King County

Wastewater Treatment Division
Department of Natural Resources and Parks
King Street Center, KSC-NR-0500
201 South Jackson Street
Seattle, WA 98104-3855

November 1, 2008

Mark Henley
Washington State Department of Ecology
3190 160 Avenue SE
Bellevue, WA 98008-5442

Dear Mr. Henley:

Enclosed is King County Wastewater Treatment Division's Annual Combined Sewer Overflow Report prepared in accordance with the requirements established within National Pollutant Discharge Elimination System Permit WA-002918-1 and WAC 173-245-090. The report contains an overview and status of King County's Combined Sewer Overflow (CSO) Control Program, 2007/2008 overflow volume and frequency information.

During this reporting period, an extended period of heavy rainfall created significant challenges for the region. December 3, 2007 brought 4.10 inches at West Division gauges, with some recording as much as 4.50 inches in a 24-hour period. CSOs during this storm accounted for 96% of the total CSO volume discharged over the year.

The total volume of untreated CSOs was approximately 815 million gallons (MG) during the year compared to a baseline of 2,339 MG. The total of 815 MG represents 2.25 percent of flow from the West Service Area, and is a 65.2 percent reduction in CSO volume over the 1981–1983 baseline.

Continued progress is being made toward meeting performance goals at the Mercer/Elliott West treatment and storage facilities. Of the 350.33 MG of CSO managed at the Mercer/Elliott West facilities, 37.8 percent was captured and received full secondary treatment at West Point Treatment Plant, 53.9 percent received primary treatment and disinfection at Elliott West, and only 8.3 percent was discharged untreated at the Denny Regulator.

King County is working diligently to enable these control facilities to achieve their performance goals and to implement our CSO control plan by year 2030.

If you have any questions, please contact me at 206-684-1236, or Karen Huber, Wastewater Engineer IV, at 206-684-1246.

Sincerely,

Christie True
Division Director

Enclosure

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Combined Sewer Overflow Control Program

2007–2008 Annual Report

October 2008

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

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Background

The King County Wastewater Treatment Division (WTD) provides wholesale wastewater conveyance and treatment for flows from the City of Seattle and 34 other cities and sewer districts including the Muckleshoot Indian Tribe. Only the City of Seattle wastewater collection system contains combined sewers that collect both wastewater and stormwater. Seattle's collection system conveys flows to county trunks and interceptors, which then convey flows to the West Point Treatment Plant located in Discovery Park. A small portion of flows from the combined sewer system is treated at the South Treatment Plant in Renton. When medium to large storms occur, flows may exceed the capacity of the collection system pipes. When this happens, combined sewer overflows (CSOs) occur at some of the 38 county CSO locations that discharge to Lake Washington, Lake Union, the Lake Washington Ship Canal, the Duwamish River, Elliott Bay, and Puget Sound (Figure 1). The City of Seattle is responsible for 88 CSO locations in its local sewer systems.

CSOs are a recognized source of water pollution that can result in temporary increases in bacterial counts and aesthetic degradation of shorelines, in long-term adverse effects on sediment quality at discharge points, and in raised public health concerns in areas where there is potential for public contact. Since the 1970s when the basic sewer system infrastructure was in place, King County has been implementing CSO control projects to improve water quality in the Seattle area.

Report Requirements

This report is prepared and submitted to the Washington State Department of Ecology (Ecology) in accordance with the requirements established in the West Point Treatment Plant National Pollution Discharge Elimination System (NPDES) permit and in WAC 173-245-090. The report provides the following:

- An overview and status of King County's CSO Control Program.
- CSO volumes and frequencies for June 1, 2007, through May 31, 2008.
- Annual reports for the four CSO treatments facilities—Alki, Carkeek, Henderson/Norfolk, and Mercer/Elliott West.
- Progress on the first Regional Wastewater Services Plan (RWSP) CSO control projects at the South Magnolia, North Beach, Barton Street, and Murray Avenue CSO locations.

Figure 1. King County CSO Locations

CSO Control Status

The total volume of untreated CSOs was approximately 815 million gallons (MG) during 2007–2008 compared to a baseline of 2,339 MG. The total of 815 MG represents a 65.2 percent reduction in CSO volume over the 1981–1983 baseline average.

CSOs during December 3, 2007, storm accounted for 96 percent of the total CSO volume discharged over the year. The storm brought 3.77 inches of rain for the day at SeaTac, the second highest total on record in the past 50 years. Average rainfall at gauges in the Seattle area was slightly higher at 4.10 inches, with some gauges recording as much as 4.50 inches in a 24-hour period. The amount and intensity of rainfall during this storm overwhelmed most of the system.

Continued progress is being made in starting up the Mercer/Elliott West and Henderson/Norfolk CSO treatment and storage facilities that came online May 2005. These are complex facilities that operate intermittently. Experience with other CSO treatment facilities has shown that intermittent operation prolongs the startup process. The infrequent opportunities to assess performance and the need to schedule construction for dry-weather periods extend the time required to refine facility performance. King County is working diligently to enable these facilities to achieve their performance goals.

Although full control has not yet been achieved at the Denny and Dexter Regulators (controlled by Mercer/Elliott West facilities), much has been accomplished. Of the 350.33 MG of CSO managed at the Mercer/Elliott West facilities, 37.8 percent was captured and received full secondary treatment at the West Point Treatment Plant in Seattle, 53.9 percent received primary treatment and disinfection at Elliott West, and only 8.3 percent was discharged untreated at the Denny Regulator. The number of untreated discharges at Denny Regulator met the one untreated discharge per year regulatory target. The volume of untreated discharge was 97.7 percent less than pre-project levels.

In 2007–2008, 15 percent of the CSO managed by this system received secondary treatment at the South Treatment Plant in Renton, while 85 percent received primary treatment and disinfection in the Henderson Tunnel, with discharge to the Duwamish River. Of the primary treated discharges, one was designated as an “untreated” event for purposes of calculating solids limit performance. No untreated discharges occurred at the three system outfalls (Henderson, Martin Luther King, and Norfolk).

In fall 2007, the U.S. Environmental Protection Agency (EPA) notified the county that its wet-weather management programs were going to be audited. Such audits are occurring across the country under a strategy set by EPA’s Office of Enforcement and Compliance Assurance (OECA). Agencies are selected to be audited based on their size, population served, and system complexity. The City of Seattle was informed it would undergo a similar audit at the same time. OECA and EPA Region X staff, accompanied by Ecology staff, performed an intensive inspection over five days in early January 2008. King County is committed to working with the regulatory community to ensure that its programs comply with regulations.

Section 1

Overview and Status of King County's CSO Control Program

This section summarizes the evolution of King County's CSO control program and then describes the status of CSO control projects and ongoing elements of the program.

1.1 Overview of CSO Control Program

King County first formalized CSO control with the development of the *1979 CSO Control Program* (1979 Program). The 1979 Program identified nine projects to reduce the number of CSO events into freshwater (Lake Washington, Lake Union, and the Lake Washington Ship Canal). In 1985, the Washington State Water Pollution Control Act (RCW 90.48) introduced new regulations that required all municipalities with CSOs to develop plans for "...the greatest reasonable reduction at the earliest possible date." The county prepared the *1986 Plan for Secondary Treatment Facilities and Combined Sewer Overflow Control* (1986 Plan) to meet this requirement.

Before the 1986 Plan was implemented, the Washington State Department of Ecology (Ecology) promulgated new regulations (WAC 173-245-020) that defined "greatest reasonable reduction" to mean "control of each CSO such that an average of one untreated discharge may occur per year." The county worked with Ecology to develop an interim goal of 75 percent reduction of CSO volumes system wide by the end of 2005. The county's *Final 1988 Combined Sewer Overflow Control Plan* (1988 Plan) identified 11 CSO control projects designed to meet this interim goal.

As part of the 1995 National Pollutant Discharge Elimination System (NPDES) permit renewal for the West Point Treatment Plant, King County prepared an update and amendment to the 1988 Plan. The *1995 CSO Update* assessed the effectiveness of CSO reduction efforts to date, reevaluated priorities for control of CSO sites, and identified three control projects for completion in 1995–2000.[1]

In November 1999, the King County Council approved the *Regional Wastewater Services Plan* (RWSP). The RWSP identifies wastewater projects to be built through 2030 to protect human health and the environment, serve population growth, and meet regulatory requirements. The RWSP included a CSO control plan that consists of the amended 1988 Plan, a goal for achieving

[1] Ecology's CSO regulation (WAC 173-245) requires that CSO plan updates be submitted with each NPDES permit renewal for the West Point Treatment Plant. Updates are intended to document progress on implementing the county's CSO control program, identify its program for the next five years, and provide a vehicle for making changes in the overall long-term program.

control at each CSO location by 2030,[2] and identification of 21 CSO control projects at a total cost of $378 million (2005 dollars) to meet this goal.

An update of the RWSP's CSO control plan—*Year 2000 CSO Control Plan Update* (2000 Plan Update)—was included in the June 2000 submission of the West Point Treatment Plant NPDES permit renewal application. The 2000 Plan Update describes King County's progress in implementing its CSO control program, documented its compliance with state and federal CSO control requirements, and identified two large control projects—Denny Way/Lake Union and Henderson/Martin Luther King (MLK)/Norfolk CSO Control Projects—for completion in the next five-year NPDES permit cycle. The resulting Mercer/Elliott West and Henderson/Norfolk CSO control systems came online in spring 2005.

King County completed the *2008 CSO Control Plan Update* in April 2008. The plan update describes the county's wastewater system and the control status of its CSOs,how the county is meeting the U.S. Environmental Protection Agency's (EPA's) Nine Minimum Controls, and the methods and results of efforts to monitor and model CSO volume and frequency and receiving water bodies. The also describes completed, in process, and planned CSO control projects and then describes available CSO control strategies and how they apply to county projects.

1.2 Programs to Meet EPA's Nine Minimum Controls

King County has implemented a number of programs to satisfy the requirements of the Nine Minimum Controls, which are a part of EPA's codified CSO Control Policy. These programs are summarized in Table 1.

Table 1. King County's Compliance with EPA's Nine Minimum Controls

Nine Minimum Controls	King County Compliance Effort
Proper operation and regular maintenance programs for the sewer system and CSOs	Proper facility operation is managed by West Point staff using SCADA.[a] Asset management programs implemented by the West Point Treatment Plant, South Treatment Plant, and collection system maintenance division maintain CSO outfalls, regulator stations, and pump stations. Collection system staff inspect sewers on a specified schedule and perform corrective actions when deficiencies are found. Maintenance schedules and records of visits are available for inspection on request.
Maximize use of collection system for storage	The Regional Wastewater Services Plan emphasizes storage projects for CSO control. SCADA manages regulator stations to maximize flows in interceptors and to store excess flows in large trunk sewers.
Review and modification of pretreatment requirements to ensure that CSO impacts are minimized	King County's Industrial Waste Program issues approvals that set limits on the chemical contents of industrial discharges. The program includes monitoring and permit enforcement, education, and technical assistance to businesses on appropriate waste pretreatment and disposal techniques. WTD also administers and helps fund the Local Hazardous Waste Management Program. Current water quality assessment and sediment management plan data indicate that there is no need for a CSO-specific pretreatment program.

[2] Prior to King County's adoption of the RWSP, Ecology had withdrawn the 1988 Plan's interim goal of 75 percent reduction of CSO volumes by 2005 in favor of allowing the county to prioritize control projects in terms of protection of human health rather than reduction of volumes.

Nine Minimum Controls	King County Compliance Effort
Maximization of flow to secondary treatment plant for treatment	SCADA is used to maximize flow to the West Point Treatment Plant via operation of regulator and pump stations. All analysis for CSO control project alternatives include storage and transfer to the secondary and CSO treatment plants.
Elimination of CSOs during dry weather	King County CSOs do not occur as a result of inadequate dry-weather flow capacity. The county provides enough capacity in the combined sewer system to transfer 2.25 times the average wet-weather flow to secondary treatment, as negotiated with Ecology. The only overflows seen in the combined system during dry weather result from problems such as power outages, mechanical failures, or human error. These events are rare and are immediately reported to Ecology. (Table 5 lists dry-weather overflows that occurred during the 2007–2008 season.) Overflows occurring during precipitation (CSOs) can be exacerbated by power outages, mechanical failures, or human error. Such overflows in 2007-08 are listed in Table 7. Operation and maintenance programs, as described for the first control, focus on preventing dry-weather overflows and exacerbated CSOs. The conveyance system is monitored through SCADA and direct observation; corrective action is taken immediately if a problem occurs. Equipment problems are immediately reviewed, and repair or replacement activity is undertaken in a timely manner.
Control of solid and floatable materials in CSOs	The City of Seattle's catch basin maintenance program limits the introduction of floatable materials to sewers. King County developed an information campaign with brochures and TV spots to educate the public that trash should not be flushed to the sewers. Information is available on the CSO control website under "Resources and Links" at http://dnr.metrokc.gov/WTD/cso/library.htm. The majority of floatables in the King County system are captured in the large volume of wastewater transferred to the treatment plant before overflows occur. Overflow weirs also hold back solids and floatables in the conveyance system prior to overflow. Observations of the quantity of floatables are noted in logs at each facility and are available for inspection on request. These observations have indicated that additional floatables and solids controls are not needed at this time. If additional floatables control is found to be needed in the future, the needs will be addressed in the CSO control projects implemented under the county's long-term control plan.
Pollution prevention programs to reduce contaminants in CSOs	King County has implemented the Industrial Waste Program and has been a major participant in the Local Hazardous Waste Management Program. Both programs serve to reduce discharge to sewers of chemicals and other substances that adversely impact the environment and the wastewater treatment process. Educational materials on controlling trash disposal to sewers are a part of the larger public information program.
Public notification program to ensure that public receives adequate notice of CSO events and impacts	King County operates a CSO Notification and Posting Program as a joint project with the City of Seattle and Public Health–Seattle & King County. This program includes the posting of signs at publicly accessible CSO locations, an information phone line, a Web site, a brochure, and other public outreach activities. A public notification feasibility study, required in the most recent modification of the West Point NPDES permit, was submitted to Ecology on July 1, 2007. The study reviewed and recommitted to continuing the public notification program elements described above. It also identified the potential to provide real-time

Nine Minimum Controls	King County Compliance Effort
	notification of overflows. A Web site that provides this notification went live December 2007. The county is seeking public opinion on the usefulness of the Web site's approach and format as a part of its outreach programs. It is also investigating automated email as another notification method, but it is not ready for external use yet.
Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls	In 1986, King County began a sampling program to characterize each CSO and identify high priority sites for early control. The program included collecting water quality data for five CSO sites per year and collecting sediment samples at each site. In the 1990s, sampling was expanded to assess compliance with state Sediment Management Standards. The county's extensive monitoring for its 1999 *CSO Water Quality Assessment of the Duwamish River and Elliott Bay* found that the majority of risks to people, wildlife, and aquatic life would not be reduced by removal of CSOs because most risk-related chemicals come from sources other than CSOs. Monitoring of CSO volume and frequency will continue after completion of CSO control projects to verify achievement of control goals. King County may undertake additional sampling on completion of specific CSO control projects where it is deemed useful to verify project effectiveness. Such monitoring plans will be developed during project implementation as needed.

[a] The Supervisory Control and Data Acquisition (SCADA) system controls the West Point Treatment Plant collection system.

1.3 Status of CSO Control Projects

This section presents an overview of King County's completed, current, and planned CSO control projects. Projects began in the late 1970s. Many early projects involved sewer separation, flow diversion, and new tunnels. Most current and future projects involve construction of storage tanks and CSO treatment facilities.

1.3.1 Completed CSO Control Projects

Tables 2 and 3 summarize CSO control projects and other projects associated with CSO controls that have been completed to date.

Table 2. Completed CSO Control Projects

Project	Description	Completion Date	Status
Ft. Lawton Tunnel	Parallel tunnel to the West Point plant to provide greater transfer capacity.	1991	Completed.
Hanford/Bayview/ Lander Separation & Storage	Partial separation of the Lander and Hanford basins, and reactivation of the Bayview Tunnel. (Joint project with the City of Seattle.)	1992	Remaining control will occur under RWSP projects in 2017 (Hanford), 2019 (Lander), and 2026 (Hanford at Rainier). Lander stormwater management is ongoing.

