STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
Northwest Regional Office • 3190 160th Avenue SE • Bellevue, Washington 98008-5452 • (425) 649-7000

September 28, 2012

Karen Huber, Lead
King County CSO Program
KSC-NR-0500
201 S Jackson St
Seattle, WA 98104-3855

Re: Post-Construction Monitoring Plan for King County Combined Sewer Overflow (CSO) Controls - APPROVAL

Dear Ms. Huber:

Pursuant to condition S18.K.3.a of King County's NPDES permit, WA-02918-1, the required CSO Post-Construction Monitoring Plan (PCMP) was submitted to the Department of Ecology (Ecology) on June 30, 2010 for review and approval. Ecology reviewed the draft PCMP and provided comments on September 22, 2010. The County responded to Ecology's comments eighteen months later by providing a revised draft to Ecology on March 30, 2012. Ecology issued comments on the revised draft PCMP on July 30, 2012. The final PCMP document was received by Ecology on September 18, 2012. Ecology has reviewed the final PCMP (September 2012) for consistency with the permit requirements and is hereby **approved** for use as a general plan to conduct post-construction monitoring near the County's CSO outfalls. Enclosed please find an approved copy of the final PCMP for your records.

King County's NPDES permit condition S18.K.3.b requires the County to implement the PCMP after Ecology approval. Specifically, the County is required to submit a CSO PCMP Data Report no later than August 31, 2012. As this compliance date has passed, please provide the required PCMP data report as soon as possible.

Ecology reserves the right to require additional monitoring and other types of monitoring activities if the water and sediment quality standards are not being met.

If you have any questions concerning this approval, please contact Mark Henley at (425) 649-7103 or via e-mail at Mark.Henley@ecy.wa.gov.

Sincerely,

Kevin C. Fitzpatrick
Water Quality Section Manager

KCF:MH:bl
Enclosure: Post-Construction Monitoring Plan for King County Combined Sewer Overflow (CSO) Controls (dated September 2012)

cc: Central Files, King County, WA-02918-1, WQ 3.1

e -cc: Betsy Cooper, King County
Rob Grandinetti, EPA
Mark Henley, Municipal Unit Supervisor, Ecology
Alison Evans, Facility Manager, Ecology

Post Construction Monitoring Plan for King County CSO Controls

September 2012

FINAL

King County

Department of
Natural Resources and Parks
Wastewater Treatment Division

For comments or questions, contact:
Karen Huber
King County Wastewater Treatment Division
201 South Jackson Street
KSC-NR-0512
Seattle, WA 98104-3856
206-684-1246
Karen.Huber@kingcounty.gov

This information is available in alternative formats on request at 206-684-1280 (voice) or 711 (TTY).

Contents

Contents i
Summary iii
1 Introduction 1
1.1 Background 1
1.2 Regulations 2
1.2.1 Regulations for Planning and Design of CSO Control Facilities 3
1.2.2 Water Quality Regulations 3
1.2.3 Sediment Quality Regulations 5
1.3 Locations and Control Status of County CSOs 5
1.4 Goals of CSO Control Plan 6
1.5 Purpose of this Post Construction Monitoring Plan 7
2 Existing Data 11
2.1 Untreated CSO Quality 11
2.2 Treated CSO Quality 12
2.3 Ambient Water Quality 12
2.4 Sediment Quality 13
2.5 Rainfall 18
2.6 Discharge Onset, Duration, and Volume 18
3 Post-Construction Monitoring 19
3.1 Monitoring to Verify the Effectiveness of CSO Controls 20
3.1.1 Discharge Frequency 20
3.1.2 Treatment Effectiveness 22
3.1.3 Green Stormwater Infrastructure 23
3.2 Monitoring to Assess Compliance with Water Quality Standards 24
3.2.1 Effluent Monitoring 25
3.2.2 Ambient Water Quality Monitoring 25
3.2.3 Sediment Monitoring 29
3.3 Quality Control and Data Management 36
4 Data Evaluation and Progress Reporting 37
4.1 Discharge Frequency 37
4.2 Compliance with Surface Water Quality Standards 38
4.3 Compliance with Sediment Management Standards 38
4.4 Influence of Other CSOs 39
5 References 41
Appendix A. Water Quality Standards A-1
Appendix B. Flow Measurement Sampling and Analysis Plan and Quality Assurance Project Plan B-1
Appendix C. Treated CSO Sampling and Analysis Plan and Quality Assurance Project Plan C-1
Appendix D. Receiving Water Characterization Study Sampling and Analysis Plan and Quality Assurance Project Plan D-1
Appendix E. Freshwater Lakes Sampling and Analysis Plan and Quality Assurance Project Plan E-1

Appendix F. Beaches Sampling and Analysis Plan and Quality Assurance Project Plan F-1
Appendix G. Marine Water Column and Nearshore Sampling and Analysis Plan and Quality Assurance Project Plan G-1
Appendix H. Sediment Sampling and Analysis Plan and Quality Assurance Project Plan H-1

Tables

Table 1. King County CSO Discharge Locations and Status 9
Table 2. Sediment Samples near CSO Discharge Locations and Status 15
Table 3. Post Construction Compliance Monitoring Plan 19
Table 4. Initiation of King County CSO Treatment and Effluent Quality Monitoring 23
Table 5. PCMP Ambient Sampling Locations 27
Table 6. Sediment characterization schedule 34

Figures

Figure 1. King County CSO Locations 8
Figure 2. PCMP Ambient Monitoring Locations 28
Figure 3. PCMP Sediment monitoring flowchart 33

Summary

King County's post construction monitoring plan is designed to assess, document, and report on the effectiveness of its combined sewer overflow (CSO) control program in achieving performance requirements and complying with state water and sediment quality standards.

Post construction monitoring to be conducted at each CSO is summarized in the following table. All CSO locations will be monitored for onset, duration, and volume of the discharge. In addition, discharge locations that provide CSO treatment will be monitored for influent and effluent quality. Sampling of the wet-weather discharges will be done in coordination with sampling for NPDES permit compliance. In addition to this monitoring, King County will continue to collect precipitation data at an equivalent level to the existing network of rain gauges and will continue its ongoing ambient monitoring program.

Post Construction Compliance Monitoring Plan

Medium	Post Construction Monitoring to be Conducted
CSO discharge	Untreated CSOs controlled to one overflow per year or less: Overflow onset, duration, and volume using SCADA and portable meters Treated CSO discharges: Overflow onset, duration, and volume using SCADA Influent and effluent quality sampling; reasonable potential analysis to assess compliance with water quality standards
Sediment	Sites with adequate characterization and no existing SMS exceedances: No sediment monitoring Sites with existing SMS exceedances or inadequate sediment characterization: Project-specific pre-construction (if needed) and post-construction sediment monitoring used to determine if SMS still exceeded; a site specific cleanup plan if needed
Receiving water	Ongoing ambient monitoring programs and sampling specified in the NPDES permit

SCADA = supervisory control and data acquisition system.

