waterway, EPA and Ecology classified the estuary as a high priority study area. In the 1982 state/EPA agreement, both agencies identified the Duwamish Waterway as having one of the four worst water quality problems in the state. As the designated water quality management agency for the Green/Duwamish basin, Metro was awarded a grant to inventory pollutants entering and impacting the waterway and to develop a strategy for pollution control. The 1983 *Water Quality Assessment of the Duwamish Estuary* (also known as the Harper-Owes Study) documented this work. It overlapped TPPS activities in some areas.

The assessment synthesized the findings of the many Duwamish studies performed through July 1982 in order to identify data strengths, deficiencies, and gaps requiring further investigation. Public input and interagency task force review comments were considered in developing a ranked list of beneficial uses of the estuary. Mass balances were performed for 20 parameters to identify impacts to beneficial uses. Upstream sources were found to contribute more than two-thirds of the total sediment, iron, and mercury load, as well as much of the organic carbon and pesticides. Major impacts to beneficial uses were attributed to ammonia, residual chlorine, copper, lead, mercury, PCBs, and PAHs. Temperature, dissolved oxygen, nitrite, cadmium, DDT, pathogens, and sediments were considered to produce only minor impacts.

The Renton Treatment Plant (now called South Treatment Plant) was found to contribute nearly 80 percent of the total ammonia load. The anticipated diversion of Renton plant effluent out of the Duwamish River in 1986 was expected to result in marked reductions in ammonia, chlorine,

dissolved oxygen, nitrite, and cadmium impacts. CSOs were found to be a source of all pollutants measured—but only a small source. One exception was fecal coliform bacteria. An estimated 80 percent of the total pathogens released to the estuary was estimated to originate from CSOs. While concentrations of toxicants were found to be relatively high in CSOs, the small annual volume made them a minor source.

The most significant finding was that the majority of metal and organic toxicants could not be attributed to documented sources, which shifted attention to the heavy industrial and commercial activity along the river. Future conditions were projected to adversely impact beneficial uses. Temperature, sediment, pathogens, copper, lead, mercury, PCBs, and PAHs were identified as the greatest contributors to future adverse impacts.

The study made 11 recommendations:

- Flow augmentation
- River bank shading
- Erosion controls
- Maintenance dredging
- CSO controls
- Paving of a contaminated parking area on Harbor Island
- Control of shipyard emissions
- Additional investigations
- Good housekeeping measures
- Preservation of local wildlife habitat
- Improved river access

CSO Implication: CSOs were identified as a minor contributor to the larger pollution problem; CSO control was recommended as a part of the solution.

1988 Draft *Elliot Bay Action Plan*

In 1985, the Puget Sound Estuary Program (PSEP) was formed to minimize toxic chemical contamination of Puget Sound and to protect its living resources. The Urban Bay Action Program, an element of the PSEP, developed the 1988 action plan for the Elliott Bay Action Program. Its objectives were as follows:

- Identify specific toxic areas of concern in the bay and the Duwamish Waterway based on chemical contamination and associated adverse biological effects
- Identify historical and ongoing sources of contamination
- Rank toxic problem areas and sources (to the extent possible) in terms of priority for development of corrective actions

- Implement corrective actions to reduce or eliminate sources of ongoing pollution and restore polluted areas to support natural resources and beneficial uses.

The plan described actions that had been completed and actions to be completed in the future. It identified and ranked environmental indicators and problem areas. Problem areas included the following:

- Seattle South Waterfront
- North Harbor Island I
- North Harbor Island II
- West Waterway I
- West Waterway II
- Denny Way CSO Area

Problem stations included the following:

- EW-05 (center of East Waterway between Terminals 25 and 30)
- AB-01 (east of Duwamish Head)
- KG-01 (near mouth of Slip 1 across from the southern end of Kellogg Island)
- KG-05, KG-06 (north of Kellogg Island)
- DR-12 (in Slip 3)
- DR-15 (in Slip 2)
- DR-16 (north of Terminal 115 on west side of waterway)

Early accomplishments of the Elliott Bay Action Program included more than 175 inspections at 102 sites, identification of 42 unpermitted discharges, and development of permits and best management practices for shipyards. Fifteen contaminated upland sites were identified for cleanup; two cleanups and negotiation of cleanups for twelve additional sites were completed. By September 1987, enforcement actions included 36 notices of violation, 22 administrative orders, and 28 fines totaling \$44,500 (1988 dollars).

Through these efforts, most known direct industrial discharges to the bay and river were ended or routed to the municipal sewer system under permits. In addition, the effluent discharge from the Metro Renton Treatment Plant was relocated from the Duwamish River to Puget Sound off Duwamish Head in 1987. The remaining ongoing contaminant sources were believed to include contaminated groundwater, storm drains, CSOs, and a few unidentified direct discharges.