Project	Description	Completion Date	Status
Carkeek Transfer/CSO Treatment	Transfer of flows up to 9.2 mgd from the Carkeek basin to the West Point plant. Treatment of flows above 9.2 mgd at the Carkeek CSO plant.	Facilities online in 1994; upgrades completed in 2005	The Carkeek plant was receiving more flow than anticipated. Upgrades began in 2005 to the pumps that transfer flow to West Point toward increasing their capacity from 8.4 to 9.2 mgd. Also in 2005, the chlorine system was further modified and a dechlorination system was added.
Kingdome Industrial Area Storage & Separation	Installation in 1994 of a pipeline (used for storage) in conjunction with Seattle and WSDOT street projects. Completion by the Public Facilities District in 1999 of 60 percent of the Level 1 separation between Alaska Way and 3rd Ave. in conjunction with Safeco Field construction.	1994 & 1999	Remaining control will occur in 2026 under an RWSP project.
University Regulator Phase 1 and Densmore Drain	Separation of stormwater from northwest Seattle and parts of I-5, and the diversion of Green Lake outflow from the sewer. The Densmore drain was built to convey these flows to north Lake Union for discharge.	1994; improvements and upgrades completed in 2007 and 2008	Improvements to the hydraulics of the drain were completed in fall 2007 and functioned well over the wet season. Upgrades to the Densmore pumps were completed spring 2008. Remaining control will occur in 2016 under an RWSP project (University/Montlake CSO).
Harbor Pipeline	Installation of a pipeline to convey overflow from the Harbor Avenue Regulator Station to the West Seattle Tunnel for storage.	1996	The pipeline was put into operation in 2000–2001.
Alki Transfer/CSO Treatment	Transfer of flows up to 18.9 mgd from the Alki drainage basin to the West Point plant via the West Seattle Tunnel. Treatment of flows above 18.9 mgd at the Alki CSO plant.	Facilities online in1998; modifications completed in 1999 and 2005	Additional Alki CSO plant modifications were completed in 1999. In 2005, further modifications were made of the chlorine system and a dechlorination system was added.
63rd Ave. Pump Station	Diversion of overflows to the West Seattle Tunnel or Alki CSO plant.	Diversion completed in 1998; upgrades completed in 2008	Control strategy was upgraded in 2008 to smooth flow peaks at Alki. Hydraulic drive on inlet regulator gate to West Seattle Tunnel to be replaced in 2009
Denny Way/Lake Union CSO Control Project	Storage and primary treatment of Lake Union flows in the Mercer Tunnel, with screening, disinfection, and discharge at Elliott West.	2005	Major construction completed; see Section 1.3.2 for startup discussion. Ten years of post-construction sediment monitoring is being carried out. See Section 1.4.5.
Henderson/Norfolk CSO Control Project	Storage, primary treatment, and disinfection of Henderson and Martin Luther King flows in the Henderson Tunnel; transfer of flows to secondary treatment plants; discharge of excess treated CSOs at Norfolk.	2005	Major construction completed; see Section 1.3.2 for startup discussion.

Table 3. Completed Associated Projects

Project	Description	Completion Date	Status
Renton Sludge Force Main Decommissioning	Stopped pumping sludge to the Elliott Bay Interceptor for conveyance to the West Point plant after South plant developed solids management capability; the decommissioning decreased solids discharge from the Interbay Pump Station at Denny during CSOs.	1988	Completed.
Denny Sediment Remediation	Sediment remediation project	1991 and 2007	Capping completed in 1991. Ten-year data review of capping project completed in early 2007. Completed Interm cleanup of Areas A and B, replacing approximately 15,000 cubic yards of sediment in front of original discharge; a 10-year monitoring program began in April 2008. Ongoing evaluation of Areas C,D, and E.
Ballinger and York Pump Stations	Construction of two new pump stations to divert flows to and from the West Point collection system. Flows are currently diverted away from West Point in the wet season.	1992 (York); 1993 (Ballinger)	Completed.
West Point Treatment Plant Expansion	Increased plant hydraulic capacity from 325 to 440 mgd; enables conveyance and treatment of more flow from the combined system.	1995	Completed.
Allentown Diversion/ Southern Transfer	Designed to offset addition of Alki flows to the Elliott Bay Interceptor; resulted in significant volume reduction at Norfolk.	1995	Completed.
CSO Monitoring Program	*NPDES Overflow and Sediments:* Initial characterization monitoring to identify project priorities. *Sediment Baseline:* Sediment characterization to identify cleanup needs.	1995 and 1997	Completed.
CSO Water Quality Assessment of the Duwamish River and Elliott Bay	Complex study to determine the existing environment and the relative contribution of CSOs to pollution.	1999	Completed.
North Creek Pump Station	Diversion of flow away from West Point to the South plant collection system during wet weather.	1999	Completed.
Norfolk Sediment Remediation[a]	Source control, dredging, and capping.	1999	Capping completed in 1999. A 5-year post-construction monitoring program was completed in 2007.
Duwamish/Diagonal Sediment Remediation[a]	Source control, dredging, and capping.	2004	A 10-year monitoring program for recontamination potential is in progress.

[a] These projects were done under the Elliott Bay/Duwamish Restoration Panel (EBDRP) under the consent decree to settle the 1990 litigation by National Oceanic and Atmospheric Administration (NOAA) against the City of Seattle and King County (then Metro) for natural resource damages attributed to CSOs and storm drains. These are also identified as early action cleanups in the Lower Duwamish Superfund site.

1.3.2 New and Recent CSO Projects

CSO Treatment Technology Pilot

King County began a program in 2007 to identify and pilot test potential CSO treatment technologies to help determine the best technologies to control CSOs in the Lower Duwamish Waterway. After review of numerous treatment technologies, two technologies were recommended for pilot testing: chemically enhanced primary clarification (CEPC) and CEPC with lamella plates. These technologies are common options for clarifying drinking water and industrial process water.

The county held a workshop in December 2007 to share information and to hear stakeholder views about the technologies being considered and pollutants of concern. A work plan for the pilot project will be completed in fall 2008. The current schedule calls for pilot testing to occur in winter 2008.

The pilot testing will help determine efficiency, operating and design requirements, and feasibility of these technologies for use in CSO treatment. Information from the testing will be combined with other information available, such as the characteristics of other treatment technologies identified during previous pilot studies and analyses of operating CSO treatment facilities conducted by both King County and other jurisdictions.

Puget Sound Beach Projects

Four CSO control projects are currently in predesign: South Magnolia, North Beach, Barton Street, and Murray Avenue. These four projects are referred to as the Puget Sound Beach Projects. In January 2007, King County hired Carollo Engineers for the planning and predesign phase of the projects. Storage was identified in the RWSP as the method of control for these projects. An initial assessment, however, indicated that reducing upstream sources may be a cost-effective solution and now demand management options are also being evaluated.

Demand management reduces the amount of water that reaches a CSO location through a combination of upstream storage, stormwater reduction, and/or stormwater diversion. To support this evaluation, new flow meters were installed in December 2007 and were monitored through June 2008. The consultant will be using these data to calibrate a detailed hydrologic/hydraulic model of the basins. This model will be used to evaluate CSO control alternatives for each basin, including storing flows, conveying and treating flows, removing stormwater from the combined sewer system, treating CSO at the point of discharge to Puget Sound, and a combination of the alternatives.

King County will explore the use of green stormwater infrastructure as an alternative for CSO control in one of the basins. The most suitable basin will be identified in cooperation with the City of Seattle, and the feasibility and costs of the strategy will be assessed.

Community involvement meetings were held in all four project areas. Staff members attended meetings and briefed community groups and residents on the projects. Information pieces and a Web site (http://dnr.metrokc.gov/WTD/projects/cso/index.htm) were developed. Public comments are being tracked and will be used to involve stakeholders in future community meetings.

Predesign will continue through 2009 and end with issuance of facility plans in 2010. Construction is expected to begin in 2011 and to be substantially completed by 2013. Because CSO control facilities run intermittently, a reasonable and effective commissioning period is needed before a facility is considered fully operational. Depending on the alternatives selected for these projects, the commissioning period is expected to extend at least into the following NPDES permit cycle.

Ballard Siphon Replacement

The Ballard Siphon, built in 1935, consists of two woodstave siphon barrels that rest on the bottom of the Lake Washington Ship Canal. The siphon carries flows collected from Seattle's north end near Carkeek Park and from the Ballard area across the Ship Canal. From there, the flows are conveyed to the West Point Treatment Plant.

In November 2005, King County conducted a sonar inspection of the Ballard Siphon. The inspection showed spots of abnormalities in the integrity of the pipe. Since sonar inspections are a new technology, it is unclear how long the abnormalities had been present and how high the risk of failure. Subsequent analyses and inspections indicated that the anomalies were not threatening; however, replacing the siphon is continuing forward as a high priority project in order to maintain siphon integrity and function and because the project will yield CSO control benefits. The completed project will eliminate CSO events at the Ballard Regulator earlier than planned. It will also reduce overflows at 11th Avenue, likely reducing the scope of a future control project at this site. The Ballard Siphon project includes two major components: (1) slip-lining the existing woodstave siphon barrels to extend their useful life, and (2) tunneling an 84-inch-diameter pipe below the canal. Design is expected to be completed in 2008. Construction is expected to begin in 2009 and be substantially completed in late 2011.

Densmore Stormwater System Improvements

The Densmore stormwater system was built in 1994 to reduce CSOs at the University Regulator Station. It collects stormwater from the Haller Lake area and Green Lake drainage and collects outflow from Green Lake that had previously entered the combined sewer system. The Densmore stormwater pipeline runs from Green Lake to Lake Union. A pump station located near Green Lake discharges the stormwater to Lake Union just west of the I-5 bridge. In the event of pump failure, high-level weirs allow stormwater to discharge to the combined sewer to prevent damage to the pump station or to Green Lake park facilities.

The Densmore stormwater project has not resulted in the expected CSO reduction, mainly because of hydraulic, mechanical, and electrical problems. Hydraulic improvements were completed in October 2007 and appeared to function well over this wet season. The system will continue to be evaluated over the next several wet seasons to further improve CSO control.

Denny Way/Lake Union CSO Control Project

The Denny Way/Lake Union CSO control project consisted of the construction of several CSO facilities to store and treat CSOs from the county's Dexter Regulator and City of Seattle CSOs at Lake Union and to control the county's largest CSO at the Denny Regulator on Elliott Bay. Construction was completed in May 2005. The completed project is called the Mercer /Elliott West CSO Control System.

The project consisted of three major elements: the East Portal, which captures flow from a number of sewer lines in the South Lake Union area; the 14-foot-diameter Mercer Tunnel; and the Elliott West CSO Treatment Facility located on Elliott Bay. Two new CSO outfalls were built in Elliott Bay—one outfall to replace the outfall structure at the Denny Way Regulator and another outfall, including monitoring and dechlorination facilities, for the Elliott West CSO Treatment Facility. The Mercer Tunnel provides storage for up to 7.2 MG and primary clarification for all flows entering the tunnel. The Elliott West CSO Treatment Facility was designed to provide final treatment—screening, disinfection, and dechlorination—to flows that exceed the capacity of the tunnel. Such treatment was expected to occur about 14–20 times per year.

During the first three years of operating these CSO facilities, King County has faced several challenges. Such challenges are typical for large and complex CSO control systems. The seasonal and intermittent operation of these facilities prolongs the commissioning period.

A large hurdle to effective operation continues to be the substantial amount of dry-weather flows that enter the Mercer Tunnel from Seattle's East Lake Union system. These flows have been reducing the tunnel's storage capacity by 1–2 MG, causing pump damage and complicating treatment compliance. County investigations determined that extensive sedimentation in city sewers upstream of the tunnel were causing base flows to back up and overflow into the tunnel. After the city completed three extensive pipeline cleanings in 2006 and 2007, the volume of dry-weather flows to the tunnel was reduced but not resolved. Dry-weather flows into the tunnel resumed with the December 3, 2007, storm. As a result, the city and the county completed temporary weir modifications (stoplog installation) in July 2008 (Figure 2). Flows will be monitored during the next wet season to verify that the temporary modifications have worked. Meanwhile the city will continue to investigate its East Lake Union system for possible sources of sediments. If the sedimentation can be corrected, the weir will be returned to its original configuration.

Figure 2. Stoplog Installation at Valley Connection from East Lake Union

The large storm on December 2–4, 2007, severely challenged the system. Hydraulic constraints had been identified during the previous wet season and a consultant was hired in 2007 under an emergency waiver to assist the county in identifying solutions. Two recommendations had been implemented prior to this storm—the duckbill valve had been removed from the Elliott West outfall (March 2007) and the treated effluent flow was limited to 240 mgd. However, an effluent overflow occurred in Myrtle Edwards Park as a result of the storm. Construction began in September 2008 to implement recommended modifications to the dechlorination and transition structures. These modifications will raise the elevation of these structures and install new bisulfite mixing and sampling equipment to assist in meeting the chlorine discharge standards.

The consultant also recommended modifications to the sampling system at the Elliott West facility because a significant fraction of solids being captured and transported to West Point was not being measured. These modifications are scheduled to be completed in October 2008. Manual samples indicated that the facilities met the total suspended solids percent removal limit for the first time during this 2007–2008 wet season.

Disinfection continued to be a challenge. During the December storm the facility ran out of sodium bisulfite used for dechlorination. This loss triggered an automatic shutdown of chlorination to prevent discharge of high levels of chlorine, which resulted in a bacteria limit violation. The consultant recommended modifications to the chlorination system to increase capacity and the ability to control dosing rates. The contract for this work is expected to be advertised early in 2009. Another contract will be advertised in 2009 to restore landscaping and replace artwork disturbed by the construction of the dechlorination and transition facilities. A final report containing recommendations for additional improvements to the facility is expected in April 2009.

Although the Mercer/Elliott West facilities have not yet achieved complete CSO control, they are making substantial progress toward that goal. Treatment of Denny/Lake Union flows at Elliott West has improved. Of the 0.224 million pounds TSS coming to the facilities in 2007–2008, 65.4 percent were removed and the regulatory target of 50 percent removal was met. Substantial progress has also been made in controlling CSOs at the Denny and Dexter locations:

- Untreated overflows at the Denny Regulator decreased to one from a baseline of 32 events. Of the 350.33 MG of CSO that would have discharged in 2007–2008 from an uncontrolled Denny CSO into Elliott Bay, 37.8 percent was captured and received secondary treatment, 53.9 percent received primary treatment and some disinfection, and only 8.3 percent was discharged untreated. This represents a 97.7 percent reduction from pre-project levels.
- In the first two wet seasons, the Dexter Regulator continued to have frequent overflows but of much lower volume than before the facilities went online. Investigation identified needed programming changes to the gate controls. A new programmable logic controller was installed, and the program changes were made in August 2007. Untreated overflows were reduced from an average of 15 to 5 events this year. While the volume of untreated CSO discharges was higher than the baseline, 99.7 percent occurred during the December 3, 2007, storm. The second largest discharge was only 0.07 MG, suggesting that control may be acheived with additional refinement of the operating controls. This work is being scheduled.

King County is committed to completing the refinements to these facilities to achieve full control as quickly as possible. For additional information on the performance of the Mercer/Elliott West CSO Control Facilities, see Section 2.4.4 and Appendix C.

Henderson/Norfolk CSO Control Project

The Henderson/Norfolk CSO control project was implemented to control the Henderson and Martin Luther King (MLK) CSOs into Lake Washington and the Norfolk CSO into the Duwamish River. King County upgraded the Henderson Pump Station and constructed a large storage and treatment tunnel between Henderson Street and Norfolk Street in the Rainier Valley. The facilities were designed to provide primary clarification, chlorinate and dechlorinate flows that exceed the capacity of the storage and treatment tunnel, and discharge treated flows at the Norfolk CSO in the Duwamish Waterway. The design assumed that this discharge would occur approximately two to four times per year.

Base flows, settled solids, and stored flows from the tunnel are conveyed to the South plant at Renton or to the West Point plant, depending on capacity in the Elliott Bay Interceptor, for secondary treatment. The disinfection system has continued to require refinement. During 2007, control strategy changes were made to the hypochlorite pumps to better maintain proper dosing levels with changes in influent flow. This will help meet very low effluent chlorine limits while meeting effluent fecal coliform limit. Manual sample ports were installed on the effluent discharge structure just before the point of bisulfite addition. Measurement of the Cl2 residual prior to bisulfite addition helps the operator determine the proper dose range for the bisulfite dechlorination pumps.

The Henderson/Norfolk project was also completed in May 2005 but did not operate during its first season. Following adjustments made in 2006 to the influent gate control programming, the Henderson Tunnel began filling and treating CSO. During the 2007–2008 season, all of the CSO managed by this system received treatment, 15 percent received secondary treatment at South plant, and 85 percent received primary treatment and disinfection in the tunnel with discharge to the Duwamish Waterway. The treated discharge from the Henderson Tunnel to the Norfolk outfall was designated as the "one untreated discharge per year" for purposes of calculating solids limit performance; otherwise, no untreated discharges occurred at the three system outfalls (Henderson, MLK, and Norfolk).

For additional information on the performance of the Henderson/Norfolk CSO control facilities, see Section 2.4.5 and Appendix D.

1.3.3 Future CSO Projects

Table 4 lists future CSO control projects included in the *2008 CSO Control Plan Update*. The table includes a brief description of the facilities to be constructed and a projected completion date. Five other projects that were in the RWSP are not listed because they are either under way (Puget Sound Beach projects) or have been eliminated because monitoring and modeling data indicate that they are already controlled (SW Alaska Street CSO).