Assumptions used to develop the plan are as follows:

- CSOs controlled to no more than one untreated event per year on average will request and be granted an average once per year exemption to the numeric mixing zone size criteria described in Section 173-201A-400 WAC and will be deemed to comply with receiving water quality standards. Monitoring for these sites focuses on characterizing the quantity and frequency of discharges.
- The effectiveness of the CSO control at treated CSO sites is to be assessed by monitoring their ability to provide the equivalent of primary treatment— at least 50 percent removal of the total suspended solids and discharges less than 0.3 mL/L/hr of settleable solids on an annual basis—and on other NPDES permit limits that apply to the effluent.

- King County will evaluate treated CSO compliance with state water quality standards by conducting a reasonable potential analysis based on the treated effluent quality data and existing ambient quality data.
- Data from previous studies and from ongoing monitoring programs are sufficient to characterize ambient water quality in receiving waters.
- At locations where SMS are currently met with an uncontrolled CSO, the activity of reducing the CSO discharge to achieve control will not degrade the existing sediment quality.
- All CSOs currently meeting SMS will be evaluated for the potential of new upstream sources discharging to the combined sewer system, or other factors adversely affecting sediment quality on a case-by-case basis.

Monitoring data and evaluation will be reported to the Washington State Department of Ecology through the monthly discharge monitoring reports, annual CSO reports, and CSO plan updates. The post construction monitoring plan will be updated periodically to reflect changing conditions and requirements.

1 Introduction

King County's wastewater collection and treatment system currently has 38 combined sewer overflow (CSO) locations and 4 CSO treatment plants. Their outfalls discharge to Lake Washington, Lake Union, Lake Washington Ship Canal, Duwamish River, Elliott Bay, and Puget Sound. The county is working toward controlling all its CSO locations by 2030 to meet the Washington State standard of no more than one untreated overflow on average per year at each location. These CSOs are regulated through the National Pollutant Discharge Elimination System (NPDES) permit for the West Point Treatment Plant.

In response to the Clean Water Act of 1972, the Municipality of Metropolitan Seattle (Metro) adopted the *Combined Sewer Overflow Control Program* in 1979. Since adoption of this first program, Metro and then later King County have modified plans to respond to evolving CSO regulations and wastewater system needs. The most recent CSO control plan was adopted in 1999 as part of the county's Regional Wastewater Services Plan (RWSP) and was updated in 2000 and 2008 as a part of the West Point plant's NPDES permit renewal.

This document describes a post construction compliance monitoring plan to measure the effectiveness of CSO controls and to provide information for use in demonstrating compliance with state water and sediment quality standards.

The following sections in this chapter provide background on the impetus for the plan, regulations that guide environmental protection and CSO control, and locations and control status of county CSOs.

A History of CSO Plans

1979—Metro adopted its first *Combined Sewer Overflow Control Program.*

1985 and 1986—The *Plan for Combined Sewer Overflow Control* and the *Supplemental Plan for Combined Sewer Overflow Control* were prepared as part of a system-wide planning effort

1988—The *1988 Combined Sewer Overflow Control Plan* was prepared in response to Ecology's 1987 definition of control as one untreated discharge per year.

1995—As part of the 1995 West Point NPDES permit renewal, King County prepared an update and amendment to the 1988 plan.

1999—A CSO control plan was adopted as part of the Regional Wastewater Services Plan (RWSP). The plan lists 21 control projects to bring all CSOs into control by 2030.

2000—The RWSP CSO control plan was updated as part of the West Point NPDES permit renewal. No changes to the RWSP CSO control plan were recommended.

2006—The first CSO control program review was completed.

2008—The RWSP CSO control plan was updated as part of the West Point NPDES permit renewal. No changes to the RWSP CSO control plan were recommended.

1.1 Background

The U.S. Environmental Protection Agency (EPA) requires CSO communities to conduct a post-construction monitoring program for their controlled CSOs to "verify compliance with water quality standards and protection of designated uses as well as to ascertain the effectiveness of CSO controls" (Section II.C.9 of the CSO Control Policy). In accordance with this requirement, Section 18.K of the West Point NPDES permit requires King County to implement a post construction compliance monitoring program and to prepare a plan that describes the program:

> The Permittee must implement a post construction compliance monitoring program adequate to verify compliance with water quality standards and protection of designated uses as well as ascertain the effectiveness of CSO controls. This water quality compliance monitoring program must include a plan that details the monitoring protocols to be followed, including

> the necessary effluent and ambient monitoring and, where appropriate, other monitoring protocols such as biological assessments, whole effluent toxicity testing, and sediment sampling. The plan must be reviewed and approved by Ecology….The plan should include a discussion of controlled outfalls that may be influenced by other County or City of Seattle uncontrolled outfalls that may adversely influence or interfere with the water quality assessment of controlled outfalls. The Permittee must provide adequate justification for not performing post construction monitoring for controlled CSO outfalls where water quality may be impacted by nearby outfalls.

The post construction monitoring plan described in this document groups CSO controls into two categories to evaluate their effectiveness. One category consists of the implementation of conveyance system improvements, including storage or Green Stormwater Infrastructure (GSI), with the objective of reducing the average number of overflows to no more than one untreated event per year on average as specified in WAC 173-245-020(22). Compliance will be based on a 20-year moving averaging period, including past years and the current year. It is assumed that for CSOs controlled to this standard the County will request and the State will grant the mixing zone exemption described in WAC 173-201A-400 (see "Regulations" below) and the CSO will be deemed to meet the surface water quality standards. Monitoring for these types of controls focuses on characterizing the quantity and duration of discharges, monitoring the condition of the GSI-managed area, as well as the confirmation that there are no exceedances of sediment management standards at the outfall due to the CSO. If the CSO appears to have contributed to existing SMS exceedances, then such contamination will be remediated.

The second type of control consists of a CSO treatment facility that is designed to provide the equivalent of primary treatment and disinfection. Monitoring for this type of control focuses on characterizing the quantity, duration, and quality of both the influent and treated effluent. The effectiveness of the CSO control is to be assessed from the ability to provide the equivalent of primary treatment: at least 50 percent removal of the total suspended solids (TSS) and discharges less than 0.3 mL/L/hr of settleable solids. In addition, the treated effluent must meet any limits defined in the NPDES permit that the reasonable potential analysis identified as being needed.

Monitoring activities designed to demonstrate compliance with water quality standards include effluent and sediment sampling. A reasonable potential calculation is proposed as the methodology to demonstrate compliance with surface water quality standards. Compliance with sediment quality standards will be demonstrated through sediment sampling combined with model predictions.