To characterize contaminant inputs from CSOs and storm drains, sediment was collected from the downstream end of 7 CSOs, 20 storm drains (SDs), and 15 combination CSO/storm drains. These inline sediments were compared to offshore sediments to evaluate CSO and storm drain contributions to the contamination in priority areas and stations. Ten priority drainages were

identified for source control activities. Six of these drainages discharged to priority problem areas and were considered high priority:

- SW Lander CSO/SD (Seattle 105)
- SW Hanford CSO/SD (Seattle 162)
- SW Florida CSO/SD (Seattle 098)
- Fox S CSO/SD (Seattle 116)
- Michigan CSO (Metro W039)
- Michigan SD (Seattle)

Four of the drainages were outside of priority problem areas:

- Slip 4 CSO/SD (Seattle 117)
- Duwamish SD (Seattle)
- Slip 6 SD (Seattle)
- S 96th Street SD (Seattle)

Site-specific action plans were then developed. Potential sources, status, actions, responsible entities, and implementation dates were compiled. Recommended actions included underground tank removal, upland soil and aquatic sediment remediation, rerouting of discharges to the sewer system, enhanced permitting by Metro's Industrial Waste Program and by Ecology, stormdrain and CSO outfall cleaning, CSO control, implementation of BMPs, and further investigations.

CSO Implication: Control of direct discharges and stormwater source control were identified as the greatest needs; these controls were expected to improve CSO discharge quality. Metro's Denny Way and Michigan CSOs were identified as priorities for control. Although the Denny Way CSO was not identified as a candidate for source control activities, it was determined that controlling the site would benefit the Denny Way "problem area."

1988–1996 Metro Receiving Water Monitoring Program

In Administrative Order number DE-84-577, Ecology instructed Metro to develop and implement a plan for monitoring receiving waters in the vicinity of its primary treatment plants—West Point, Alki, Carkeek, and Richmond Beach—and in other point source discharge areas. (The Renton plant provided secondary treatment.) The proposed plan included water column surveys of fecal coliform and enterococcus bacteria; subtidal sediment surveys including benthic taxonomy, amphipod bioassays, and analysis of conventional constituents (particle size distribution, total organic carbon, oil, and grease), metals, and extractable organic priority pollutants (plus a survey); intertidal monitoring of water for bacteria and of sediments for metals

and extractable organic priority pollutants; and clam and algae tissue samples for analysis of bacteria, metals, and extractable organic priority pollutants. Monitoring was to occur quarterly to biennially at a range of stations near the treatment plants and nearby shorelines.

This “point source” monitoring program was approved by Ecology on April 5, 1988, in a first amendment to Administrative Order DE-84-577. Data were reported to Ecology as QA/QC was completed and were summarized in annual water quality status reports for marine waters. The monitoring program was implemented until discontinued after issuance of the 1996 NPDES permit for the West Point plant, which was upgraded to provide secondary treatment, and after closure of the Richmond Beach plant. After 1996, Metro focused its monitoring program on collecting data on key parameters that could be used in long-term trend assessments. This monitoring continues under ongoing programs described later in this appendix. In parallel, an ambient monitoring program was implemented to provide background data that could be compared to the point source monitoring data. The comparison would help identify impacts related to Metro discharges and ensure that water quality improvements were not undermined.

CSO Implication: These monitoring efforts affirmed that CSO control was a minor to moderate part of a larger wet-weather problem and that while CSO control was part of the solution, it would not bring the largest benefit.

1988–1997 Metro/King County CSO Discharge and Sediment Characterization Study

In approving Metro’s 1988 CSO control plan, Ecology required characterization of CSO and sediment quality. The purpose of the characterization was to obtain additional information to be used in setting site control priorities and a control project schedule. Because some sampling had already been done, the approved monitoring plan called for taking four discharge samples at five active overflow sites per year until all sites had been sampled. The sampling was completed in 1994. Sediment sampling was also completed for all sites at the rate of five sites per year. When the state promulgated the Sediment Management Standards and attendant testing protocols, additional sediment sampling was done to fully meet these requirements. This additional sampling was completed in 1997.

Analysis of overflow samples showed that the variability between different samples at a site was generally greater than variability among sites. Sediment sampling confirmed that sediments had been significantly impacted by pollution and that the contamination resulted from many sources. Recognizing that further understanding of sediment contamination was needed, King County made it a focus of both the 1999 *CSO Water Quality Assessment of the Duwamish and Elliott Bay* and the 1999 *Sediment Management Plan*.

CSO Implication: The Denny Way CSO, containing overflow from the Elliott Bay Interceptor via the Interbay Pump Station, was slightly higher in pollutant concentrations than the other CSOs, affirming it as a priority site for control; chemistry at other overflows did not greatly influence their control priority.

1999 Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay

King County completed the 1999 CSO Water Quality Assessment of the Duwamish and Elliott Bay (WQA) with support from a large stakeholder group and a peer review panel. The WQA reviewed the health of the Duwamish River and Elliott Bay estuary and the effects of CSO discharges. A computer model was developed to predict existing and future water and sediment quality conditions, and a risk assessment was undertaken to identify risks to aquatic life, wildlife, and human health. Findings identified during the course the WQA were taken into account during development of the RWSP CSO control program.

The WQA identified some risks to fish, wildlife, and humans in the estuary and predicted limited improvement if CSO discharges were eliminated from the estuary (Table 2).