Table 4. RWSP CSO Control Projects

CSO Project	Project Description	Year Controlled
University/Montlake	7.5-MG storage tank	2015
Hanford #2	3.3-MG storage and treatment tank	2017
West Point Treatment Plant improvements	Primary and secondary enhancements	2018
Lander St.	1.5-MG storage/treatment at Hanford	2019
Michigan	2.2-MG storage and treatment tank	2022
Brandon St.	0.8-MG storage and treatment tank	2022
Chelan Ave.	4.0-MG storage tank	2024
Connecticut St.	2.1-MG storage and treatment tank	2026
King St.	Conveyance to Connecticut St. treatment	2026
Hanford at Rainier Ave.	0.6-MG storage tank	2026
8th Ave. S	1.0-MG storage tank	2027
West Michigan	Conveyance upgrade	2027
Terminal 115	0.5-MG storage tank	2027
3rd Ave. W	5.5-MG storage tank	2029
Ballard	1.0-MG storage tank (40 percent King County)	2029
11th Ave. NW	2.0-MG storage tank	2030

1.4 Ongoing CSO Program Elements

1.4.1 SCADA (CATAD) System Modifications

Supervisory Control and Data Acquisition (SCADA), formerly called CATAD (Computer Augmented Treatment and Disposal System), controls the West Point Treatment Plant collection system.

Projects to enhance the use of storage capacity in existing sewers are part of ongoing improvements to the SCADA system. In 1992, storage levels behind regulator stations were raised to improve capture of CSO. Currently, a modified CSO drawdown strategy is being employed at the Interbay Pump Station. This strategy provides storage capacity in the upper portion of the Elliott Bay interceptor (EBI) for as long as possible. The available storage will be used when flow exceeds the allowed flow through the pump station.

SCADA computer hardware and software at West Point was replaced with a new system in May 2004 to bolster the reliability of monitoring and control of offsite regulator and pump stations. The system was subsequently tested and refined. QA/QC work was performed on input values, error checking routines were implemented for the sensors, and new flow calculations were added

to estimate flows from new CSO facilities. Efforts are under way to improve the calibration of King County's model of the West Point system. Following these efforts, control strategies will be developed and tested to further minimize CSOs in the system.

1.4.2 System Maintenance and Upgrades

The following work was completed this year to improve performance at county CSO locations:

- Electrical and control system (PLC) upgrades were completed at Belvoir (July 2007), 30th Avenue (September 2007), East Marginal (December 2007), and West Marginal (June 2008) Pump Stations.
- Bubblers were repaired or replaced at Lake Ballinger Pump Station (August 2008), Lake City Regulator Station (August 2008), and Brandon Regulator Station (August 2008).
- Repairs were made to the Montlake Regulator Station's bubbler. Review has revealed some possible inccuracies in the data collected.[3] No overflow was measured during the large December 2007 storm, as would have been expected, but later overflows in the season were measured. Further investigation and a review of maintance records is under way to determine if modifications were made between these events. The position of the regulator gate would indicate that the Montlake did overflow during the December storm, but the overflow volume cannot be determined.
- Permanent emergency generators are being installed at all pump stations. A generator was installed at Kenmore Pump Station in 2007–2008. Installation at the Barton and Murray Pump Stations is currently in design.

1.4.3 CSO Notification and Posting Program

The King County Department of Natural Resources and Parks, Public Health–Seattle & King County, and Seattle Public Utilities jointly developed and are implementing a CSO Notification and Posting Program. Ecology approved the program as meeting state and federal requirements for public notification and providing information to the community regarding the possible health impacts of CSOs. Public notification is one of EPA's Nine Minimum Controls. The county's program has evolved so that it can integrate better with other public information and involvement programs. The current program includes the following elements:

- Outreach and education through an integrated program that addresses CSO control planning and updates, control projects, public notification, special projects (such as sediment remediations and technology pilots), and general wastewater management and water quality topics. Program activities include workshops, open houses, brochures, mailings, briefings, meetings, and treatment plant tours.
- Communication of status and projects through an informative county CSO Web site that contains data, reports, and links to related information and contacts.

[3] The 2006–2007 CSO control program annual report described data evaluation and repair needs of the Montlake Regulator's bubbler.

- Maintenance of signage at all publicly accessible CSO sites. The warning signs include a graphic and description of a CSO, the information phone number, and a CSO number assigned to each site that corresponds to its NPDES discharge serial number.
- Continued funding of Public Health–Seattle & King County to provide a Web site covering CSO-related public health information, brochures on CSO risks and precautions, business and group CSO educational visits, and a CSO information telephone line.

The recently modified NPDES permit for West Point required the county to conduct a study to determine the feasibility of providing more immediate notification of overflows, including the feasibility of providing a Web-based system. Technology upgrades to the West Point SCADA system now allow for provision of "real time" overflow information on the Internet. This system was implemented in December 2007 (http://dnr.metrokc.gov/wtd/cso/status.htm) and has received between 50 and 200 discrete visitor sessions each month. More detail on this program, the alternatives considered, other agency approaches, and public involvement is provided in the *Final Public Notification Feasibility Study*, submitted to Ecology on July 1, 2007. The report can be accessed on the county's CSO Control Program Web site (http://dnr.metrokc.gov/wtd/cso/library.htm).

1.4.4 Lander and Densmore Stormwater Management Program

King County and the City of Seattle jointly manage stormwater discharges in the Lander and Densmore drainage basins that occur as the result of county sewer separation projects. This ongoing management program includes Densmore-specific requirements under the NPDES municipal stormwater permit. Program elements include source control, baseline sampling of stormwater discharges, and inspections. As specified in a local agreement between the city and county, the city maintains the stormwater system and manages any necessary source control enforcement actions.

The Lander stormwater system was built in 1992 to reduce CSOs at the Lander Regulator Station. A new wastewater sewer was built, and the original pipeline was cleaned and converted to a storm drain. A low-flow diversion of stormwater to the Elliott Bay Interceptor was included to capture any first flush of pollutants during rain. In 2008, the county verified that this diversion is not operationing because programming was lost during offsite SCADA upgrades. The programming will be restored after higher priority site programming is completed, anticipated for completion by third quarter 2009. The first-flush stormwater and remaining Lander CSO discharge share the same city-owned outfall to the Duwamish River East Waterway.

1.4.5 Sediment Management

Denny Way Post-CSO Control Project Sediment Monitoring

A 10-year post-control sediment sampling program began in 2006 near the outfall for the new Elliott West CSO Treatment Facility. Surface sediment samples from 16 stations are being collected and analyzed for sediment chemistry and benthic infauna. Monitoring the sediment near the new outfall was part of the requirements for the Section 7 Endangered Species Act consultation for the U.S. Army Corps of Engineers permit.

Denny Way Phase 2 (A&B areas) Sediment Remediation

Under an Agreed Order with Ecology, King County dredged approximately 15,000 cubic yards of contaminated sediments in front of the old Denny Way CSO outfall. After dredging, the shoreline and tideland area was restored for ecological health of salmonids.

A 10-year monitoring program, started in April 2008, is evaluating additional areas further offshore with sediments exceeding sediment management standards. After five years of monitoring, alternatives for cleaning up additional areas will be evaluated with Ecology and other stakeholders.

Lower Duwamish Waterway Superfund Assessments and Remediations

In 2000, EPA declared an area of the Duwamish Waterway from the south end of Harbor Island to the Turning Basin as a Superfund site. King County, City of Seattle, Port of Seattle, and The Boeing Company formed a working group to complete early action cleanups at several locations in the area and complete the work necessary to determine the final Superfund cleanup of the waterway. The site risk assessments are complete and the draft remedial investigation report is out for public review. Some key findings are as follows:

- The waterway contains a diverse assemblage of aquatic and wildlife species and a robust food web that includes top predators.
- Much of the sediment contamination resulted from historical releases that are now generally buried under cleaner more recently deposited sediment. Almost all new sediment that enters the waterway comes from the Green River.
- In general, high concentrations of chemicals, including PCBs, were detected in surface sediment in localized areas—frequently called "hot spots"—separated by larger areas of the Lower Duwamish Waterway with lower concentrations. Relatively high surface sediment contamination is present in some areas as a result of a number of processes, including low net sedimentation rates in a few areas with primarily historical contamination or because of the presence of ongoing localized sources.
- The highest risks to people are associated with consumption of fish, crabs, and clams, with lower risks associated with activities that involve direct contact with sediment, such as clamming, beach play, and netfishing.
- Most of the human health risk is from PCBs, arsenic, cPAHs, and dioxins and furans.
- Ecological risks to fish and wildlife were relatively low, with the exception of risks to river otter from PCBs.
- Sediment contamination in approximately 75 percent of the Lower Duwamish Waterway is estimated to have no effect on the benthic invertebrate community; approximately 7 percent of the surface sediment has chemical concentrations exceeding the higher of the two state standards associated with potential adverse effects to the benthic invertebrate community. The potential for effects in the remaining 18 percent of the Lower Duwamish Waterway is more uncertain. Most of the state sediment standard exceedances were for PCBs and phthalates, although 41 different chemicals had at least one exceedance.

The draft remedial investigation report included two recommendations in its key findings:

- The control of local sources of toxics is critical to the long-term success of specific remedial actions in the Lower Duwamish Waterway.
- Continued coordination of cleanup actions and source control will be necessary to ensure that any actions taken are not unduly impacted by local sources.

King County has completed two early action cleanups in front of King County CSOs (Norfolk and Duwamish/Diagonal). Monitoring programs are under way at both locations. Design is complete for the cleanup of Slip 4 (in cooperation with the City of Seattle). Cleanup of Slip 4 is on hold while Ecology completes source control actions at North Boeing Field that threaten recontamination of the cleanup site.

Duwamish East Waterway Superfund Sediment Assessment and Remediation

In 2006, King County, City of Seattle, and Port of Seattle formed a working group to complete the work necessary to determine the final Superfund cleanup of the East Waterway of the Duwamish River. EPA approved the scope of the remedial investigation/feasibility study in spring 2007, and work has started. The Hanford/Lander CSOs are part of the East Waterway cleanup. Removal of approximately 20,000 cubic yards of sediment in front of the Lander CSO will occur in winter 2008–2009.

Section 2

Summary of CSO Volumes and Frequencies

King County monitors rainfall and the frequencies and volumes of both untreated and treated CSOs at its regulator and pump stations and treatment facilities in the Seattle area. This section presents the results of this monitoring for the 2007–2008 CSO year.

In summary, the annual rainfall for the reporting period was 30.95 inches as an average over local rain gauges. King County had 87 untreated CSO discharges for a total of approximately 815 MG of CSO. The West Point Treatment Plant, the Carkeek and Alki CSO Treatment Plants, and the Elliott West and Henderson/Norfolk CSO Treatment Facilities discharged approximately 550 MG of treated CSOs.

Despite below average rainfall over the year, an intense period of heavy rainfall created significant challenges for the region. December 3, 2007, brought 3.77 inches of rain for the day at SeaTac, the second highest total on record in the past 50 years. Average rainfall at gauges in the Seattle area was slightly higher at 4.10 inches, with some gauges recording as much as 4.50 inches in a 24-hour period. The amount and intensity of rainfall during this storm overwhelmed most of the system. CSOs during this storm accounted for more than 96 percent of the total CSO volume discharged over the year (Figure 3).

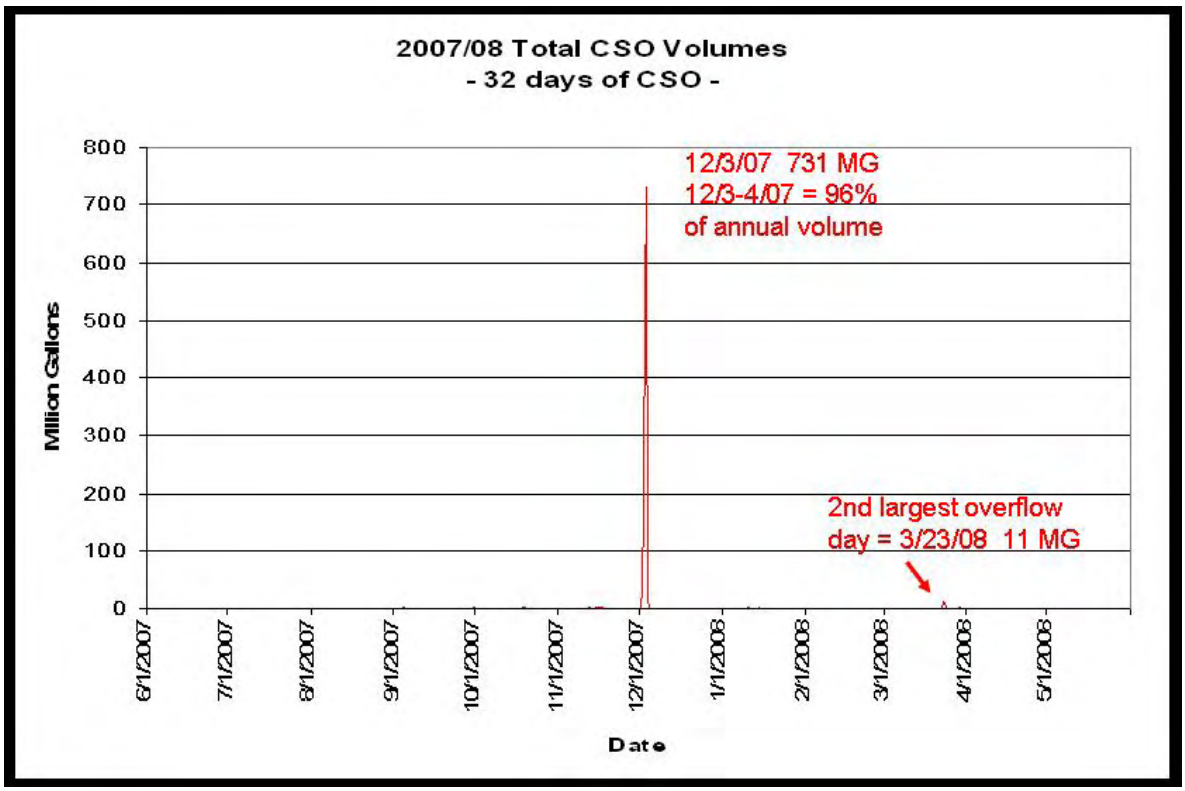

Figure 3. Daily Untreated CSO Volumes, June 2007–May 2008

Overall King County's system performed as expected during this major storm. Emergency response procedures were employed during the event, and lessons learned from past events helped to better manage system flows, improve communication, and ensure that appropriate personnel were available to respond. Examples of impacts and system responses to the storm are as follows:

- Flows to the West Point Treatment Plant were controlled at the Interbay, Duwamish, and West Seattle Pump Stations. Flow through West Point peaked at 475 mgd on the morning of December 3, and the plant sustained damaged to the primary clarifier flights.
- Flow from the Mercer/Elliott West CSO facilities was limited to 240 mgd, but this was still too much flow for the system during high tide. Overflows occurred from manholes in the plaza near Myrtle Edwards Park.
- The Carkeek CSO Treatment Plant was flooded by Pipers Creek on December 3 (Figure 4). Creek water entered the plant's primary tankage and flowed out onto the street and out the gate. The plant continued to operate at maximum capacity for most of the day. Creek flows adversely impacted permit limit compliance, in particular causing a violation of the setteable solids limit for the plant.
- Large CSO discharges occurred at the University (191 MG versus an annual baseline of 126 MG) and at the Murray (107.4 MG versus an annual baseline of 6 MG) CSO outfalls. No operational problems or issues could be identified. These volumes appear reflect the large and intense rainfall, particularly in the area north of the combined area. The system allowed more discharge of combined flows at University in order to give priority to the separate system flows entering the system above the Matthews Park Pump Station.

Figure 4. Pipers Creek Overflowing into Carkeek CSO Plant on December 3, 2007.

2.1 Dry-Weather Overflows

Overflows from CSO structures that are not primarily caused by rainfall are called dry-weather overflows (DWOs). In King County's system, DWOs usually result from mechanical failures, power outages, or occasional human error. Under EPA's Nine Minimum Controls, DWOs are to be prevented. King County's facility inspection and preventive maintenance activities and its program to provide backup generators at all CSO facilities work to prevent DWOs from occurring. Table 5 provides information on the DWOs that occurred during the 2007–2008 wet season.

Table 5. Dry Weather Overflow Events, June 2007–May 2008

Date	Location	Estimated Volume	Estimated Duration	Receiving Water	Cause and Resolution
July 2, 2007	Murray Pump Station	1,000 gallons	~10 minutes	Puget Sound	Seattle City Light power failure; a moble generator was started and worked until power was restored.
May13–23, 2008	Ravenna Drop Structure	Approximately 6.4 MG	10 days	Ravenna Creek and Union Bay	See text.