1.2 Regulations

In Washington State, the planning and design of the CSO controls are required to follow the requirements set out by the Washington State Department of Ecology (Ecology) in Chapter 173-245 WAC, submission of plans and reports for construction and operation of combined sewer overflow reduction facilities. These regulations include requirements for flow monitoring, hydraulic model development and verification, sampling of pollution levels, and sediment sampling if historical contamination may be present.

Once the Ecology-approved designs are constructed, WAC 173-201A-010 requires compliance with Chapter 173-201A WAC, water quality standards for surface waters of the State of

Washington; Chapter 173-204 WAC, sediment management standards; and applicable federal rules. These regulations are described below.

1.2.1 Regulations for Planning and Design of CSO Control Facilities

The plans and specifications developed during project design must conform to the guidance in the *Criteria for Sewage Works Design* (WAC 173-245-050), which states that "compliance with the state water quality standards is a requirement that must always be achieved" (C3-1.2.3). Analyses of how the design will meet applicable criteria are submitted to Ecology prior to project construction as part of a project-specific engineering report or facility plan. The NPDES permit sets conditions and permit limits to assure the goals and requirements are met. Following project completion, post construction monitoring assesses whether the CSO control is operating as designed and complies with state water quality standards.

Regulations Related to CSO Control

Clean Water Act (CWA)—Adopted in 1972 to eliminate the discharge of pollutants into the nation's waters and to achieve and maintain fishable and swimmable waters.

National Pollutant Discharge Elimination System (NPDES)—The Washington State Department of Ecology (Ecology) implements the CWA by issuing NPDES permits to wastewater agencies and industries that discharge effluent (including CSOs) to water bodies.

Water Quality Standards—To implement CWA, Ecology has developed biological, chemical, and physical criteria to assess a water body's health and to impose NPDES permit limits accordingly.

State CSO Control Regulations—Ecology requires agencies to develop plans for controlling CSOs at the earliest possible date so that an average of one untreated discharge per year occurs at each location.

Wet Weather Water Quality Act of 2000—The U.S. Environmental Protection Agency (EPA) requires agencies to implement Nine Minimum Controls and to develop long-term CSO control plans.

Sediment Quality Standards—Ecology developed chemical criteria to characterize healthy sediment quality and identified a threshold for sediment cleanup. King County has participated in sediment cleanup at some of its CSO locations.

Endangered Species Act (ESA)—Some species of fish that use local water bodies where CSOs occur have been listed as threatened under ESA.

1.2.2 Water Quality Regulations

Washington State surface water quality standards, Chapter 173-201A WAC, require meeting quantifiable standards as well as protecting the designated use of a water body. The standards include both numeric and narrative criteria (Appendix A).

Water quality standards must be met at the point of discharge or at the edge of a mixing zone. The standards include language that exempts one CSO discharge per year on average from the numeric water quality standards to align with the state CSO control standard. The exemption is implemented as a mixing zone of unlimited extent in WAC 173-201A-400 (mixing zones) which specifically applies to controlled CSO discharges:

> (11) Combined sewer overflows complying with the requirements of Chapter 173-245 WAC, may be allowed an average once per year exemption to the numeric size criteria in subsections (7) and (8) of this section and the overlap criteria in subsection (9) of this section, provided the discharge complies with subsection (4) of this section.

Referenced subsection (4) reads as follows:

> (4) No mixing zone shall be granted unless the supporting information clearly indicates the mixing zone would not have a reasonable potential to cause a loss of sensitive or important habitat, substantially interfere with the existing or characteristic uses of the water body, result

in damage to the ecosystem, or adversely affect public health as determined by the department.

Treated CSO discharge events, which may occur multiple times per year, are evaluated against water quality standards. The numeric size criteria exemption of a mixing zone is not applied to treated CSO discharge events, and water quality standards will be evaluated at the boundary of the mixing zone. The applicability of numeric standards to CSOs are as follows:

- The acute aquatic life numeric standards are applicable because of the intermittent and short duration (typically less than 48 hours) of CSOs.
- The chronic aquatic life standards, intended to be protective of four-day exposure durations (Ecology, 2008, Table VI-4), typically would not be applicable to shorter duration discharges.
- The human health criteria are based on lifetime exposure and are evaluated with the annual/maximum monthly effluent averages (Ecology, 2008, Table VII-1) and are not appropriate for CSO discharges.

Narrative criteria are designed to protect all existing and designated uses and are given in WAC 173-201A-260 (2) for fresh and marine waters (see Appendix A):

(a) Toxic, radioactive, or deleterious material concentrations must be below those which have the potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those waters, or adversely affect public health (see WAC 173-201A-240, toxic substances, and 173-201A-250, radioactive substances).

(b) Aesthetic values must not be impaired by the presence of materials or their effects, excluding those of natural origin, which offend the senses of sight, smell, touch, or taste (see WAC 173-201A-230 for guidance on establishing lake nutrient standards to protect aesthetics).

The 1972 federal Clean Water Act requires states to prepare a list of water bodies that do not meet water quality standards for ensuring the water is healthy for such uses as fish and wildlife habitat and recreation in and on the water. Water bodies identified on the list must attain water quality standards within a reasonable period, either through a water cleanup plan based on total maximum daily loads (TMDLs) or other pollution control mechanisms. Water cleanup plans describe the type, amount, and sources of water pollution in a particular water body; analyze how much the pollution needs to be reduced or eliminated to meet water quality standards; and provide targets and strategies to control the pollution (Ecology, 2002).

Ecology compiles environmental data, including King County's, into a database named EIM. Violations of water quality standards identified through these data form the basis for the state's 303(d) list of impaired water bodies. The most recent list was published in 2008 and covers both fresh and marine waters. Subsequent to the 2008 listing, Ecology decided to publish assessments of marine waters and fresh waters in alternating two-year cycles, starting with a marine water assessment in 2010.

All of the receiving water bodies for county CSOs have listings for impairment because of fecal coliform bacteria levels. Water column samples also indicate impairment for dissolved oxygen (Duwamish Waterway), pH (Duwamish River), total phosphorus (Lake Washington and Lake

Union),[1] lead (Lake Washington Ship Canal and Lake Union), and aldrin (Lake Union). The Duwamish Waterway has listings for impairment from a wide variety of chemicals detected in sediment and tissue samples. In addition, there are a few sediment and tissue listings at discrete locations in Lake Washington and Puget Sound.

1.2.3 Sediment Quality Regulations

Regulation of contaminated sediments in the marine environment of Washington State typically falls under the authority of Ecology. In 1991, Ecology adopted the Sediment Management Standards (SMS; Chapter 173-204 WAC) for designating marine sediments that have acute or chronic adverse effects on aquatic organisms. Ecology has begun the process of creating a consistent set of standards for freshwater sediments (Ecology, 2011). Currently, state standards for freshwater sediment quality are determined on a case-by-case basis (WAC 173-204-315).