Table 2. Water Quality Assessment Findings Regarding CSOs

Risk Target	Risk	CSO Control Benefit
Water column—dwelling aquatic organisms; salmon by direct or dietary exposure	None identified	No benefit
Sediment-dwelling organisms; salmon via dietary exposure	Potential risk from PCBs, TBT, bis(2-ethylhexyl) phthalate, mercury, PAHs; low risk from 1,4-dichlorobenzene	Slightly reduced risk ^a ; slight decrease in loadings of bis(2-ethylhexyl) phthalate, mercury, PAHs, and 1,4-dichlorobenzene
Wildlife	Low-to-high risks, depending on the species, from PCBs, lead, copper, and zinc	Slight decrease in loadings of lead, copper, and zinc
Humans – chemical exposures	Significant risk from exposure to arsenic and PCBs from fish consumption; potential risk from exposure to arsenic and PCBs when netfishing, swimming, windsurfing, and SCUBA diving	No benefit; the identified risk is not related to CSOs
Humans – pathogen exposures	Potential risk from fecal coliform, giardia, and viruses. People should avoid water contact during and for 48 hours after overflows.	Reduced risk; any benefit from reduced fecal coliform would not be apparent because inputs from other sources are so high

Table 2. Water Quality Assessment Findings Regarding CSOs

Risk Target	Risk	CSO Control Benefit
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^a CSOs were not believed to be a significant source of PCBs or tributyl tin (TBT), but were considered a moderate source of 1,4 -dichlorobenzene.

CSO Implications: The findings of the WQA affirmed that CSO pollution is a very small part of a larger problem, mainly because of the low pollutant concentrations in CSOs and the brief and infrequent exposure to CSOs. It recommended the continuation of CSO control to meet state regulations and helped determine the priority of the CSO projects in the RWSP. It recommended that locations with greater potential for human contact—the Puget Sound beaches—be controlled first. Locations in the Duwamish Waterway were set later in the schedule because of the perceived lower human health and environmental benefit from CSO control at these sites. It identified sediment contamination as the largest risk in the river environment.

1999 *Sediment Management Plan*

The *Sediment Management Plan* assessed areas near seven county CSOs that were listed on the Washington State Contaminated Sites list. The areas were assessed for their risk, preferred cleanup approach, partnering opportunities, and potential for recontamination after remediation (Table 3). The remediation schedule for these areas, shown in Table 3, is being implemented.

The *Sediment Management Plan* highlighted the growing interest in sediment management as a factor in CSO control planning and the need for more information about CSOs as an ongoing or historical contributor to contamination. The sediment management program was formed to implement the plan and any new projects developed after the plan in the broader context of wastewater planning. The program addresses sediment quality issues near CSO discharges and treatment plant outfalls, evaluates and addresses emerging wastewater treatment sediment quality issues, and incorporates sediment quality considerations into comprehensive planning.

CSO Implications: Contamination of sediments with chemicals such as PCBs was identified as resulting mainly from historical inputs. The plan, therefore, recommended that sediment remediation near CSOs proceed ahead of CSO control (except near the Denny Way CSO where control should come first). It recommended coordinated efforts to solve phthalate pollution problems.

Table 3. Recommended Projects in the Sediment Management Plan

Nearby CSO and Water Body	Cleanup Priority	Recommended Cleanup Approach	Partnering Opportunity	Cost (million \$) ^a	Scheduled to be Completed
Duwamish/ Diagonal ^b (Duwamish River)	High	Dredging and capping	King County under direction of EBD RP ^c	8.90 ^d	Completed 2004

Table 3. Recommended Projects in the Sediment Management Plan

Nearby CSO and Water Body	Cleanup Priority	Recommended Cleanup Approach	Partnering Opportunity	Cost (million \$) ^a	Scheduled to be Completed
King Street (Puget Sound, Elliott Bay)	High	Capping	WSDOT and Seattle	2.60	2008
Hanford (Duwamish River)	Medium/High	Dredging and confined aquatic disposal	Port of Seattle	15.49	2007
Lander (Duwamish River)	Medium/High	With Hanford	U.S. Army Corps of Engineers	3.45	2007
Denny A & B ^e (Puget Sound)	Medium	Dredging and capping		2.23	2006
Denny C & D (Puget Sound)	Medium	Capping		0.90	2009
Chelan Ave. (Puget Sound, Elliott Bay)	Low/Medium	Dredging and confined aquatic disposal		2.80	2010
Brandon St. (Duwamish River)	Low	Capping		0.50	2012

^a These costs are given in 2005 dollars (the original estimates, given in 1998 dollars, escalated by 3 percent per year).

^b This project was added after the SMP.

^c These costs were not included in the SMP; it was assumed that they would be paid by the Elliott Bay/Duwamish Restoration Program (EBDRP).

^d EBDRP administers projects funded under a 1990 settlement of litigation by the National Oceanic and Atmospheric Administration (NOAA) for natural resource damages from City of Seattle and King County CSOs and storm drains.

^e This is a City of Seattle storm drain; King County's Hanford No. 1 CSO uses this outfall.