On May 13, 2008, King County diverted sewer flows at the Ravenna Drop Structure in order to facilitate repair of a bubbler downstream in the Lake City Tunnel. WTD records indicated that this diversion would send wastewater flows to the Laurelhurst Trunk. Seattle Public Utilities notified the county on May 23 that they had noticed unusual flows in their nearby storm drain system for about 10 days. Inspection determined that wastewater had been inadvertently sent into Ravenna Creek, which discharges into Union Bay. King County crews redirected the flows back to the Lake City Tunnel, initiated an Overflow Report to notify appropriate agencies, posted warning signs and took water quality samples. For the next several days King County cleaned up debris from the creek and used absorbent materials to take up oils and residue. The immediate response is being followed by a remediation effort in coordination with Washington State Fish and Wildlife and the University of Washington.

The county later determined that documents (manuals, drawings, and as-builts) used to locate wastewater pipes had not been updated at the completion of a project in 2004 to daylight Ravenna Creek and remove its flows from the combined sewer. To prevent such overflows in the future, the county has accelerated an existing project to update these documents and has developed a new standard operating procedure to confirm diversions.

Review of the stream diversion project has identified that it may have inadvertently created an overflow point to the creek. Overflows may have been occurring during extreme storms since 2004. The county is working with Ecology, Seattle Public Utilities, Seattle Parks, and State Fish and Wildlife to identify near-term and permanent solutions.

2.2 Annual Rainfall

As shown in Table 6, rainfall measured for the 2007–2008 CSO year was 30.95 inches as an average over local rain gauges; this average is below the baseline average of 37 inches per year. Although rain gauge maintenance and calibration have improved, problems occurred with gauges at Ballard, Chelan, and East Marginal. Rainfall for these stations, therefore, is not included in the table.

Table 6. Rainfall at Pump and Regulator Stations, June 2007–May 2008 (in inches)

Station	2007							2008					Total
	June	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
Denny Way Lake Union	0.62	1.05	0.54	1.7	1.71	2.27	8.01	3.45	0.9	3.64	1.64	0.42	25.95
Denny Way Local	0.89	1.29	0.01	1.52	2.41	2.86	9.88	4.61	1.33	3.98	2.15	0.69	31.62
Kenmore	1.27	1.79	1.1	2.51	2.94	3.19	9.77	3.95	1.49	3.41	2.98	1.1	35.5
King Street	0.61	0.97	0.65	2.12	1.72	2.5	8.12	2.52	0.69	3.59	1.49	0.62	25.6
Matthews Park	1.03	1.55	1.08	1.74	2.58	2.82	9.58	4.34	1.55	3.68	2.95	1.04	33.94
Pine Street, E.	1.09	1.24	0.81	2.04	2.28	2.62	8.53	3.64	1.46	3.94	1.8	0.66	30.11
Rainier Avenue	0.97	1.32	1.24	2.12	2.26	2.84	8.56	3.75	1.22	4.34	1.5	0.88	31
University	0.79	1.39	0.86	2.3	2.72	2.76	10	4.77	1.41	4.13	2.03	0.72	33.88
Average	0.91	1.33	0.79	2.01	2.33	2.73	9.06	3.88	1.26	3.84	2.07	0.77	30.95

Note: Data for Ballard, Chelan, and East Marginal are not included becaure of rain gauge problems at these locations.

2.3 Annual Untreated CSO Events

Figure 1 in the Executive Summary shows the locations of existing permitted King County CSO discharges and the discharge serial numbers (DSNs) used in Tables 8 and 9 below.

West Point's SCADA system monitors the volume and frequency of CSOs at regulator and pump stations and makes operating adjustments in response to the monitoring. The county looks at the combined system area as four service areas: (1) the South Service Area (south of the Ship Canal), (2) the North Service Area (north of the Ship Canal including the Montlake and Dexter Regulator Stations), (3) the Alki Service Area, and (4) the Henderson Service Area. The South, North, and Alki areas drain to West Point; the Henderson area drains primarily to the South Treatment Plant at Renton

Portable flow meters are deployed at seven CSO locations not currently monitored by SCADA: 11th Avenue NW, SW Alaska Street, Hanford at Rainier, South Magnolia, North Beach Pump

Station, West Duwamish Siphon, and Terminal 115. Portable meters also supplement SCADA in a few locations.

2.3.1 Untreated CSO Volumes

Overflows that occurred during precipitation and were exacerbated by power outages, mechanical failure, or human error in the 2007–2008 CSO year are listed in Table 7. King County is implementing an aggressive program to place permanent emergency generators at all pump stations, and continually seeks to improve maintenance practices.

Table 7. CSOs Exacerbated by Non-Precipitation Events, June 2007–May 2008

Dates	Location	Estimated Volume	Estimated Duration	Receiving Water	Cause & Resolution
December 3–4, 2007	Duwamish Pump Station	6.3 MG	2 hours	Duwamish	Additional flow volume because the station was down for one 36-minute period and one 1.5-hour period; these were periods when the third pump was to turn on but station gates did not respond as expected.

As shown in Table 8, the total volume of untreated CSOs for 2007–2008 was 815.62 MG (396.72 MG in the South Service Area; 298.01 MG in the North Service Area; and 120.88 MG in the Alki Service Area). The 815.62 MG total represents a 65.2 percent reduction over the 1981–1983 baseline of 2,339 MG.

Figure 5 illustrates the progress King County has made in CSO volume reduction as compared to total annual rainfall over time. A simple statistical trend line has been added to illustrate control progress. While a somewhat reasonable relationship between total rainfall and total CSO volume can be computed, large and/or intense storms can dramatically impact CSO volume, representing most of the year's CSO volume. This impact was evident in 2007–2008 when approximately 96 percent of the annual overflow volume was related to the December 2–4 storm.

Replacement portable monitors were installed at the Hanford at Rainier site in mid December 2008 after access previously blocked by Sound Transit construction was restored. The new monitors provided reliable monitoring. The trunk level sensor at Brandon was not operating properly during the 2007–2008 CSO year and was repaired in August 2008. King County is developing a computer program that will automatically review overflow data for anomalies so that repair can occur more quickly and data loss can be minimized.

The CSO volume at the South Magnolia location remained significantly higher than the calculated baseline. Recent inspections of the downstream line found no obstructions, so it is assumed that modifications to the hydrobrake in the upstream City of Seattle system have resulted in the conveyance of much more combined flow to South Magnolia. The city has restored the hydrobrake to its proper function, and the county will recalculate the baseline to represent these corrections. The increased overflow will be managed by the control project currently in predesign.

Table 8. Untreated CSO Volume Summary, June 2007–May 2008 (in million gallons)

Station	DSN	Service Area	2007							2008					2007-2008 Total	1981–1983 Baseline [a]
			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		
11th Ave. NW [b]	004	North	0	0	0	0	0.56	0.15	21.40	0.04	0	0.06	0.02	0	22.22	
30th Ave. NE	049	North	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
3rd Ave. W	008	North	0	0	0	0	0	0	41.90	0	0	0	0	0	41.90	106
53rd Ave. SW	053	Alki	0	0	0	0	0	0	1.27	0	0	0	0	0	1.27	<1
63rd Ave. PS	054	Alki	0	0	0	0	0	0	0	0	0	0	0	0	0	10
8th Ave. S/ W. Marginal Way	040	South	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Alaska St., SW [b]	055	Alki	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Ballard	003	North	0	0	0	0	0	0	0.91	0	0	0	0	0	0.91	95
Barton St.	057	Alki	0	0	0	0	0	0	12.21	0	0	0	0	0	12.21	8
Belvoir	012	North	0	0	0	0	0	0	4.09	0	0	0	0	0	4.09	<1
Brandon St. [c]	041	South	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	64
Canal St.	007	North	0	0	0	0	0	0	1.02	0	0	0	0	0	1.02	1
Chelan Ave.	036	South	0	0	0	0	0	0	4.45	0	0	0	0	0	4.45	61
Denny Reg.	027a	South	0	0	0	0	0	0	29.07	0	0	0	0	0	29.07	502
Dexter	009	North	0	0	0	0.07	0.01	0	28.40	0	0	0	0	0	28.48	24
Duwamish PS, W. [b]	035	South	0	0	0	0	0	0	6.27	0	0	0	0	0	6.27	<1
Duwamish PS, E.	034	South	0	0	0	0	0	0	10.10	0	0	0	0	0	10.10	
Hanford (total)	031/2	South	0	0	0	3.58	0	2.80	35.64	0.73	0	2.90	0	0	>45.65	644
Hanford #1 (Hanford at Rainier) [b,d]			*NM*	*NM*	*NM*	*NM*	*NM*	*NM*	*PD*	*0*	*0*	*1.11*	*0*	*0*	*>1.11*	
Hanford #2			*0*	*0*	*0*	*3.58*	*0*	*2.80*	*35.64*	*0.73*	*0*	*1.79*	*0*	*0*	*44.55*	
Harbor Ave.	037	South	0	0	0	0	0	0	27.41	0	0	0	0	0	27.41	36
Henderson	045	South	0	0	0	0	0	0	0	0	0	0	0	0	0	15
King Street	028	South	0	0	0	0.20	0	0	18.01	0	0	0.49	0	0	18.70	55
Kingdome	029	South	0	0	0	0	0	0	27.62	0	0	0	0	0	27.62	90
Lander St.	030	South	0	0	0	0	0	0.34	65.48	1.43	0	9.64	0	0	76.89	143
Magnolia, S. [b]	006	South	0	0	0	0.99	1.24	3.14	37.10	2.51	0	2.13	0	0	47.11	14
Marginal Way, E.	043	South	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Matthews Park	018	North	0	0	0	0	0	0	0	0	0	0	0	0	0	<1

Station	DSN	Service Area	2007							2008					2007-2008 Total	1981–1983 Baseline [a]
			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		
Michigan	039	South	0	0	0	0.04	0	0	95.99	0	0	0	0	0	96.03	190
Michigan, W.	042	South	0	0	0	0	0	0	2.70	0	0	0	0	0	2.70	2
Martin Luther King, Jr,. Way	013	South	0	0	0	0	0	0	0	0	0	0	0	0	0	60
Montlake[f]	014	North	0	0	0	0	0	0	0	0	0	0	0	0	0	32
Murray Ave.	056	Alki	0	0	0	0	0	0	107.40	0	0	0	0	0	107.40	6
Norfolk St.	044	South	0	0	0	0	0	0	0	0	0	0	0	0	0	39
North Beach [b, e]	048a	North	0	0	0	0	0	0	7.26	0	0	0	0	0	7.26	6
North Beach [b, e]	048b	North	0	0	0	0	0	0	0.53	0	0	0	0	0	0.53	0
Pine, E St.	011	North	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Rainier Ave.	033	South	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Terminal 115 [b]	038	South	0	0	0	0	0	0	4.73	0	0	0	0	0	4.73	2
University	015	North	0	0	0	0	0.57	0	191.03	0	0	0	0	0	191.60	126
Approximate Total			0.00	0.00	0.00	4.88	2.39	6.43	781.28	4.70	0.00	15.22	0.02	0.00	814.92	2,339
2007–2008 Rainfall Average (baseline is historical average in inches)			0.91	1.33	0.79	2.01	2.33	2.73	9.06	3.88	1.26	3.84	2.07	0.77	30.95	37

NM = not monitored.
PD = partial data.

[a] Baselines for CSO volumes will occasionally be revised as improvements are made to the computer modeling system to provide more accurate projections on historical and future conditions.
[b] Portable flow meters; not currently monitored by SCADA.
[c] The Brandon trunk level sensor was not operating properly. Repair occurred August 2008. Overflows were not calculated for this site.
[d] Access to the overflow structure and meters was restored in December following Sound Transit construction completion.
[e] The North Beach Pump Station has two outfalls. A 16-inch-diameter outfall (48b) from the wet well and a 30-inch-diameter (48a) outfall from the inlet trunk. The 30-inch-diameter outfall discharges on the beach, and the 16-inch-diameter outfall discharges farther out in Puget Sound. The baseline value is for both outfalls combined.
[f] Montlake did not record an overflow during the December 2-4 storm, but gate position suggests an overflow probably occurred. See Section 1.4.2 for details.

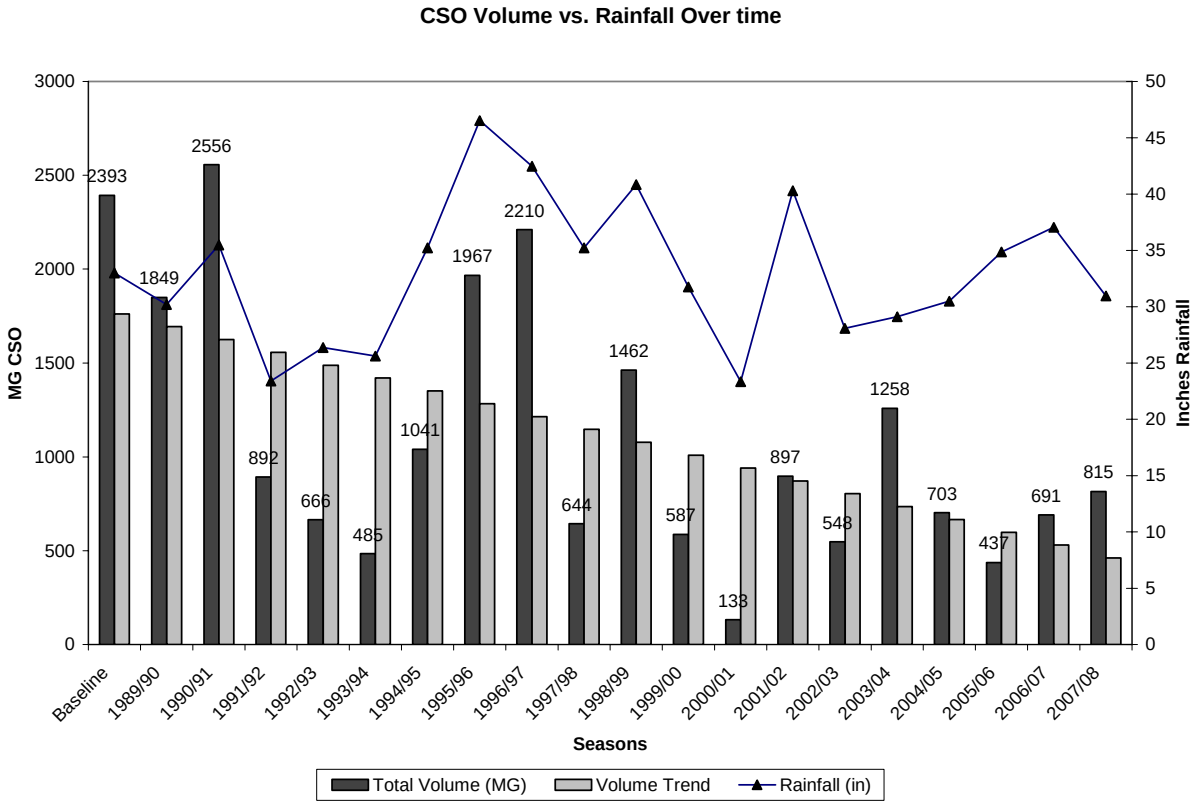

Figure 5. Annual CSO Volume versus Total Rainfall (1989 through 2008)

2.3.2 Untreated CSO Frequencies

As shown in Table 9, there were a total of 87 untreated CSO events in 2007–2008 (58 events in the South Service Area; 25 events in the North Service Area; and 4 events in the Alki Service Area). The total of 87 untreated CSO events represents an 81.5 percent reduction in frequency over the 1981–1983 baseline of 471 events.