Three sets of standards were established under the SMS: sediment quality standards, sediment cleanup standards, and source control standards (Ecology, 2007):

- Sediment quality standards (SQS) correspond to a sediment quality that will result in no adverse effects, including acute or chronic adverse effects, on biological resources and no significant health risk to humans. The SQS includes chemical concentration criteria for 47 chemicals. If sediment chemical concentrations exceed SQS criteria, the sediments are designated as potentially having an adverse effect on biological resources and fail the SQS. Sediments failing the SQS may be reevaluated using biological tests described in WAC 173-204-315 to confirm or refute the original designation.
- If sediments exceed the SQS for any one of the 47 listed chemicals, they are subject to sediment cleanup standards set forth in WAC 173-204-520. Cleanup screening levels (CSLs) set the maximum degree of concentration needed to identify a cluster of potential concern, above which the cluster is defined as a cleanup site. Similarly, minimum cleanup levels (MCULs) establish the maximum degree of contamination to be allowed on a site after cleanup and are to be used in the evaluation of cleanup alternatives as specified in the SMS. MCULs are set at the same concentration as CSLs.
- Source control standards define the maximum level of sediment contamination allowed in sediments impacted by permitted ongoing discharges (WAC 173-204-420). Ecology has the ability to designate a zone (sediment impact zone or SIZ) in which contamination above the SQS standards is allowed provided that appropriate source control activities have occurred and the discharge is not expected to create a cleanup site (WAC 173-204-400/410).

1.3 Locations and Control Status of County CSOs

King County CSO outfalls and CSO treatment facilities are shown in Figure 1. Eighteen county CSO locations are reported as controlled to a frequency of, on average, less than one untreated event per year (Table 1). Four of the controlled locations receive treatment equivalent to primary and disinfection. The RWSP CSO control plan lists conveyance system improvements, storage facilities, and treatment facilities to bring the remaining CSOs into control.

[1] King County data indicate that total phosphorus levels do not exceed standards in Lake Washington and the Lake Washington Ship Canal.

The West Point Plant also provides some CSO treatment via a CSO-related bypass. The CSO flows receive primary treatment and then are mixed with secondary treated effluent before disinfection and discharge. The mixed effluent complies with secondary treatment standards.

As shown in Table 1, no King County outfalls that discharge treated CSO or will discharge treated CSO in the future are near (less than 500 feet) other CSOs. Other CSOs are near 15 untreated county CSOs, either currently controlled or not yet controlled to one overflow per year or less. It is assumed that once untreated CSOs are controlled, they meet state water quality standards with the application of the mixing zone exemption in WAC 173-201A-400, as described above under "Water Quality Regulations." As a result, adjacent discharges will not affect the ability of these CSOs to comply with the numeric water column quality standards.

Ongoing Reporting on Status of CSO Control Program

Monthly discharge monitoring report (DMR). Reports on onset, duration, volume, and frequency of discharge events; treated CSO quality; and rainfall.

Annual CSO control program report. Compiles and summarizes DMR information for each calendar year.

CSO control plan update. Submitted about every five years with renewal application for the West Point NPDES permit. Reports on progress and plans to control all CSOs to the state standard.

1.4 Goals of CSO Control Plan

King County's CSO Control plan is intended to fulfill the mandate encoded in King County Code 28.86.080. Of specific relevance to this PCMP are the CSO control policies 1 and 2:

> CSOCP-1: King County shall plan to control CSO discharges and to work with state and federal agencies to develop cost-effective regulations that protect water quality. King County shall meet the requirements of state and federal regulations and agreements.
>
> CSOCP-2: King County shall give the highest priority for control to CSO discharges that have the highest potential to impact human health, bathing beaches and/or species listed under ESA.

The Washington State requirements in WAC 173-245-015 state:

> All CSO sites shall achieve and at least maintain the greatest reasonable reduction, and neither cause violations of applicable water quality standards, nor restrictions to the characteristic uses of the receiving water, nor accumulation of deposits which: (a) Exceed sediment criteria or standards; or (b) have an adverse biological effect.

where the greatest reasonable reduction is defined in WAC 173-245-020 (22) as:

> "The greatest reasonable reduction" means control of each CSO in such a way that an average of one untreated discharge may occur per year.

The CSO control plan proposes controlling all of King County's CSOs to no more than one untreated discharge per year. The performance of CSO treatment facilities is proposed to meet Washington State requirements of the equivalent of primary treatment, defined by at least a fifty percent removal of the total suspended solids from the waste stream, and less than 0.3 ml/l/hr. of settleable solids in the discharge. Disinfection is proposed for treated discharges.

1.5 Purpose of this Post Construction Monitoring Plan

As outlined in EPA's CSO Control Policy, post construction compliance monitoring is intended to provide data that can be used to:

- Verify the effectiveness of CSO controls
- Demonstrate compliance with WQS, protection of designated uses and sensitive areas

The data gathered under this PCMP is intended to be used to determine if King County is achieving the goals of its CSO Control Plan. The data will first provide an assessment of system performance to determine if the CSO Control Plan has resulted in the system meeting the standard of an average of one or fewer untreated overflows per year and treated discharges receiving the equivalent of primary treatment and disinfection as outlined in WAC 173-245. Next, the data will assess if water quality standards are being met by the CSO discharges. The proposed monitoring reflects the guidance on how to conduct effective post construction compliance monitoring issued in the document "CSO Post Construction Compliance Monitoring Guidance" (EPA, 2011).