Table 9. Untreated CSO Event Frequency Summary, June 2007–May 2008 (based on a 24-hour inter-event interval)

Station	DSN	Service Area	2007							2008					2007–2008 Total	1981–1983 Baseline [a]
			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		
11th Ave. NW [b]	004	North	0	0	0	0	1	2	1	1	0	1	1	0	7	16
30th Ave. NE	049	North	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
3rd Ave. W.	008	North	0	0	0	0	0	0	1	0	0	0	0	0	1	17
53rd Ave. SW	052	Alki	0	0	0	0	0	0	1	0	0	0	0	0	1	<1
63rd Ave. PS	054	Alki	0	0	0	0	0	0	0	0	0	0	0	0	0	2
8th Ave./W. Marginal Way	040	South	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Alaska St. SW [b]	055	Alki	0	0	0	0	0	0	1	0	0	0	0	0	1	1
Ballard	003	North	0	0	0	0	1	0	1	0	0	0	0	0	2	13
Barton	057	Alki	0	0	0	0	0	0	1	0	0	0	0	0	1	9
Belvoir	012	North	0	0	0	0	0	0	1	0	0	0	0	0	1	<1
Brandon St. [c]	041	South	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	36
Canal St.	007	North	0	0	0	0	0	0	1	0	0	0	0	0	1	<1
Chelan	036	South	0	0	0	0	0	0	1	0	0	0	0	0	1	7
Denny Reg.	027a	South	0	0	0	0	0	0	1	0	0	0	0	0	1	32
Dexter	009	North	0	0	0	1	1	1	1	0	0	1	0	0	5	15
Duwamish PS, W. [b]	034	South	0	0	0	0	0	0	1	0	0	0	0	0	1	<1
Duwamish PS, E.	035	South	0	0	0	0	0	0	1	0	0	0	0	0	1	<1
Hanford (total)	031/2	South	0	0	0	2	0	3	2	2	0	4	0	0	>13	58
Hanford #1 (Hanford at Rainier) [b,d]			*NM*	*NM*	*NM*	*NM*	*NM*	*NM*	*PD*	*1*	*0*	*2*	*0*	*0*	*>3*	*30*
Hanford #2			*0*	*0*	*0*	*2*	*0*	*3*	*2*	*1*	*0*	*2*	*0*	*0*	*10*	*28*
Harbor Ave.	037	South	0	0	0	0	0	0	1	0	0	0	0	0	1	30
Henderson	045	South	0	0	0	0	0	0	0	0	0	0	0	0	0	12
King Street	028	South	0	0	0	1	0	0	1	0	0	2	0	0	4	16
Kingdome	029	South	0	0	0	0	0	0	1	0	0	0	0	0	1	29
Lander II St.	030	South	0	0	0	1	0	2	1	1	0	2	0	0	7	26
Magnolia, S. [b]	006	South	0	0	0	2	3	4	5	5	0	4	0	0	23	25
Marginal, E.	043	South	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Matthews Park	018	North	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Michigan St.	039	South	0	0	0	1	0	0	1	0	0	1	0	0	3	34

Station	DSN	Service Area	2007							2008					2007–2008 Total	1981–1983 Baseline [a]
			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May		
Michigan, W.	042	South	0	0	0	0	0	0	1	0	0	0	0	0	1	5
Martin Luther King, Jr., Way	013	South	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Montlake [f]	014	North	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Murray Ave.	056	Alki	0	0	0	0	0	0	1	0	0	0	0	0	1	5
Norfolk St.	044	South	0	0	0	0	0	0	0	0	0	0	0	0	0	20
North Beach Inlet [b, c]	048a	North	0	0	0	0	0	0	1	0	0	0	0	0	1	18
North Beach Wet Well [b, c]	048b	North	0	0	1	0	1	1	1	0	0	0	1	0	5	18
Pine, E St.	011	North	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Rainier Ave.	033	South	0	0	0	0	0	0	0	0	0	0	0	0	0	<1
Terminal 115 [b]	038	South	0	0	0	0	0	0	1	0	0	0	0	0	1	4
University	015	North	0	0	0	0	1	0	1	0	0	0	0	0	2	13
Approximate Total			0	0	1	8	8	13	31	9	0	15	2	0	87	489.0
2007-2008 Rainfall Average (baseline is historical average in inches)			0.91	1.33	0.79	2.01	2.33	2.73	9.06	3.88	1.26	3.84	2.07	0.77	30.95	**37**

NM = not monitored.
PD = partial data.

[a] Baselines for CSO volumes will occasionally be revised as improvements are made to the computer modeling system to provide more accurate projections on historical and future conditions.
[b] Portable flow meters; not currently monitored by SCADA.
[c] The Brandon trunk level sensor was not operating properly. Repair occurred August 2008. Overflows were not calculated for this site.
[d] Access to the overflow structure and meters was restored in December following Sound Transit construction completion.
[e] The North Beach Pump Station has two outfalls. A 16-inch-diameter outfall (48b) from the wet well and a 30-inch-diameter (48a) outfall from the inlet trunk. The 30-inch-diameter outfall discharges on the beach, and the 16-inch-diameter outfall discharges farther out in Puget Sound. The baseline value is for both outfalls combined.
[f] Montlake did not record an overflow during the December 2-4 storm, but gate position suggests an overflow probably occurred. See Section 1.4.2 for details.

The modified West Point NPDES permit requires that the county provide the five-year moving average of untreated CSOs at controlled facilities, identified in the permit as the Carkeek CSO Treatment Plant, Alki CSO Treatment Plant, Elliott West CSO Control Facilities, and Henderson/Norfolk CSO Control Facilities. In practice all discharges at these plants receive some treatment, but one discharge may be designated as the "one untreated discharge per year" for the solids limits calculations. The details of these events are provided in the CSO plant annual reports found in Appendices A–D. All four plants had an average of one or less designated "untreated" discharge during this permit cycle.

2.4 Annual Treated CSO Events

Tables 10 and 11 provide information on the volume and frequency of treated CSOs discharged from the West Point Treatment Plant, Alki and Carkeek CSO Treatment Plants, and the Elliott West and Henderson/Norfolk CSO Treatment Facilities—the King County facilities that provide primary treatment of CSOs. The text that follows the tables provides detail on the data. King County holds traning in CSO plant operation and reporting before the start of each wet season.

Table 10. Treated CSO Volumes by Month, June 2007–May 2008 (in million gallons)

CSO Facility	June 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08	Total
Alki plant	0	0	0	0	0	0	77.8	0	0	0	0	0	77.8
Carkeek plant	0	0	0	0	0	0	35.63[a]	0	0	0	0	0	35.63
Elliott West	0	0	0	0	0	1.02	184.75	0	0	2.96	0	0	188.73
Henderson/ Norfolk	0	0	0	0	0	0	19.8	0	0	0	0	0	19.8
West Point CSO process	0	0	0	10.18	3.45	15.84	179.32	12.72	0.53	6.18	0	0	228.22
Total Treated	0	0	0	10.18	3.45	16.86	497.3	12.72	0.53	9.14	0	0	550.18

[a] Volume reflects flooding of Pipers Creek into the plant

Table 11. Treated CSO Frequency by Month, June 2007–May 2008 (events or days)[a]

CSO Facility	Jun 07	Jul 07	Aug 07	Sep 07	Oct 07	Nov 07	Dec 07	Jan 08	Feb 08	Mar 08	Apr 08	May 08	Total
Alki plant (events)	0	0	0	0	0	0	1	0	0	0	0	0	1
Carkeek plant (events)	0	0	0	0	0	0	1	0	0	0	0	0	1
Elliott West (events)	o	0	0	0	0	1	1	0	0	1	0	0	3
Henderson/Norfolk (events)	0	0	0	0	0	0	1	0	0	0	0	0	1
West Point CSO process (days)	0	0	0	2	2	2	5	3	1	1	0	0	16

[a] Events are defined by a 48-hr dry inter-event interval; West Point uses days rather than events.

2.4.1 West Point Treatment Plant


West Point Treatment Plant

In addition to secondary treatment of up to 300 mgd of base wastewater flows (defined as 2.25 times the average wet-weather flow of 133 mgd), West Point provides CSO treatment (equivalent to primary treatment) for flows between 300 mgd and the peak of 440 mgd. Combined sewer flows that would otherwise overflow at points around the combined system are transferred to the West Point Treatment Plant. After receiving CSO treatment, these flows are mixed with secondary effluent for disinfection, dechlorination, and discharge from the deep marine outfall. The resulting effluent must meet secondary effluent quality limits, with a small reduction in total suspended solids (TSS) percent removal requirements.

Tables 10 and 11 gives the number of days that CSO treatment occurred at West Point and the volume of flow receiving CSO treatment during each month. Table 12 provides the daily information. For the 2007–2008 CSO year, treatment occurred on 16 days with a total volume of 228.22 MG of treated CSO discharges from West Point.

Table 12. CSO Treatment Summary for West Point from June 07 to May 08

Date	Volume Treated at West Point (MG)
9/25/2007	0.09
9/30/2007	10.09
10/10/2007	1.63
10/19/2007	1.82
11/15/2007	9.31
11/17/2007	6.53
12/2/2007	76.13
12/3/2007	101.99
12/18/2007	1.01
12/22/2007	0.14
12/31/2007	0.05
1/9/2008	5.23
1/14/2008	7.39
1/23/2008	0.1
2/8/2008	0.53
3/23/2008	6.18
Total Volume	**228.22**
Number of Days	**16**

2.4.2 Alki CSO Treatment Plant

The total volume of treated CSO discharged from the Alki CSO Treatment Plant was 77.8 MG; this discharge occurred during a single event in December (Tables 10 and 11). Flows peaked over 60 mgd for most of the storm, which exceeded the capacity of the plant outfall under the tidal conditions at the time. On the second day of the storm the plant treated a record of 55 MG.

The Alki regulator gate was inspected and tested in the fall. To address flow surge that occurred last season, the gate was left 50 percent open to allow flows to enter the plant sooner. The wet well level set points that trigger pumps to turn on and off at the 63rd Street Pump Station were also adjusted just prior to the 2007–2008 season. These modifications were made to smooth out flow peaks, promote improved solids capture, and limit short circuiting of the bisulfite feed points. These problems were not experienced this year, although it is difficult to determine success based on only a single operation. Improvements to the dechlorination system, including installation of two high capacity bisulfite pumps, also were made. Performance in 2007–2008 does not reflect the dechlorination system improvements because calibration and testing had not yet been completed before the December storm.

During the 2007–2008 season, the Alki plant achieved only 41.9 percent of the minimum 50 percent required TSS removal for its single discharge event. The December storm event was designated as the “one untreated even per year,” which brought the plant into technical compliance with the permit limit for percent removal of total suspended solids (TSS). The ability of the plant to comply with the 50 percent TSS removal requirement is influenced by the balance of storm flows treated at Alki and those transferred to West Point via the West Seattle Tunnel.

The greater the number of smaller storm flows sent directly to West Point without entering the plant, the more difficult it is for Alki to achieve solids removal. While Alki was designed to handle a range of storm flows, influent concentrations, and surface overflow rates, the West Seattle Tunnel can receive more of the smaller storms than expected. While this greater volume in the West Seattle Tunnel benefits the environment by transferring more Alki flows to West Point for treatment, it leaves the Alki CSO plant to treat the more difficult flows and lowers the average TSS removal achievable at Alki.

More detailed information about the Alki CSO Treatment Plant can be found in Appendix A of this report.

2.4.3 Carkeek CSO Treatment Plant

During this reporting period, the Carkeek CSO Treatment Plant operated nine times with only one discharge event of 35.63 MG on December 3 (Tables 10 and 11). During the December storm, Pipers Creek flooded the plant. As a result, the Carkeek plant reported only 13.9 percent TSS removal for the 2007–2008 wet season, which is below the permit requirement of greater than 50 percent removal. Similarly, the annual average settleable solids was 0.65 ml/L/hr compared to the limit of 0.3 mL/L/hr. Designating the one discharge event as the "one untreated event per year" brought the plant into technical compliance with the limits.

This is the third year of operating the improved disinfection system and the new dechlorination system; both the systems worked well in meeting the effluent fecal coliform and residual chlorine limits. Additional refinements to these systems are described, along with other information about the Carkeek CSO Treatment Plant, in Appendix B of this report.

2.4.4 Elliott West CSO Treatment Facilities

The Elliott West CSO Treatment Facilities began operating in May 2005. While some refinements in the operating protocols remain to be done to achieve full control at the Denny and Dexter Regulators (described earlier in Section 1.3.2), much has been accomplished. During this reporting period, there were three discharge events from the Elliott West CSO outfall. The total discharge volume for the reporting period was 188.73 MG during the year.


Elliott West CSO Control Facility

Of the 350.33 MG of CSO that would have discharged from an uncontrolled Denny Regulator into Elliott Bay in 2007–2008, 37.8 percent was captured and received secondary treatment, 53.9 percent received primary treatment and some disinfection, and only 8.3 percent was discharged untreated. This represents a 97.7 percent reduction from pre-project levels. Denny Regulator only overflowed once during the season. Treatment of Denny/Lake Union flows at Elliott West was better identified through improved sampling. Of the 0.224 million pounds of TSS coming to the facilities, 65.4 percent was removed and the regulatory target of 50 percent removal was met without dropping an event from the solids calculation.

With funding from the City of Seattle, stop logs were added to the overflow weir at the Valley Street connection in July 2008 to block dry-weather overflows into the Mercer Tunnel. The sustainability of this control will be monitored through the next wet season

A surface discharge of treated effluent occurred out of the manhole covers and access slabs on the dechlorination and outfall transition structures by the Denny Regulator during the discharge on December 3. This was similar to an event last season, and analysis indicates that the cause may be hydraulic surges during rapid ramping up of the main pumps at Elliott West facility under extreme peak flows. Corrections were already in design, including modification of the dechlorination vault by building an aboveground structure to dampen the hydraulic surges and provide air release. This work is under way and expected to be complete in October 2008.

Disinfection continued to be a challenge. Disinfection failures occurred in November and December. Actions and progress being made to correct this and achieve full permit compliance are described in Section 1.3.2 and in Appendix C.

2.4.5 Henderson/Norfolk CSO Control Facilities

No untreated discharges occurred at the three system outfalls (Henderson, Martin Luther King, and Norfolk). The Henderson Tunnel filled and discharged only once during this reporting period. All of the CSO managed by this system received treatment—15 percent received secondary treatment at South plant and 85 percent received primary treatment and disinfection in the tunnel with discharge to the Duwamish Waterway. However, TSS percent removal during this very dilute event was only 41.5 percent. This one treated discharge from the Henderson Tunnel to the Norfolk outfall was designated as an “untreated” event for purposes of calculating solids limit performance and compliance was achieved.

Operations staff continues to troubleshoot and fine tune the disinfection system. The hypochlorite feed rate required manual operation during the December treatment event, and chlorination was briefly lost. The programmable logic control strategies and pump volume settings for the hypochlorite feed pumps will be adjusted and the outcomes evaluated during the coming season.

More detailed information about the Henderson/Norfolk CSO Control Facilities is in Section 1.3.2 and Appendix D of this report.

2.4.6 Ecology Permit Compliance Monitoring System Summaries

Ecology has requested that compliance information for the CSO treatment facilities be summarized. This summary is presented in Table 13.

Table 13. Ecology Permit Compliance Summary, 2007–2008, for King County CSO Control Facilities

Name	MonPoint	Parameter	Unit	Value Reported	DCHG Min	DCHG Max	Value Type	FirstDt	LastDt
Alki	91	Solids, suspended, % removal	Percent	No violation[b]	50		Average	31-Dec-03	31-Dec-08
Alki	91	Number of events	Number of events	3[c]		29	Maximum	31-Dec-03	31-Dec-08
Alki	91	Solids, settleable	mL/L	0.2[d]		0.3	Average	31-Dec-03	31-Dec-08
Alki	91	Flow, in conduit or through treatment plant	Million gallons/year	51.8[d]		108	Maximum	31-Dec-03	31-Dec-08
Carkeek	46	Solids, suspended, % removal	Percent	94.4[e]	50		Average	31-Dec-03	31-Dec-08
Carkeek	46	Number of events	Num of events	4.6[f]		10	Maximum	31-Dec-03	31-Dec-08
Carkeek	46	Solids, settleable	mL/L	No violation[g]		0.3	Average	31-Dec-03	31-Dec-08
Carkeek	46	Flow, in conduit or through treatment plant	MG/year	28.65[h]		46	Maximum	31-Dec-03	31-Dec-08
Elliott West	27	Solids, suspended, % removal	Percent	92.2[I]	50		Average	1-Jul-05	31-Dec-08
Elliott West	27	Number of events	Number of events	8[j]			Average	1-Jul-05	31-Dec-08
Elliott West	27	Solids, settleable	mL/L	0.1[k]		0.3	Average	1-Jul-05	31-Dec-08
Elliott West	27	Volume, total	MG	331.18[l]			Average	1-Jul-05	31-Dec-08
Henderson	44	Solids, suspended, % removal	Percent	No violation[m]	50		Average	1-Jul-05	31-Dec-08
Henderson	44	Number of events	Num of events	1[p]			Average	1-Jul-05	31-Dec-08
Henderson	44	Solids, settleable	mL/L	0.2		0.3	Average	1-Jul-05	31-Dec-08
Henderson	44	Volume, total	MG	9.6			Average	1-Jul-05	31-Dec-08

[a] Headings: Name = CSO name; MonPoint = state discharge serial number; Parameter = what is being measured and reported; Unit = unit of measure; Value Reported = measurement reported for compliance; DCHG Min – the minimum value meeting the permit limit; DCHG Max = the upper value meeting the permit limit;Value Type = how the reported value is calculated; FirstDt = date when limit became effective; LastDt = expiration date of the NPDES permit and limits.

[b] The single discharge was designated the"one untreated event/year" and dropped from the annual solids limit calculations, leaving no reportable data.

[c] This limit is assessed as a 5-year average; 2007–2008 frequency was one event.