Figure 1. King County CSO Locations

Table 1. King County CSO Discharge Locations and Status

DSN No.[a]	Facility	Nearby CSO[b]	Receiving Water	Status
003	Ballard Siphon Regulator		Lake Washington Ship Canal via city Storm Drain	Not controlled
004	11th Avenue NW (also called East Ballard)		Lake Washington Ship Canal	Not controlled
006	Magnolia Overflow	City CSO 064 – 300 feet north	Elliott Bay/Puget Sound	Not controlled[d]
007	Canal Street Overflow	City CSO 174 – 500 feet west County CSO 008 – 500 feet west	Lake Washington Ship Canal	Controlled
008	3rd Ave W and Ewing Street	City CSO 174 – 200 feet north County CSO 007 – 500 feet east	Lake Washington Ship Canal	Not controlled
009	Dexter Avenue Regulator		Lake Union	Not controlled[c]
011	E Pine Street Pump Station Emergency Overflow	City CSO 028 – 350 feet south City CSO 027 – 100 feet west	Lake Washington	Controlled
012	Belvoir Pump Station Emergency Overflow	Shares outfall with County CSO 049 City CSO 018 – 250 feet south	Lake Washington	Controlled
013	Martin Luther King Way Trunkline Overflow	Shares outfall with County CSO 045 City CSO 047 – 125 feet north City CSO 176 – 200 feet south	Lake Washington via storm drain	Controlled
014	Montlake Overflow		Lake Washington Ship Canal	Not controlled
015	University Regulator		Lake Washington Ship Canal	Not controlled
018	Matthews Park Pump Station Emergency Overflows		Lake Washington	Controlled
027b	Elliot West CSO Treatment Facility	County CSO 027a 340 feet inshore	Elliott Bay	Controlled — CSO treatment facility
027a	Denny Way Regulator	County CSO 027b 340 feet offshore	Elliott Bay	Not controlled[c]
028	King Street Regulator		Elliott Bay	Not controlled
029	Kingdome Regulator (replaced Connecticut Street Regulator)		Elliott Bay via the Connecticut storm drain	Not controlled
030	Lander Street Regulator		East Waterway of Duwamish River	Not controlled
031	Hanford #1 Overflow (Bayview N, Bayview S, and Hanford at Rainier)	Shares outfall with county CSO 034 and city CSO 111	Duwamish River via Diagonal storm drain	Not controlled
032	Hanford #2 Regulator		East Waterway of Duwamish River	Not controlled
033	Rainier Avenue Pump Station Emergency Overflow	City CSO 039 – 50 feet NE City CSO 038 – 100 feet SE	Lake Washington	Controlled
034	East Duwamish Pump Station Emergency and Siphon Aftbay Overflows	Shares outfall with county CSO 031 City CSO 111 – 50 feet south	Duwamish River via the Diagonal storm drain	Controlled
035	West Duwamish Siphon Forebay Overflow		Duwamish River	Controlled
036	Chelan Avenue Regulator	City CSO 104 – 300 feet NE	West Waterway of Duwamish River	Not controlled
037	Harbor Avenue Regulator	City CSO 099 – 50 feet north	West Waterway of Duwamish River via a city storm drain	Not controlled[c]
038	Terminal 115 Overflow		Duwamish River via a city storm drain	Not controlled

DSN No.[a]	Facility	Nearby CSO[b]	Receiving Water	Status
039	Michigan Regulator (also called South Michigan Regulator)		Duwamish River	Not controlled
040	8th Avenue S Regulator and West Marginal Way Pump Station Emergency Overflow	Both facilities share the same outfall.	Duwamish River	Controlled
041	Brandon Street Regulator		Duwamish River	Not controlled
042	West Michigan Regulator (SW Michigan Street Regulator)		Duwamish River	Not controlled
043	East Marginal Pump Station		Duwamish River	Controlled
044	Norfolk Outfall and Henderson/MLK CSO Treatment Facility		Duwamish River	Controlled—CSO treatment facility
045	Henderson Pump Station	Shares outfall with county CSO 013 City CSO 047 – 125 feet north City CSO 176 – 200 feet south	Lake Washington via a storm drain	Controlled[c]
046	Carkeek CSO Treatment Facility Outfall		Puget Sound	Controlled—CSO treatment facility
048b	North Beach Pump Station Emergency Overflow (inlet structure)		Puget Sound	Not controlled[d]
048a	North Beach Pump Station Emergency Overflow (wet well)		Puget Sound	Not controlled[d]
049	30th Avenue NE Pump Station	Shares outfall with county CSO 012 City CSO 018 – 250 south	Lake Washington	Controlled
051	Alki CSO Treatment Facility Outfall		Puget Sound	Controlled —CSO treatment facility
052	53rd Avenue SW Pump Station Emergency Overflow		Puget Sound	Controlled
054	63rd Avenue SW Pump Station Emergency Overflow		Puget Sound	Controlled
055	SW Alaska Street Overflow		Puget Sound	Controlled
056	Murray Avenue Pump Station Emergency Overflow	City CSO 090 – 200 feet east	Puget Sound	Not controlled[d]
057	Barton Street Pump Station Emergency Overflow	City CSO 094 – 150 feet east	Puget Sound	Not controlled[d]

[a] DSN = discharge serial number, as set in the NPDES permit.
[b] Distances between outfalls are based on GIS data and may not be exact.
[c] Control project was completed; currently refining system operation and control strategies.
[d] Control project is in design.

2 Existing Data

As part of its CSO Control Program, Metro and then King County have conducted sampling to characterize ambient water quality conditions, untreated CSO quality, treated CSO quality, and sediment quality near CSO discharges. These data are included in Ecology's EIM database.

In the late 1980s, Metro began a sampling program to characterize CSOs to comply with the requirements of Chapter 173-245 WAC and to identify any high priority sites for early control. Overflow quality data were collected for five CSO sites each year, and sediment samples were collected at each site in the West Point service area.[2]

Later, sampling was expanded to assess compliance with state Sediment Management Standards. In parallel to this, the county conducted extensive monitoring and modeling for its 1999 *King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay* (King County, 1999).

The following sections describe data from these and other CSO-related monitoring programs.

Findings and recommendations regarding CSO control—1958–2009 environmental studies

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

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

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

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

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

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

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

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

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

2009 *Comprehensive Sediment Quality Summary Report for CSO Discharge Locations.*

2.1 Untreated CSO Quality

Untreated (in-pipe) CSO quality data are usually collected at the regulator or pump station just upstream of the overflow location.

Overflow quality was first characterized in the late 1980s and early 1990s under the CSO sampling plan to meet the requirements of Chapter 173-245 WAC. The data have been supplemented over time through special studies and control project definitions. The untreated CSO quality data were compiled and summarized in the *Comprehensive Sediment Quality Summary Report for CSO Discharge Locations* (King County, 2009a).

These historical untreated CSO sampling data indicate that four chemicals—copper, silver, zinc, and ammonia—could approach or exceed acute marine water quality standards without additional source control or adequate removal in

[2] The service areas for the Carkeek and Alki Treatment Plants were not included in that original sampling plan because they were independent from the West Point system until 1994 (Carkeek) and 1998 (Alki).

treated CSO discharges. Other chemicals for which there are numeric water quality standards were either not detected or detected at sufficiently low concentrations that an exceedance of acute marine water quality standards was not probable.

The County has conducted two programs to assess how CSO discharges comply with the narrative criteria of the water quality standards. The County maintains a CSO information telephone line and directs the public to this phone number through signage at each CSO location and on the County's CSO web site. To date, no complaints have been received suggesting that a CSO discharge has violated narrative standards (adversely affected a characteristic water uses, or that a CSO discharge has offended aesthetic sensibilities). Additionally, eight uncontrolled CSO discharges were observed, photographed, and assessed for the presence of solid and floatable material under a floatables observation plan submitted to Ecology and EPA.

2.2 Treated CSO Quality

Sampling of treated CSOs is done in accordance with the West Point plant's NDPES permit and includes analysis for priority pollutants (metals and volatile organic, acid extractable, and base neutral compounds). Sampling results are submitted to Ecology with the monthly discharge monitoring reports (DMRs). Ecology maintains a searchable database of these data (Water Quality Permit Life Cycle System, http://www.ecy.wa.gov/programs/wq/permits/wplcs/index.html).

King County's CSO treatment plants provide a hypochlorite-based disinfection followed by dechlorination. Failure of a component of the disinfection system could result in an exceedance of water quality standards for fecal coliform bacteria, total residual chlorine, and/or pH. Limits for these compounds are included in the current NDPES permit (Ecology, 2009).

2.3 Ambient Water Quality

King County conducts ambient water quality monitoring in all water bodies where CSOs discharge. Samples are usually taken monthly and are typically analyzed for parameters such as nutrients, fecal indicator bacteria, dissolved oxygen, temperature, water clarity, turbidity, total suspended solids, pH (fresh water), salinity, and chlorophyll. The monitoring program has produced a comprehensive historical dataset that documents and assess trends in ambient water quality. Information and data can be found at http://green.kingcounty.gov/marine/ and http://www.kingcounty.gov/environment/waterandland/lakes.aspx.

In addition to routine monitoring programs, other monitoring efforts have looked at ambient water quality. In 1996–1997, for the 1999 *King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay* (WQA), ambient water quality samples were collected from the Duwamish River and Elliott Bay during periods when CSOs were overflowing for analysis of metals and a number of organic compounds. In 1999–2001, samples were collected from the Central Basin of Puget Sound for analysis for a similar range of parameters, and between 1999 and 2008, quarterly samples were collected from Lake Washington and the Lake Washington Ship Canal. In all studies, metal compounds were detected at concentrations significantly below water quality standards, while most organic compounds were not detected. Organic compounds that were detected also were below water quality standards.

The WQA identified some risks to fish, wildlife, and humans in the estuary, but because CSOs were not found to be a significant source, the WQA predicted limited improvement if CSO discharges were eliminated from the estuary. Risk of infection from direct contact with viruses and *Giardia* in CSO discharges during and soon after CSO events were predicted to be reduced with removal of CSOs throughout the Duwamish River and along the Elliott Bay shoreline. In the immediate vicinity of CSOs, risks to sediment dwelling organisms from organic enrichment, and possibly from 1,4-dichlorobenzene and bis(2-ethylhexyl) phthalate, were predicted to be reduced by removal of CSOs. The WQA concluded that even if CSOs were eliminated from the Elliott Bay/Duwamish system, minimal to no improvement in water quality would be observed because most pollutants were shown to come from sources other than CSOs.

More information on these studies can be found in the WQA report (King County 1999) and in the *1999/2000 Water Quality Status Report for Marine Waters* (King County, 2001) and *2001 Water Quality Status Report for Marine Waters* (King County, 2002).

In the 2009 West Point NPDES permit renewal specific ambient sampling requirements for areas near West Point and CSO discharges were included. To satisfy these requirements KC will continue to perform existing, longstanding KC ambient monitoring programs described above as well as add 2 new monitoring stations to be more fully representative of CSO discharge areas.

2.4 Sediment Quality

Data on sediment quality around King County's CSO outfalls have been collected for a variety of purposes, including compliance with State Sediment Management Standards (SMS) and as a part of joint efforts such as Superfund projects in the Duwamish Waterway. Sediment quality data are available for most CSOs to help determine whether impacts have occurred and next steps are needed. Data for the other CSOs have not been collected because the sites were in fresh water for which there are no numeric sediment quality standards[3] or because the CSO basin was primarily residential and could be characterized by CSO data for similar residential basins. Existing data are included in the *Comprehensive Sediment Quality Summary Report for CSO Discharge Locations* (King County, 2009a). Table 2 provides a brief summary of the sediment samples that have been collected near CSO discharge locations.

For CSOs discharging into Puget Sound, current sediment quality data show either no exceedances of SQS or a single exceedance of a phthalate compound. For CSOs discharging into Elliott Bay and the Duwamish River, sediment quality data show multiple exceedances of SQS, often including PAHs, total PCBs, phthalate compounds, and some metals. CSOs discharging into Lake Washington and the Ship Canal have multiple exceedances of the freshwater sediment guidelines for metals, total PCBs, PAHs, phthalate compounds, and other organic compounds.

In addition, the county conducts ambient subtidal sediment monitoring in Elliott Bay, the Central Basin of Puget Sound, and three embayments: Quartermaster Harbor, Outer Salmon Bay, and Fauntleroy Cove. The latest sampling in 2007 found sediment in these areas to be of good quality with some evidence of minor impacts from human activities in a few locations (King County, 2009b).

[3] The SMS contains a narrative freshwater standard that can be evaluated on a case-by-case basis. There are currently no promulgated numeric standards for freshwater, or for the protection of human health but there are narrative standards.

King County sediment quality data, along with available QA/QC data, are included in the EIM database.

Table 2. Sediment Samples near CSO Discharge Locations and Status

DSN No.[a]	Facility	Receiving Water	Last date of sediment sample	Number of Stations	SQS Exceedances[b,c] (number)	Status
003	Ballard Siphon Regulator	Lake Washington Ship Canal via city Storm Drain	1989	1	total PCBs, bis(2-ethylhexyl) phthalate	expect area-wide cleanup; characterize following cleanup
004	11th Avenue NW (also called East Ballard)	Lake Washington Ship Canal	1989	1	total PCBs, bis(2-ethylhexyl) phthalate	expect area-wide cleanup; characterize following cleanup
006	Magnolia Overflow	Elliott Bay/Puget Sound	2011 (1996)	6 (6)	pending (previous: none)	Adequately characterized
007	Canal Street Overflow	Lake Washington Ship Canal	--	None		expect area-wide cleanup; characterize following cleanup
008	3rd Ave W and Ewing Street	Lake Washington Ship Canal	2011 (1989)	7 (1)	pending (previous: total PCBs, bis(2-ethylhexyl) phthalate; **total PAHs**)	expect area-wide cleanup; characterize following cleanup
009	Dexter Avenue Regulator	Lake Union	2001	1	DDE, **total PCBs**, bis(2-ethylhexyl) phthalate, **carbazole**, **chromium**, **copper**, **dibenzofuran**, **lead**, **mercury**, nickel, **tributyltin**, **total PAHs**	expect area-wide cleanup; characterize following cleanup
011	E Pine Street Pump Station Emergency Overflow	Lake Washington	2000	2	bis(2-ethylhexyl) phthalate (1), nickel (2)	Inadequate characterization; other contributing sources
012	Belvoir Pump Station Emergency Overflow	Lake Washington	--	None	--	Inadequate Characterization
013	Martin Luther King Way Trunkline Overflow	Lake Washington via storm drain	2000	3	total PCBs (2), bis(2-ethylhexyl) phthalate (3), dibenzofuran(1), dieldrin(1), nickel (2), silver(1), tributyltin(3), **total PAHs** (3), TPH-residual (1)	Inadequate characterization; other contributing sources
014	Montlake Overflow	Lake Washington Ship Canal	2011 (1996)	7 (1)	pending(previous: bis(2-ethylhexyl) phthalate)	Adequately characterized
015	University Regulator	Lake Washington Ship Canal	2011 (1996)	7 (1)	pending (previous: bis(2-ethylhexyl) phthalate)	Adequately characterized
018	Matthews Park Pump Station Emergency Overflows	Lake Washington	--	None	--	Inadequate Characterization
027b	Elliot West CSO Treatment Facility	Elliott Bay	2009	16	total PCBs (7); multiple PAHs (2); benzyl butyl phthalate (3); bis(2-ethylhexyl) phthalate (5); mercury (6)	Adequately characterized