Name	MonPoint	Parameter	Unit	Value Reported	DCHG Min	DCHG Max	Value Type	FirstDt	LastDt

[d] This limit is assessed as a 5-year average; 2007–2008 volume was 77.8 MG.
[e] The single discharge was designated the"one untreated event/year" and dropped from the annual solids limit calculations. Performance reflects flooding by Pipers Creek during the December storm.
[f] This limit is assessed as a 5-year average; 2007–2008 frequency was one event.
[g] The single discharge was designated the"one untreated event/year" and dropped from the annual solids limit calculations, leaving no reportable data. Performance reflects flooding by Pipers Creek during the December storm.
[h] This limit is assessed as a 5-year average; 2007–2008 volume was 35.63 MG. Performance reflects flooding by Pipers Creek during the December storm.
[i] One discharge was designated the"one untreated event/year" and dropped from the annual solids limit calculations.
[j] This limit is assessed as a 3-year average; 2007–2008 frequency was three events.
[k] One discharge was designated the"one untreated event/year" and dropped from the annual solids limit calculations.
[l] This is not a limit. It is for reporting only. It is a 3-year average; 2007–2008 volume was 188.73 MG.
[m] The single discharge was designated the"one untreated event/year" and dropped from the annual solids limit calculations, leaving no reportable data.
[n] This is assessed as a 3-year average; 2007–2008 frequency was one event.
[p] This is not a limit. It is for reporting only. It is a 3-year average; 2007–2008 volume was 19.8 MG.

Appendices

Appendix A. Alki CSO Treatment Plant Annual Report, June 2007–May 2008

Appendix B. Carkeek CSO Treatment Plant Annual Report, June 2007–May 2008

Appendix C. Elliott West CSO Control Facilities, June 2007-May 2008

Appendix D. Henderson/Norfolk CSO Control Facilities, June 2007-May 2008

Appendix A
Alki CSO Treatment Plant
Annual Report
June 2007 - May 2008

This 2007-2008 annual report summarizes performance of King County's Alki CSO treatment facilities. These facilities came on-line for CSO treatment in 1998, and were fully operational in 2000. It currently operates under the NPDES permit for the West Point Treatment Plant (WA-0029181-1), which is in effect through December 31, 2008.

There was one inflow event and one discharge event during the June 1, 2007 - May 31, 2008 CSO reporting period. A total of 81.8-MG entered the facility, and 77.8-MG treated CSO was discharged. The largest (and only) discharge event occurred over 56 hours on Dec. 2-4, 2007. This was the largest discharge event to date at the Alki CSO facility.

Table 1 summarizes the permit performance of the facility during this CSO year. The daily and maximum settleable solids and fecal coliform limits were met. The monthly and event-based limits for settleable solids were met. The 50% annual suspended solids limit was not met during this large and dilute event. But when it is designated as the "one untreated event" and dropped from the solids limit calculation, there is no permit violation. The facility did not meet the monthly and daily limits for chlorine residual. Dechlorination continued to be a challenge. It is discussed further below. All permit-required composite and grab samples were collected and analyzed for this CSO year.

Table 2 summarizes the annual and running 5-year average discharge volumes and frequency. Compliance is only assessed at the end of a permit cycle, prior to permit renewal. This year is a compliance reporting year.

Season's Weather Conditions

35.0-inches of rain fell during the reporting year, compared to a historic average of 37-inches. The weather pattern was drier than normal, but with record breaking snow packs in the Central Cascades. 26% of the annual rainfall occurred in December 2007, with 5.3-inches falling over 34-hours during Dec. 2-3, 2007, producing the one discharge event this CSO year. A small snowfall preceded the rainstorm, contributing to the runoff entering the CSO treatment facility.

Operational Challenges (see monthly reports for more details)

For the most part, all of the tanks, equipment and instrumentation at Alki and the 63rd Pump Station operated according to their control strategies. The main exception was only one bisulfite pump was available for dechlorination. Modifications made to prevent short-circuiting of the dechlorination channel (i.e., primary treated CSO spilling over the channel wall) appeared to be successful. Some of the challenges that continued through this wet season included influent pumping control, hypochlorite control, and dechlorination capacity and control.
Prior to this season, several changes were made to Alki and the 63rd Ave. Pumping Station to dampen surge flows, and thus improve solids removal, reduce short-circuiting around the dechlorination channel, and improve control of the chlorination and dechlorination systems. The

Alki tunnel inlet regulator gate was set at 70% open to have flow enter Alki sooner, hopefully allowing better overall solids capture. The level setpoint controls for operating the three influent pumps (i.e., 63rd Ave. Pump Station) were adjusted to smooth flow peaks/surges. Also, the Alki effluent/outlet weir level was lowered to eliminate short-circuiting of the bisulfite feed points.

Closing the regulator gate had a limited impact to solids removal due to the extreme nature of the Dec. 2-4 storm. In fact, the West Seattle Tunnel was full for the entire event. The changes to the influent pump setpoints did not have the desired effect. This was in large part due to the extreme storm, as well as the control strategy that allowed flows as high as 70-80 mgd through Alki during the first half of Dec. 3. Subsequently, the influent pumps were manually set to limit flow to 60-mgd. Lowering the outlet/effluent weir was effective at reducing the amount of short-circuiting when the flows jumped to 80-mgd. There was no short-circuiting when the flows were 60-mgd and below.

Table 1: Treatment Performance and Permit Limit Compliance

Parameter	Long Term Average Limit[d]	Long Term Ave.	Yearly Average Limit[e]	Yearly Ave.	Monthly Limit	Monthly	Maximum of Daily Averages Limit[f]	Max. Daily
Number of Events/Yr	**29**	3						
Volume/Yr (MG)	**108**	51.8						
Number of designated "untreated events" in permit cycle	1	1						
Total Suspended Solids Removal Efficiency[g]			**50%**	No viola-tion				
Settleable Solids, ml/l/hr			**0.3**	0.2	**1.9 max**	0.3 (max)		
Fecal Coliform Bacteria, org/100 ml.					**1700 monthly geo-mean**	22 geo-mean		

[d] Long-term average will be calculated using data collected over a full permit cycle. Data shall be collected and reported for the period of the permit cycle prior to permit renewal

[e] The yearly limitations will be calculated using per-event data points. Data shall be collected and reported on a schedule concurrent with the annual CSO report, June 1 to May 31, to include the entire wet season for purposes of determining compliance with these limitations.

[f] The maximum daily effluent concentration determined from a continuous measurement is calculated as the average of the pollutant concentrations measured over the day.

[g] The total removal efficiency for TSS is to be calculated on a mass balance basis as the percent of solids captured at the CSO Treatment Plant and then permanently removed at the West Point Treatment Plant based on the estimated removal efficiency at West Point.

Parameter	Long Term Average Limit[d]	Long Term Ave.	Yearly Average Limit[e]	Yearly Ave.	Monthly Limit	Monthly	Maximum of Daily Averages Limit [f]	Max. Daily
Total Residual Chlorine, ug/L							**290**	1134 12/2 3228 12/3 1286 12/4

Table 2: Alki Yearly and Average Discharge Volumes & Event Frequency

Year	Discharge Volume per Year, MG	Discharge Events per Year	"once per year untreated event"[h]
June 03 – May 04	34	3	1 - Nov-03 event removed
June 04 – May 05	20	1	1 – Jan. 18-19 event removed
June 05 – May 06	59	4	1 - Jan. 29 event removed
June 06 – May 07	68	6	1 - Dec. 14 event removed
June 07 – May 08	78	1	1 – 12/2-4/08 event removed
Running 5-year average	51.8	3	1 per year
5-year average for compliance -Seasons ending in the Permit Cycle of 2004-2008	51.8	3	1 per year

As mentioned previously, flow exceeded Alki's treatment capacity (60-mgd) for extended periods of the storm. Historically optimal solids capture occurs at 45-MGD. The plant treated a record 55-MG of combined sewage during the second day of the event, averaging 48% TSS removal. The suspended solids coming into the plant that day were unusually high at 124 mg/L, as was the grit and sand load entering the plant. This led to suspicion that the raw primary sludge pumped from Alki's primary sedimentation tanks to the West Seattle Tunnel was being returned to the plant via the 63rd Pump Station. Operators subsequently turned off Alki's primary sludge pumps in an effort to clear the grit and sand, allowing the chlorine analyzers and their sample pumps to work.

Hypochlorite was injected into one or both force mains at a dose sufficient to bring all four fecal coliform sample counts down below 400 cfus/100mls. The geometric mean of the three daily averages was 22 cfus/100 mls. The monthly maximum limit is 1700 cfus/100 mls. These results, along with results from the influent Cl2 analyzer, suggest that the hypochlorite dose setpoint can

h One event each season may be excluded from the solids calculations as the one untreated event per year, but not from frequency and volume counts.

be notably lowered without compromising the ability to meet the fecal coliforms limits. Lowering the hypochlorite dose setpoint will also help meet the chlorine residual limit in the future. Hypochlorite is dosed into the force mains rather than the 63rd Ave wet well to avoid overflowing chlorinated CSO from the 63rd Ave. Pump Station.

Alki was unable to dechlorinate down to 290µg/L permit levels during this storm. This was primarily due to the under-capacity of the bisulfite system, and the very high hypochlorite doses applied to the influent. There was only one 9-gpm bisulfite pump available during this storm. This pump was replaced with two 12-gpm bisulfite pumps later in Dec. 2007. Earlier in 2007, Maintenance staff installed a second bisulfite diffuser further down the contact channel to provide more neutralization of chlorine.

Routine Operation and Maintenance Activities (see monthly reports for more details)

The 63rd Pump Station and Alki CSO treatment plant are fully functioning and available for next season. More detail is available in the reports accompanying the monthly discharge monitoring reports. A larger capacity dechlorination system has been installed (including two 12-gpm bisulfite pumps) and is ready for the 2008-09 season. Staff will also look at fine-tuning the control strategies for the influent pumps and hypochlorite pumps prior to the upcoming season.

Operations, Maintenance and Process staff will continue to debrief after each event providing information and feedback on performance, operational and maintenance issues.

The priority pollutant sampling required for parameters to meet conditions defined in 40 CFR Appendix D, Part 122 was completed on a flow proportional effluent samples each day of the December storm as required once per the NPDES permit sample.

Table 3. Summary of Alki 2007/08 Event Data

Month	Day	Alki Inflow Event Number	Alki Inflow Volume (MG)	Alki Discharge Event Number	Alki Discharge Volume (MG)	Alki Total Influent TSS (lbs)	Alki Total Effluent TSS Discharged @ Alki + WP (lbs)	Alki % TSS Removal	Alki Effl. Settl Solids (ml/l/hr)	Alki Effl. pH	Alki Avg Effl. Fecal Coliform(#/100 ml)	Alki Effl. Residual Chlorine (uGu/l)
June 2007	No events											
July 2007	No events											
August 2007	No events											
September 2007	No events											
October 2007	No events											
November 2007	No events											
December												
2		1a	9.8	1a	9.0	5313	4426		0.30	6.9	2	1134
3		1b	55.9	1b	55.1	57810	32418		0.20	7.5	174	3228
4		1c	16.1	1c	13.7	8325	5489		0.10	7.4	30	1286
	Event/Daily Max								0.3	7.5		3 Daily max violations 1134 3228 1286
	Mon. Total/Avg	1	82	1	78	71,447	42,333	40.7	0.2	6.9	22	1883
January 2008	No events											
February 2008	No events											
March 2008	No events											
April 2008	No events											
May 2008	No events											

Month	Day	Alki Inflow Event Number	Alki Inflow Volume (MG)	Alki Discharge Event Number	Alki Discharge Volume (MG)	Alki Total Influent TSS (lbs)	Alki Total Effluent TSS Discharged @ Alki + WP (lbs)	Alki % TSS Removal	Alki Effl. Settl Solids (ml/l/hr)	Alki Effl. pH	Alki Avg Effl. Fecal Coliform(#/100 ml)	Alki Effl. Residual Chlorine (uGu/l)
Annual Avg/GEM					**78**	**71,447**	**42,333**	40.7	**0.2**	**6.9**	**22**	**1883**
Min/Max or Max									**0.3**	**6.9/7.5**		3 Daily max violations 1134 3228 1286

Table 4. 2007/08 Alki Annual Values

	No.of Discharge Events	Inflow Volume (MG)	Discharge Volume (MG)	Total Alki TSS lbs-in	Total Alki /WP TSS lbs Discharged	Annual Average Alki %TSS Recovery	Annual Average Alki Settleable Solids (ml/l/lhr)	Event Maximum Alki Settleable Solids (ml/l/lhr)	Maximum Monthly Geomean Alki Effl. Fecal Coliforms (#/100 ml)	Maximum of Daily Averages of Alki Effl. Res. Cl2 (ug/l)
Including All Events	1	82	78	71,447	42,333	40.7	0.2	0.3	22	3228
Excluding 12/2-4/08 Event for solids limit calculation						N/A				

Appendix B: Carkeek CSO Treatment Plant Annual Report
June 2007 - May 2008

This annual report summarizes performance and NPDES permit compliance of the King County Carkeek CSO treatment facilities. These facilities came on-line for CSO treatment in November 1994, It currently operates under the NPDES permit for West Point Treatment Plant, Washington State Department of Ecology permit number WA-0029181-1, in effect from January 1, 2004 through December 31, 2008.

The annual monitoring period is concurrent with the annual CSO reporting period, June 1 – May 31. During the June 1, 2007- May 31, 2008 period, there were nine inflow events totaling 36.53 MG and one discharge event totaling 35.63 MG. Plant performance was significantly impacted by the flooding of the plant by Pipers Creek on December 3, as described below. The flooding likely caused violation of the setteable solids permit limt (maximum day). The annual average suspended solids percent removal and settleable solids limits were therefore also not met at 13.1 % and 0.65 ml/L/hr. After designating the discharge as the "one untreated discharge per year" though, there were no violations of those limits. TSS percent removal was then 94.4%. Because the data was dropped from the settleable solids calculation, there are no numbers to report. The daily maximum settleable solids, chlorine residual and fecal coliform limits were met.

The following table summarizes Carkeek treatment performance against permit limits during this period. Daily data is found in Table 3.

Table 1: Treatment Performance and Permit Limit Compliance

Parameter	Long Term Average Limit[9]	Long Term Ave.	Yearly Average Limit[10]	Yearly Ave.	Monthly Limit	Monthly	Maximum of Daily Averages Limit [11]	Max. Daily
Number of Events/Yr	**10**	4.6						
Volume/Yr (MG)	**46**	28.65						
Number of designated "untreated events" in permit cycle	**1**	0.8						
Total Suspended Solids			**50%**	94.4%				

[9] Long-term average will be calculated using data collected over a full permit cycle. Data shall be collected and reported for the period of the permit cycle prior to permit renewal

[10] The yearly limitations will be calculated using per-event data points. Data shall be collected and reported on a schedule concurrent with the annual CSO report, June 1 to May 31, to include the entire wet season for purposes of determining compliance with these limitations.

[11] The maximum daily effluent concentration determined from a continuous measurement is calculated as the average of the pollutant concentrations measured over the day.

Parameter	Long Term Average Limit[9]	Long Term Ave.	Yearly Average Limit[10]	Yearly Ave.	Monthly Limit	Monthly	Maximum of Daily Averages Limit[11]	Max. Daily
Removal Efficiency[12]								
Settleable Solids, ml/l/hr			**0.3**	No viola-tion	**1.9 max**	0.219 max		
Fecal Coliform Bacteria, org/100 ml.					**2800 monthly geo-mean**	101 geo-mean		
Total Residual Chlorine, µg/L							**490**	88

Table 2 summarizes the annual and running 5-year average discharge volumes and frequency. Compliance is only assessed at the end of a permit cycle, prior to permit renewal. This year is a compliance reporting year.

Table 2: Carkeek Yearly and Average Discharge Volumes & Event Frequency

Year	Discharge Volume per Year, MG	Discharge Events per Year	"once per year untreated event"[13]
June 03 – May 04	27.19	4	1 event - 10/20/2003
June 04 – May 05	4.04	4	1 event - 8/22/2004
June 05 – May 06	54.72	6	1 event - 1/8-17/06
June 06 – May 07	21.68	8	None
June 07 – May 08	35.63	1	1 event - 12/2-5/07
Running 5-year average	28.65	4.6	<1 per year (0.8 ev/yr)
Average for compliance -Wet Seasons ending in the Permit Cycle of 2004-2008	28.65	4.6	<1 per year (0.8 ev/yr)

Season's Weather Conditions

[12] The total removal efficiency for TSS is to be calculated on a mass balance basis as the percent of solids captured at the CSO Treatment Plant and then permanently removed at the West Point Treatment Plant based on the estimated removal efficiency at West Point.

[13] One event each season may be excluded from the solids calculations as the one untreated event per year, but not from frequency and volume counts.

The total rainfall at Carkeek for the 2007-08 reporting period was 37.8 inches, higher than the 30.95 inches reported over the West system. An intense storm hit the region with 6.04 inches of rain measured at Carkeek over three days, December 2-5. The storm caused severe flooding through out the region. Except for this storm, the weather pattern was drier than normal over the rest of the West system, but with record breaking snow packs in the Central Cascades.

An intense storm hit the region with 6.04 inches of rain measured at Carkeek over three days. The storm caused severe flooding through out the region.