DSN No.[a]	Facility	Receiving Water	Last date of sediment sample	Number of Stations	SQS Exceedances[b,c] (number)	Status
027a	Denny Way Regulator	Elliott Bay	2009	16	see Elliott West (027b)	Adequately characterized
028	King Street Regulator	Elliott Bay	1989	5	multiple PAHs, bis(2-ethylhexyl) phthalate; total PCBs, arsenic, mercury, silver, zinc	remediation planned
029	Kingdome Regulator (replaced Connecticut Street Regulator)	Elliott Bay via the Connecticut storm drain	1996	7	1,4-dichlorobenzene; multiple PAHs; benzyl butyl phthalate, bis(2-ethylhexyl) phthalate; total PCBs; copper	Port of Seattle dredged area in 2005; Inadequate characterization of current condition
030	Lander Street Regulator	East Waterway of Duwamish River				current area-wide cleanup; characterize following cleanup
031	Hanford #1 Overflow (Bayview N, Bayview S, and Hanford at Rainier)	Duwamish River via Diagonal storm drain	2009	23		current area-wide cleanup; early action sediment remediation completed; monitoring ongoing
032	Hanford #2 Regulator	East Waterway of Duwamish River				current area-wide cleanup; characterize following cleanup
033	Rainier Avenue Pump Station Emergency Overflow	Lake Washington	2000	2	total PCBs (1), bis(2-ethylhexyl) phthalate (1), nickel (1), silver (1), tributyltin(2)	Inadequate characterization; other contributing sources
034	East Duwamish Pump Station Emergency and Siphon Aftbay Overflows	Duwamish River				current area-wide cleanup; characterize following cleanup
035	West Duwamish Siphon Forebay Overflow	Duwamish River				current area-wide cleanup; characterize following cleanup
036	Chelan Avenue Regulator	West Waterway of Duwamish River	2011	6	pending	Adequate characterization; No Action Record of Decision
037	Harbor Avenue Regulator	West Waterway of Duwamish River via a city storm drain		None		Inadequate characterization; No Action Record of Decision
038	Terminal 115 Overflow	Duwamish River via a city storm drain		None		current area-wide cleanup; characterize following cleanup
039	Michigan Regulator (also called South Michigan Regulator)	Duwamish River				current area-wide cleanup; characterize following cleanup

DSN No.[a]	Facility	Receiving Water	Last date of sediment sample	Number of Stations	SQS Exceedances[b,c] (number)	Status
040	8th Avenue S Regulator and West Marginal Way Pump Station Emergency Overflow	Duwamish River				current area-wide cleanup; characterize following cleanup
041	Brandon Street Regulator	Duwamish River	2011	6	pending	current area-wide cleanup; characterize following cleanup
042	West Michigan Regulator (SW Michigan Street Regulator)	Duwamish River				current area-wide cleanup; characterize following cleanup
043	East Marginal Pump Station	Duwamish River				current area-wide cleanup; characterize following cleanup
044	Norfolk Outfall and Henderson/MLK CSO Treatment Facility	Duwamish River	2004	4		current area-wide cleanup; early action sediment remediation completed; monitoring completed
045	Henderson Pump Station	Lake Washington via a storm drain	2000	3	total PCBs (2), bis(2-ethylhexyl) phthalate (3), dibenzofuran(1), dieldrin(1), nickel (2), silver(1), tributyltin(3), **total PAHs** (3), TPH-residual (1)	Inadequate characterization; other contributing sources
046	Carkeek CSO Treatment Facility Outfall	Puget Sound	2000	6	None	Adequately characterized
048b	North Beach Pump Station Emergency Overflow (inlet structure)	Puget Sound	2011 (1996)	6 (6)	pending (previous: phenol (1))	Adequately characterized
048a	North Beach Pump Station Emergency Overflow (wet well)	Puget Sound	2011 (1996)	6 (6)	pending (previous: phenol (1))	Adequately characterized
049	30th Avenue NE Pump Station	Lake Washington	--	None	--	Inadequate Characterization
051	Alki CSO Treatment Facility Outfall	Puget Sound	2001	6	none	Adequately characterized
052	53rd Avenue SW Pump Station Emergency Overflow	Puget Sound	2011 (1996)	6 (6)	pending (previous: reference station exceeded Arochlor 1254, benzyl butyl)	Adequately characterized

DSN No.[a]	Facility	Receiving Water	Last date of sediment sample	Number of Stations	SQS Exceedances[b,c] (number)	Status
054	63rd Avenue SW Pump Station Emergency Overflow	Puget Sound	1997	6	None	Adequately characterized
055	SW Alaska Street Overflow	Puget Sound	1997	6	None	Adequately characterized
056	Murray Avenue Pump Station Emergency Overflow	Puget Sound	2011 (1997)	7 (6)	pending (previous: None)	Adequately characterized
057	Barton Street Pump Station Emergency Overflow	Puget Sound	2011 (1997)	6 (6)	pending (previous: benzyl butyl phthalate (2) **dimethyl phthalate** (1))	Adequately characterized

[a] DSN = discharge serial number, as set in the NPDES permit.
[b] Freshwater sediments compared to proposed criteria in November 2011 Draft Revisions Sedment Management Standards
[c] compounds in **bold** exceed Cleanup Screening Levels (CSL)

2.5 Rainfall

King County has a network of 12 rain gauges to measure rainfall across the service area. This network is supplemented by a network of 17 rain gauges operated and maintained by the City of Seattle. Data from the county's network of gauges are archived in the supervisory control and data acquisition (SCADA) system historian and summarized and reported to Ecology as part of the monthly DMRs when a CSO event occurs.