Operational Challenges (see monthly reports for more details)

The only discharge event of the reporting period occurred December 2-5, 2007 during the intense storm described above. During this storm Pipers Creek, running adjacent to the Carkeek CSO Treatment Plant, overflowed its banks and flooded the Treatment Plant. Sewage also overflowed out of the first manhole (T-04) upstream of the pump station and out of the CSO plant. Based on tank level data, it appears that the flood induced plant overflow was estimated to have taken place between approximately 10:20 AM and 11:50 AM, a period of 1.5 hours. The volume of overflow entrained with the Creek is unknown. A report detailing the events was submitted to the Department of Ecology (DOE) on December 18, 2007.

The Creek appears to have washed in a significant amount of debris into the plant impacting the effluent quality. The settleable solids monthly average exceeded the average monthly effluent limit of 0.3 ml/l/hr during that single discharge. Average TSS recovery for the month of December was 11.9%.

Routine Operation and Maintenance Activities (see monthly reports for more details)

2007-08 is the third year of operating the improved disinfection system and the newly installed dechlorination system and both the systems worked well in meeting the effluent fecal coliform and the effluent residual chlorine limits. The temporary sodium bisulfite storage tank was replaced with a permanent storage tank in May of 2007. Also, a pre-dechlorination residual chlorine analyzer was added to optimize the bisulfite dosage. However, it was decided to leave it out of the chemical loop controls until the PLC for Carkeek pump station and CSO plant were upgraded in 2008.

The Programmable Logic Control (PLC) system for the pump station and CSO treatment plant was upgraded and tested from May 12 through May 22, 2008.

Table 3. Summary of Carkeek 2007/08 Event Data

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (MGD)	Carkeek Discharge Event Number	Carkeek Discharge Volume (MGD)	Carkeek Total Influent TSS (lbs)	Carkeek Total Effluent TSS Discharged @ Carkeek + WP (lbs)	Carkeek % TSS Removal	Carkeek Effl. Settl Solids (ml/l/hr)	Carkeek Effl. pH	Carkeek Avg Effl. Fecal Coliform(#/100 ml)	Carkeek Effl. Residual Chlorine (uGu/l)
June	**No events**											
July	**No events**											
August	**No events**											
September	**No events**											
October												
10/19		1	0.07			68	4					
	Mon. Total/Avg		0.07			68	4					
November												
11/17		2	0.05			75	5					
	Mon. Total/Avg		0.05			75	5					
December												
12/2		3	8.9	1a	8.310	10466	8006		0.40	6.8	150	42
12/3			23.77	1b	23.770	9317	9317		0.90	6.7	170	31
12/4			3.5	1c	3.500	1372	1372		0.65	7.1	40	88
12/5			.09	1d	0.050	56	34			7.0		32
12/18		4	.04			42	5					
	Event/Daily Max				63				0.9	7.1	107	88

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (MGD)	Carkeek Discharge Event Number	Carkeek Discharge Volume (MGD)	Carkeek Total Influent TSS (lbs)	Carkeek Total Effluent TSS Discharged @ Carkeek + WP (lbs)	Carkeek % TSS Removal	Carkeek Effl. Settl Solids (ml/l/hr)	Carkeek Effl. pH	Carkeek Avg Effl. Fecal Coliform(#/100 ml)	Carkeek Effl. Residual Chlorine (uGu/l)
	Mon. Total/Avg		36.53	1	35.63	21252	18734				101	
January												
1/9		5	0.013			5	0.25					
	Event/Daily Max											
	Mon. Total/Avg		0.013			5	0.25					
February	**No events**											
March												
3/23		6	0.03			42	2					
3/26		7	0.02			22	1					
	Event/Daily Max											
	Mon. Total/Avg		0.05			64	3					
April												
4/4		8	<.01									
4/7		9	0.058			96	3					
	Event/Daily Max											
	Mon. Total/Avg		0.058			96	3					
May	**No events**											
Total Annual		9	36.53	1	35.63	21561	18,749					

Month	Day	Carkeek Inflow Event Number	Carkeek Inflow Volume (MGD)	Carkeek Discharge Event Number	Carkeek Discharge Volume (MGD)	Carkeek Total Influent TSS (lbs)	Carkeek Total Effluent TSS Discharged @ Carkeek + WP (lbs)	Carkeek % TSS Removal	Carkeek Effl. Settl Solids (ml/l/hr)	Carkeek Effl. pH	Carkeek Avg Effl. Fecal Coliform(#/100 ml)	Carkeek Effl. Residual Chlorine (uGu/l)
Annual Avg/GEM								13.1	0.65			
Min/Max or Max									0.9	6.7/7.1	101	88

Table 4. 2007/08 Carkeek Annual Values

	No.of Discharge Events	Inflow Volume (MGD)	Discharge Volume (MGD)	Total Carkeek TSS lbs-in	Total Carkeek /WP TSS lbs Discharged	Annual Average Carkeek %TSS Recovery	Annual Average Carkeek Settleable Solids (ml/l/lhr)	Event Maximum Settleable Solids (ml/l/lhr)	Maximum Monthly Geomean Carkeek Effl. Fecal Coliforms (#/100 ml)	Maximum of Daily Averages of Carkeek Effl. Res. Cl2 (ug/l)
Including All Events	1	36.53	35.63	21,561	18,749	13.1	0.65	0.9	101	88
Excluding 12/2-5/07 Event for solids limit calculation						No violation		No violation		

Appendix C: Elliott West CSO Treatment & Storage Facility Annual Report June 2007 - May 2008

This annual report summarizes performance and NPDES permit compliance for the King County Elliott West CSO treatment facilities. These facilities came on-line for CSO treatment in May 2005, It currently operates under the NPDES permit for West Point Treatment Plant, Washington State Department of Ecology permit number WA-0029181-1, in effect from January 1, 2004 through December 31, 2008.

The annual monitoring period is concurrent with the annual CSO reporting period, June 1 - May 31. During the June 1, 2007- May 31, 2008 period, there were 28 inflow events totaling 321.26 MG and three discharge event totaling 188.73 MG. About 98% of the total discharged CSO flow volume occurred during an extreme storm event December 2-4.

Performance was again challenged this season, but significant improvement and progress toward compliance continues to be made. These intermittently operated wet weather facilities take much longer to start up than 24/7 facilities. With so few events to test performance - the identification of problems, the requirement to implement some solutions during the next dry weather periods, then the wait for storms to assess success of solutions – can take several seasons to complete. These facilities were built to bring the city's East Lake Union CSOs into control, and to control the county's Denny Way Regulator CSO. Progress is such that of the 350.33 MG of CSO that would have discharged from an uncontrolled Denny Regulator into Elliott Bay in 2007–2008, 37.8 percent was captured and received secondary treatment, 53.9 percent received primary treatment and some disinfection, and only 8.3 percent was discharged untreated. This represents a 97.7 percent reduction from pre-project levels.

During this period Elliott West met the effluent annual average total suspended solids percent removal limit with 65.4% removal (including all the events) and was 92.2% after designating the December 2-4 discharge data as the "one un-treated CSO event per year" for solids limit calculations. The annual average effluent settleable solids concentration was 0.86 ml/l/hr, inclusive of all the discharge events – which does not meet the permit limit - but was 0.1 after designating the 12/2-12/4 discharge the "one un-treated CSO event per year". So there was no violation. The discharge event on December 4th exceeded the daily maximum settleable solids effluent limit of 1.9 ml/l/hr. Some of the causes for exceeding the daily limits include sediment buildup in the effluent sampler stilling well and sampling under low flow conditions.

Disinfection and dechlorination system performance continued to be challenged this season, resulting in three disinfection failures. As a result, Elliott West violated the monthly fecal coliform limit in December and a daily chlorine residual limit on 12/3. Corrections were already underway, but not complete at that time. More detail is provided below

The following table summarizes Elliott West treatment performance against permit limits during this period. Daily data is found in Table 3.

Table 1: Treatment Performance and Permit Limit Compliance

Parameter	Long Term Average Limit[14]	Long Term Ave.	Yearly Average Limit[15]	Yearly Ave.	Monthly Limit	Monthly	Maximum of Daily Averages Limit [16]	Max. Daily
Number of Events/Yr	**Report**	8						
Volume/Yr (MG)	**Report**	331.18						
Number of designated "untreated events" in permit cycle	**Report**	<1 (0.67)						
Total Suspended Solids Removal Efficiency[17]			**50%**	64.4%				
Settleable Solids, ml/l/hr			**0.3**	0.1	**1.9 max**	4.0 on 12/4		
Fecal Coliform Bacteria, org/100 ml.					**400 monthly geomean**	10024 in Dec-ember		
Total Residual Chlorine, µg/L							**44**	73 on 12/3

Table 2 summarizes the annual discharge volumes, frequency and running average (though the facilities have only operated 3 years).

[14] Long-term average will be calculated using data collected over a full permit cycle. Data shall be collected and reported for the period of the permit cycle prior to permit renewal Facility has only operated 3 years.

[15] The yearly limitations will be calculated using per-event data points. Data shall be collected and reported on a schedule concurrent with the annual CSO report, June 1 to May 31, to include the entire wet season for purposes of determining compliance with these limitations.

[16] The maximum daily effluent concentration determined from a continuous measurement is calculated as the average of the pollutant concentrations measured over the day.

[17] The total removal efficiency for TSS is to be calculated on a mass balance basis as the percent of solids captured at the CSO Treatment Plant and then permanently removed at the West Point Treatment Plant based on the estimated removal efficiency at West Point.

Table 2: Elliott West Yearly and Average Discharge Volumes & Event Frequency

Year	Discharge Volume per Year, MG	Discharge Events per Year	"once per year untreated event"[18]
June 05 – May 06	315.6	8	No event removed
June 06 – May 07	489.20	13	1 - 12/9-15/06 removed
June 07 – May 08	188.73	3	1 - 12/2-4/07 event
3-Year average[19] for seasons ending in 2006-2008	331.18	8	<1 per year (0.67 ev/yr)

Season's Weather Conditions

Rainfall over the West system was lower than normal (37 inches) with an average of 30.95 inches reported, but rainfall measured at West Point was about average at 37.78, An intense storm hit the region with 6.04 inches of rain measured at West Point over 12/2-12/4. Record breaking snow packs were measured in the Central Cascades.

Operational Challenges (see monthly reports for more details)

The facilities continued to receive dry weather flows from the City of Seattle sewers via the Valley Street connection near south Lake Union during this year. It had been determined that sediment buildup in the city's local system was causing flows to back up and overtop the weir. After each of three sewer cleanings conducted by the city the overflows to the Mercer tunnel would resume following the next large storm. With funding by the city, stop logs were added to the overflow weir at the Valley Street connection in July 2008 to block these overflows. The sustainability of this control will be monitored through the next wet season.

A surface discharge of treated effluent occurred out of the manhole covers and access slabs on the Dechlorination and Outfall transition structures by the Denny Regulator during the discharge on December 3rd. A similar event was seen last season and analysis had shown this to result from hydraulic surges during rapid ramping up of the main pumps at EWCSO facility under extreme peak flows. Corrections were already in design, including modification of the dechlorination vault by building an above ground structure to dampen the hydraulic surges and provide air release. This work is underway and expected to complete in October.

The disinfection system failed to activate during discharge events on November 15th and December 2nd 2007. The cause for these failures was later found be due to the conflict between the permissives/controls for the dechlorination system. The dechlorination vault level permissive was disabled for the sodium bisulfite solution (SBS) pumps to prevent disinfection failures.

Disinfection with hypochlorite automatically shuts if there is a dechlorination failure. This is done to prevent release of high levels of chlorine that may be harmful to marine life. Shut downs occurred on December 3rd and 4th when the facility ran out of the SBS used for dechlorinaton.

[18] One event each season may be excluded from the solids calculations as the one untreated event per year, but not from frequency and volume counts.

[19] Note: the facility only has only operated 3 years

Prolonged operation over the December 2nd to 4th storm had depleted the storage tanks. Concurrently, there was an area-wide supply shortage of SBS, so Elliott West's stock could not be replenished. Since then King County has stocked Elliott West with the stronger 38% SBS to create 50% more treatment capacity. King County had been using 25% solution because a small potential for crystallization of SBS in the transfer line between the storage tanks at EWCSO and the day tank inside the Denny Regulator station exists under extreme cold conditions (38% SBS solution freezes and crystallizes at 45° F). This risk is outweighed by the disinfection failures so use of the stronger SBS is an interim measure while permanent solutions are sought. Alternatives such as pneumatic purging of the lines, in-line dilution of 38% to 25%, and/or dedicating one of the two storage tanks to hold 25% SBS for extreme cold weather are being evaluated. Emergency deliveries of 38% SBS solution for the day tank at the Denny Regulator station are also being considered. Please refer to the monthly reports and Disinfection Failure Notifications sent to Ecology (Ecology Reference #s 602047, 07-3928, 602552 & 07-3955) for details.

To summarize: After the severe storms of 2006 overstressed the new facilities, King County established an emergency contract with the engineering consultant TetraTech to assist the county in investigating and resolving the facility's performance issues. The consultant identified several measures to improve the performance and permit compliance, including:

1. Improved sampling of the CSO flows transferred to West Point at the end of tunnel draining. Discrete manual sampling from the dewatering sump pump demonstrated better solids recovery than previously identified. As a result King County had been collecting discrete samples since February 2008;
2. Modifications to the dewatering sump pump flow composite auto-sampler to improve its reliability – modification of the sampler is expected to be completed mid October 2008;
3. Modifications to the disinfection and dechlorination systems to improve the treatment effectiveness, equipment reliability and storage capacity issues. A next phase of work is being developed.
4. Structural modifications to the dechorination structure to minimize the over-pressurization of EWCSO effluent pipeline if hydraulic surges occur during extreme peak flows. Construction work is currently underway and is expected to be completed by mid-October 2008.
5. Main Pump sequencing modifications to dampen rapid ramping of CSO discharge flows that may lead to over-pressurization of EWCSO pipeline and the downstream structures. A next phase of the work is being developed.

The county is currently working with the consultant to develop the scope, schedule, budget estimate, construction schedule, and define startup and commissioning assistance for the next modifications and improvements to the screening system, disinfection and dechlorination systems, and to prevent EWCSO over-pressurization;

Routine Operation and Maintenance Activities (see monthly reports for more details)

Manual discrete sampling of the dewatering sump pump and main pump flows was initiated in February 2008 for solids characterization of the flows being transferred to West Point. The auto-samplers had proven unreliable. The results of this sampling indicate that the solids capture at EWCSO facility has been better than previously thought, but was just not being identified. Significant amount of solids appear to be pumped by the dewatering pumps. Based on this modifications to the existing dewatering sump pump flow auto-sampler are being made to collect a more representative composite sample. This should be on line by mid-October and a discrete sequential sampler will collect the samples in parallel to augment the auto-sampler in capturing a

representative sample. Once reliability is established, the same modifications will be made to the main pump returned flow sampler. Currently, a portable discrete sampler set up for the main pump discharge is in place to minimize the manual labor involved in collecting the discrete samples.

Implementation of a new pre-dechlorination residual analyzer and feedback loop controls, the addition of flowmeter on the SBS dosing line, and modifications to the SBS mixing system will greatly optimize the SBS dosing and consequently minimize the chances of running out SBS inventory even under extreme events.

Table 3 Summary of Elliott West 2007/08 Event Data

Month	Day	EWCSO Inflow Event Number	EWCSO Inflow Volume (MG)	EWCSO Discharge Event Number	EWCSO Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Discharged @ EWCSO + WP (lbs)	% removal	EWCSO Effl. Settl Solids (ml/l/hr)	EWCSO Effl. pH	EWCSO Avg Effl. Fecal Coliforms (#/100 ml)	EWCSO Effl. Residual Chlorine (ug/l)
June	No events											
July	20	1a	0.87	ND	ND	900	43					
	21	1b	1.11	ND	ND	1203	58					
	22	1c	0.25	ND	ND	309	15					
	Event/Daily Max											
	Mon. Total/Avg	1	2.23			2412	116	95.2%				
August	20	1	2.20	ND	ND	10220	715					
	Event/Daily Max											
	Mon. Total/Avg	1	2	ND	ND	10220	715	93.0%				
September	4	1a	7.98	ND	ND	4274	184					
	5	1b	0.61	ND	ND	687	30					
	27	2a	0.36	ND	ND	108	5					
	28	2b	0.36	ND	ND	108	5					
	30	3	5.91	ND	ND	1963	84					
	Event/Daily Max											
	Mon. Total/Avg	3	15.22	ND	ND	7140	307	95.7%				
October	1	1	2.38	ND	ND	754	41					
	7	2a	0.55	ND	ND	2844	156					
	8	2b	0.12	ND	ND	620	34					
	17	3a	0.85	ND	ND	496	27					
	18	3b	0.48	ND	ND	280	15					
	19	3c	1.99	ND	ND	1660	91					
	20	3d	0.29	ND	ND	302	17					

Month	Day	EWCSO Inflow Event Number	EWCSO Inflow Volume (MG)	EWCSO Discharge Event Number	EWCSO Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Discharged @ EWCSO + WP (lbs)	% removal	EWCSO Effl. Settl Solids (ml/l/hr)	EWCSO Effl. pH	EWCSO Avg Effl. Fecal Coliforms (#/100 ml)	EWCSO Effl. Residual Chlorine (ug/l)
	Event/Daily Max											
	Mon. Total/Avg	3	6.66			6957	383	94.5%				
November	11	1a	0.03	ND	ND	39	3					
	12	1b	6.51	ND	ND	2634	175					
	13	1c	0.16	ND	ND	65	4					
	15	2a	3.01	1	1.02	8278	805		<0.1	NS	NS	NS
	16	2b	6.37	ND	ND	5258	350					
	17	2c	3.26	ND	ND	2610	174					
	18	2d	0.44	ND	ND	429	29					
	26	3a	1.03	ND	ND	292	19					
	27	3b	0.29	ND	ND	1301	87					
	28	3c	0.41	ND	ND	191	13					
	Event/Daily Max								<0.1			
	Mon. Total/Avg	3	21.51	1	1.02	21098	1659	92.1%	<0.1	NS	NS	NS
December	2	1a	85.00	1a	84.02	48746	46530		0.2	6.61	65	10
	3	1b	91.50	1b	91.50	12210	12210		<0.1	6.57	1700000	73
	4	1c	14.38	1c	9.23	9240	6916		4.0	7.42	2700000	25
	5	1d	4.49		ND	2172	245					
	6	1e	0.55		ND	6926	783					
	13	2a	0.37		ND	509	509					
	14	2b	0.45		ND	593	67					
	15	2c	0.25		ND	329	329					
	16	2d	1.25		ND	3169	358					
	17	2e	0.62		ND	739	84					
	18	2f	2.77		ND	392	44					
	19	2g	1.68		ND	841	95					
	20	2h	0.40		ND	167	19					
	21	2i	0.33		ND	1332	151					

Month	Day	EWCSO Inflow Event Number	EWCSO Inflow Volume (MG)	EWCSO Discharge Event Number	EWCSO Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Discharged @ EWCSO + WP (lbs)	% removal	EWCSO Effl. Settl Solids (ml/l/hr)	EWCSO Effl. pH	EWCSO Avg Effl. Fecal Coliforms (#/100 ml)	EWCSO Effl. Residual Chlorine (ug/l)
	22	2j	2.51		ND	11168	1262					
	23	2k	2.49		ND	1134	128					
	25	2l	0.91		ND	190	21					
	27	2m	1.38		ND	863	98					
	28	2n	0.59		ND	2165	245					
	29	2o	0.77		ND	1772	200					
	Event/Daily Max								4.0	7.4	2700000	73
	Mon. Total/Avg	2	212.7	1	184.75	104659	70294	32.8%	1.4		10024	36
January	2	1a	2.43	ND	ND	1257	70					
	3	1b	1.62	ND	ND	230	13					
	4	1c	0.55	ND	ND	78	4					
	5	1d	0.42	ND	ND	74	4					
	6	1e	0.64	ND	ND	133	7					
	7	1f	0.6	ND	ND	248	14					
	8	1g	1.36	ND	ND	839	47					
	9	1h	0.68	ND	ND	147	8					
	10	1i	6.16	ND	ND	1485	83					
	11	1j	0.37	ND	ND	164	9					
	12	1k	0.78	ND	ND	286	16					
	14	1l	5.70	ND	ND	2054	115					
	15	1m	1.36	ND	ND	647	36					
	19	2	1.16	ND	ND	4721	263					
	28	3a	0.62	ND	ND	486	27					
	29	3b	0.67	ND	ND	525	29					
	30	3c	0.53	ND	ND	365	20					
	31	3d	0.43	ND	ND	255	14					
	Event/Daily Max											

Month	Day	EWCSO Inflow Event Number	EWCSO Inflow Volume (MG)	EWCSO Discharge Event Number	EWCSO Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Discharged @ EWCSO + WP (lbs)	% removal	EWCSO Effl. Settl Solids (ml/l/hr)	EWCSO Effl. pH	EWCSO Avg Effl. Fecal Coliforms (#/100 ml)	EWCSO Effl. Residual Chlorine (ug/l)
	Mon. Total/Avg	3	26.1		0.00	13992	781	94.4%				
February	5	1a	0.39	ND	ND	3974	112					
	6	1b	0.78	ND	ND	10571	298					
	7	1c	0.52	ND	ND	1041	29					
	8	1d	0.70	ND	ND	1238	35					
	9	1e	1.80	ND	ND	1231	35					
	10	1f	0.40	ND	ND	614	17					
	16	2	0.40	ND	ND	504	14					
	28	3	0.26	ND	ND	334	9					
	Event/Daily Max											
	Mon. Total/Avg	3	5.25			19506	550	97.2%				
March	1	1	0.34	ND	ND	1100	44					
	3	2	0.30	ND	ND	525	21					
	11	3a	0.80	ND	ND	1334	54					
	13	3b	1.23	ND	ND	954	38					
	14	3c	0.38	ND	ND	906	36					
	15	3d	0.61	ND	ND	1252	50					
	16	3e	1.02	ND	ND	1506	61					
	23	4a	10.85	1	2.96	4483	1578		0.10	6.1	230	27
	24	4b	1.21	ND	ND	666	27					
	26	4c	1.47	ND	ND	479	19					
	28	4d	1.79	ND	ND	584	23					
	29	4e	3.54	ND	ND	1122	45					
	Event/Daily Max								0.10	6.1	230	27
	Mon. Total/Avg	4	23.54	1	2.96	14912	1997	86.6%	0.10		230	27

Month	Day	EWCSO Inflow Event Number	EWCSO Inflow Volume (MG)	EWCSO Discharge Event Number	EWCSO Discharge Volume (MG)	Total Influent TSS (lbs)	Total Effluent TSS Discharged @ EWCSO + WP (lbs)	% removal	EWCSO Effl. Settl Solids (ml/l/hr)	EWCSO Effl. pH	EWCSO Avg Effl. Fecal Coliforms (#/100 ml)	EWCSO Effl. Residual Chlorine (ug/l)
April	1	1a	0.96	ND	ND	849	29					
	2	1b	0.81	ND	ND	5593	194					
	8	2a	0.51	ND	ND	3173	110					
	9	2b	0.87	ND	ND	167	6					
	10	2c	0.66	ND	ND	4833	168					
	14	3	0.63	ND	ND	5123	178					
	18	4	0.26	ND	ND	1132	39					
	28	5a	0.84	ND	ND	2053	71					
	29	5b	0.34	ND	ND	539	19					
	Event/Daily Max											
	Mon. Total/Avg	5	5.9	ND	ND	23461	814	96.5%				
May	No events											
	Total Annual	**28**	**321.26**	**3**	**188.73**	**224357**	**77616**	**65.4%**				**73**
	Avg/GEM								**0.9**			
	Min/Max								**4.0**	**6.1/7.4**	**10024**	

Table 4 2007/08 Elliott West Annual Values

	Inflow Volume (MG)	Discharge Volume (MG)	Total EWCSO TSS lbs-in	Total EWCSO TSS lbs Discharged	Annual Average EWCSO %TSS Removal	Annual Average EWCSO Settleable Solids (ml/l/lhr)	Maximum Monthly Geomean EWCSO Effl. Fecal Coliforms (#/100 ml)	Maximum of Daily Averages of EWCSO Effl. Res. Cl2 (ug/l)
Including all Discharge Events	321.3	188.7	224357	77616	65.4%	0.86	10024	73
Excluding discharge event #1 from December 2007 (12/2-12/4)					92.2%	0.1		

Appendix D
Henderson/Norfolk CSO Treatment Plant
Annual Report
June 2007 – May 2008

This 2007-08 annual report summarizes the performance of King County's Henderson/Norfolk CSO treatment facilities. These CSO facilities came on-line in 2005. They currently operate under the NPDES permit for the West Point Treatment Plant (WA-0029181-1), which expires December 31, 2008.

There was one inflow event and one discharge event during the June 1, 2007 - May 31, 2008 CSO reporting period. A total of 23.3-MG of CSO entered the facility, and 19.8-MG of treated CSO was discharged. The largest (and only) discharge event occurred over 20 hours on Dec. 3, 2007. This was the largest discharge event to date for the Henderson/Norfolk CSO facility.

Table 1 summarizes the permit performance of the facility during this CSO year. The 50% annual suspended solids limit was not met during this large and dilute event. But when it is designated as the "one untreated event" and dropped from the solids limit calculation, there is no permit violation. Settleable solids removal met monthly and event-based limits. The facility did not meet the monthly and daily limits for chlorine residual or fecal coliforms. Disinfection and dechlorination continued to be a challenge. It is discussed further below.

Table 1: Treatment Performance and Permit Limit Compliance

Parameter	Long Term Ave. Limit[t]	Long Term Ave.	Yearly Ave. Limit[u]	Yearly Ave.	Monthly Limit	Monthly	Max. Daily Ave. Limit[v]	Max. Daily
Number of Events/Yr	**Report**	1						
Volume/Yr (MG)	**Report**	9.6						
TSS Removed Efficiency[w]			**50%**	no violation				
Settleable Solids, ml/l/hr			**0.3**	0.2	**1.9 max**	0.2	0.2	0.2
FecalColiform CFU/100 ml.					**400**	6158		
Total Residual Chlorine, ug/L							**172**	393

[t] Long-term average will be calculated using data collected over a full permit cycle. Data shall be collected and reported for the period of the permit cycle prior to permit renewal. Facility has only operated 3-yrs, so this is a 3-yr average.

[u] The yearly limitations will be calculated using per-event data points. Data shall be collected and reported on a schedule concurrent with the annual CSO report, June 1 to May 31, to include the entire wet season for purposes of determining compliance with these limitations.

[v] The maximum daily effluent concentration determined from a continuous measurement is calculated as the average of the pollutant concentrations measured over the day.

[w] The total removal efficiency for TSS is to be calculated on a mass balance basis as the percent of solids captured at the CSO Treatment Plant and then permanently removed at the West Point Treatment Plant based on the estimated removal efficiency at West Point.

Table 2 summarizes the annual and running 5-year average discharge volumes and frequency. Compliance is only assessed at the end of a permit cycle, prior to permit renewal. This year is a compliance reporting year.

Table 2: Henderson/Norfolk Yearly and Average Discharge Volumes & Event Frequency

Year	Discharge Volume Per Year, MG	Treated Discharge Events per Year	"once per year untreated event"[x]
June 05 – May 06	0	0	Did not operate
June 06 – May 07	9.0	3	1 - 12/11-15/06 event removed
June 07 – May 08	19.8	0	1- 12/2-4/07 event removed
3-year average for seasons ending in 2006-2008	9.6	1.0	<1/yr (0.66)

[a]Note: the facility only has only operated 3 years

Season's Weather Conditions

35.0-inches of rain fell during the reporting year, compared to a historic average of 37-inches. 26% of the annual rainfall occurred in December 2007, with 5.3-inches falling over 34-hours during Dec. 2-3, 2007. A small snowfall preceded the rainstorm, undoubtedly contributing to the runoff entering the CSO treatment facility.

Operational Challenges.

For the most part, the Henderson/Norfolk CSO facilities operated well during the Dec. 3 event. The hydraulic components and controls operated as designed, e.g., the inlet regulator gate modulated at the appropriate sewer levels. Equipment started, stopped, and operated in auto as designed (e.g., auto-start and flow-paced operation of the hypochlorite and bisulfite pumps). Instrumentation worked appropriately throughout the event, e.g., the effluent chlorine analyzer.

The hypochlorite pumps and bisulfite pumps operated in accordance with the control system. Unfortunately, the hypochlorite doses were excessive during the initial hours of the Dec. 3 event, resulting in a high Cl_2 residual at the tunnel outlet. In response, Operations manually turned off one of two hypochlorite feed pumps. Unfortunately, the pump that was turned off was the only pump programmed to operate below 48 MGD inlet flow. So, there was no disinfection once the inlet flow dropped below 48-mgd. The second set of grabs was collected before the hypochlorite feed was restored, resulting in a very high fecal coliform count.

Optimization of the disinfection and dechlorination systems will continue to be a challenge. This is due to the limited CSO events available for fine-tuning, as well as the difficulties of measuring the Cl_2 residual for feedback control. Currently, the hypochlorite and bisulfite pumps are only flow-paced, though there is an initially high dose of hypochlorite to address the "first flush" phenomenon. During the 2008-09 season, the controls for the hypochlorite feed pumps will be

[x] One event each season may be excluded from the solids calculations as the one untreated event per year, but not the frequency and volume counts.

adjusted to reduce that initial dosing rate. Also, a sample hatch has been installed at the tunnel outlet prior to bisulfite addition. Operations will hand-monitor the chlorine residual at this location so adjustments can be made to the hypochlorite pump dose rate during an event.

Exacerbating the effort to fine-tune the hypochlorite and bisulfite pumps are the pumps' capacities. Their capacity is based on a peak hydraulic tunnel capacity of 146 MGD. By contrast, the peak flow during the Dec. 3, 2007 storm was about 55-MGD, a storm of regional historic proportions. So, problems with controlling hypochlorite dosing may also have to consider a limited turn-down capability of the current hypochlorite and bisulfite pumps.

In Jan. 2008, a problem was found with the calculated tunnel inlet flow. Adjustments have subsequently been made to the inlet flow algorithm. These adjustments will be verified during the next filling and/or discharge event. The tunnel outlet flow algorithm appears to be fairly accurate based on the Dec. 2007 event.

During the 2007-2008 wet season, staff attempted to set up an automatic flow-paced dedicated composite sampling system for collecting priority pollutants. Various modifications were required to use the existing discrete composite sampler, including installing Teflon tubing and stainless steel components. Unfortunately, staff was unable to remove the existing suction tubing because of the difficult piping bends and configuration. A field blank has subsequently been collected for the existing sampling system to see if it can meet the quality control criteria for background contamination; the results are pending. If the field blank meets the criteria, a sampling system will be ready to collect priority pollutant samples early in the 2008-2009 CSO wet season. If the field blank does not meet the criteria, we will need to reevaluate how and where to collect tunnel discharge samples. If necessary, we will collect and combine effluent grab samples in a manner that reflects a flow composited sample.

Staff was also unable to obtain priority pollutant samples during the previous two wet seasons as well. There was no discharge event during the first wet season, and there were repeated and prolonged problems with the discharge sample pump during the second wet season.

Routine Operation and Maintenance Activities

The Henderson/Norfolk CSO inlet and outlet regulator stations, and tunnel, are fully functioning and available for next season. More detail is available in the reports accompanying the monthly discharge monitoring reports. Operations, Maintenance and Process staff will continue to debrief after each event providing information and feedback on performance, operational and maintenance issues.

Table 3. Summary of Henderson/Norfolk 2007/08 Event Data

Month	Day	Hen/Nor Inflow Event Number	Hen/Nor Inflow Volume (MG)	Hen/Nor Discharge Event Number	Hen/Nor Discharge Volume (MG)	Hen/Nor Total Influent TSS (lbs)	Hen/Nor Total Effluent TSS Discharged @ Hen/Nor + WP (lbs)	Hen/Nor % TSS Removal	Hen/Nor Effl. Settl Solids (ml/l/hr)	Hen/Nor Effl. pH	Hen/Nor Avg Effl. Fecal Coliform(#/100 ml)	Hen/Nor Effl. Residual Chlorine (ug/l)
June 2007	No events											
July 2007	No events											
August 2007	No events											
September 2007	No events											
October 2007	No events											
November 2007	No events											
December 2007												
Dec. 3	**Event/Daily Max**	1	**23.3**	1	**19.8**	**10,882**	**6320**	41.9%	**0.2**	6.3	6158	172
	Mon. Total/Avg	1	23.3	1	19.8	10,882	6320	41.9%	0.2	6.3	6158	172
Janyary 2008	No events											
February 2008	No events											
March 2008	No events											
April 2008	No events											
May 2008	No events											
Total		1	**23.3**	**1**	**19.8**	**10882**	**6320**					
Annual Avg/GEM								**41.9%**	**0.2**		**6158**	**172**
Min/Max or Max									**0.2**	**6.3**		

Table 4. 2007-2008 Henderson/Norfolk Annual Values

	No.of Dischage Events	Inflow Volume (MG)	Discharge Volume (MG)	Total Hen/Nor TSS lbs-in	Total Hen/Nor /WP TSS lbs Discharged	Annual Average Hen/Nor %TSS Recovery	Annual Average Hen/Nor Settleable Solids (ml/l/lhr)	Event Maximum Hen/Nor Settleable Solids (ml/l/lhr)	Maximum Monthly Geomean Hen/Nor Effl. Fecal Coliforms (#/100 ml)	Maximum of Daily Averages of Hen/Nor Effl. Res. Cl2 (ug/l)
Including All Events	1	23.3	19.8	10,882	6320	41.9%	0.2	0.2	6158	172
Excluding 12/3/2007 Event						no violation				