2.6 Discharge Onset, Duration, and Volume

The current program of monitoring CSO onset, volume, and duration has been in effect since the approval of the CSO control plan in 1988. The data are collected from flow meters or water surface gauges upstream of overflow weirs and input to SCADA. They are reported to Ecology as part of the monthly DMRs and are summarized in the annual CSO report. Previous CSO reports can be found at http://www.kingcounty.gov/environment/wastewater/CSO/Library/AnnualReports.aspx.

3 Post-Construction Monitoring

Post construction monitoring to be conducted at each CSO is summarized in Table 3 and described in the sections that follow.

All CSO locations will be monitored for onset, duration, and volume of the discharge. Discharge locations that provide CSO treatment will also be monitored for influent and effluent quality. Sampling of the wet-weather discharges will be done in coordination with sampling for NPDES permit compliance.

In addition to this monitoring, King County will continue to collect precipitation data at an equivalent level to the existing network of rain gauges and will continue its ongoing ambient monitoring program.

Table 3. Post Construction Compliance Monitoring Plan

Medium	Post Construction Monitoring to be Conducted
CSO discharge	Untreated CSOs controlled to one overflow per year or less: Overflow onset, duration, and volume using SCADA and portable meters Treated CSO discharges: Overflow onset, duration, and volume using SCADA Influent and effluent quality sampling; reasonable potential analysis to assess compliance with water quality standards
Sediment	Sites with no existing SMS exceedances and adequate characterization: No sediment monitoring Sites with existing SMS exceedances or no sediment quality data: Project-specific pre-construction (if needed) and post-construction sediment monitoring used to determine if SMS still exceeded; a site-specific cleanup plan, if needed
Receiving water	Ongoing ambient monitoring programs and sampling specified in the NPDES permit

SCADA = supervisory control and data acquisition system.

Assumptions used to develop the plan are as follows:

- CSOs controlled to no more than one untreated event per year on average will request and be granted the mixing zone exemption described in Section 173-201A-400 WAC and will be deemed to comply with receiving water quality standards. Monitoring for these sites focuses on characterizing the quantity and frequency of discharges.
- The effectiveness of the CSO control at treated CSO sties is to be assessed by monitoring their ability to provide the equivalent of primary treatment— at least 50 percent removal of the total suspended solids annually and discharges less than 0.3 mL/L/hr of settleable solids for each event—and on other NPDES permit limits that apply to the effluent.
- King County will evaluate treated CSO compliance with state water quality standards by conducting a reasonable potential analysis based on the treated effluent quality data and existing ambient quality data.

- Data from previous studies and from ongoing monitoring programs are sufficient to characterize ambient water quality in receiving waters.
- Implementing CSO control measures will not degrade the existing sediment quality. Presumably achieving CSO control will reduce the CSO discharge volume resulting in improved sediment quality.
- All CSOs currently meeting SMS will be evaluated for the potential of new upstream sources discharging to the combined sewer system, or other factors adversely affecting sediment quality on a case-by-case basis.

The post construction monitoring plan is described below in two major subsections that parallel EPA's CSO Post Construction Monitoring Guidance (EPA, 2011) according to the types of monitoring being conducted. Subsection 3.1 discusses monitoring to "verify the effectiveness of CSO controls." Subsection 3.2 discusses effluent and ambient monitoring to gather data to be used in assessing compliance with WQS. Each subsection will focus on the type of monitoring to be done to define what, where, and when monitoring will occur.

3.1 Monitoring to Verify the Effectiveness of CSO Controls

The CSO controls described in the County's CSO Control plan propose to limit untreated CSO discharges to one or fewer events per year on average. Section 3.1.1 describes the flow monitoring the County uses to determine the onset, duration, volume, and frequency of CSO events. Section 3.1.2 describes the effluent monitoring conducted at CSO treatment facilities to evaluate the effectiveness of the CSO treatment and ensure that the discharge is receiving the required level of treatment. Section 3.1.3 describes how post construction monitoring will be implemented for Green Infrastructure projects.

3.1.1 Discharge Frequency

Ecology has directed that the control standard of no more than one untreated event per year be assessed as a 20-year moving average of monitored event data. The standard will be met if there are no more than 20 untreated events in 20 years. Where 20 years of monitored data are not available, such as for a new control facility, the missing years are to be predicted using modeled data.

Metering is proposed at all CSO discharge locations to determine the onset, duration, and volume of each CSO event. Flow metering is implemented with permanent flow meters, portable flow meters, or weirs with level sensors depending upon the CSO. The following sections summarize how flow monitoring is conducted; additional details can be found in the CSO Discharge Flow Measurement Sample and Analysis Plan and Quality Assurance Project Plan included as Appendix B.

3.1.1.1 Methods for Measuring CSO Frequency

Direct monitoring of CSO frequency consists of recording physical data indicating that CSOs have occurred. Meters or sensors that measure CSO discharges as they occur directly monitor overflows at all CSO locations. Depending on the meter type, the data is telemetered directly to the County's SCADA system, telemetered in real time to a centralized data server, or manually downloaded by field personnel and transferred to the data server. Details of the instrumentation

can be found in the CSO Discharge Flow Measurement Sample and Analysis Plan and Quality Assurance Project Plan, the most recent plan is attached as Appendix B.

3.1.1.2 Which Outfalls to Monitor

King County currently monitors all of its CSO discharge locations with flow meters to provide estimates of overflow onset, duration, and volume. Real-time depth meters are installed upstream of overflow weirs at 32 CSO overflow points, allowing calculation and documentation of overflow onset, duration, and volume. Two locations are monitored by real-time, permanent flow meters connected to the County's SCADA system. An additional nine locations are monitored via continuously recording flow meters (velocity/depth) that are regularly downloaded. Some discharge points have multiple meters to record all potential overflow pathways.

Under this plan, overflow monitoring will continue at all CSO discharge locations. The locations and/or equipment associated with some monitoring sites may change to accommodate post construction configurations.

3.1.1.3 When and How Often to Monitor

Under this plan, overflow monitoring will be continuous at all CSO discharge locations.

3.1.1.4 Data Collection

At most locations the data will be telemetered and collected and archived as part of King County's control system. When telemetry is not feasible, data will be downloaded on a periodic basis. The data collected will allow an evaluation of whether a CSO has occurred, as well as a determination of the onset, duration, and volume of an overflow. Coincidental precipitation data will also be collected from the County's existing rain gauges (Section 2.5).

3.1.1.5 Data Evaluation

Ecology defines the minimum inter-event period (MIET) as 24 hours. A CSO event is considered to have ended only after at least 24 hours has elapsed since the last measured occurrence of an overflow. This elapsed time will be used in evaluating the overflow data and determining the number, duration, and event volumes of each overflow.

3.1.1.6 Estimating CSO Frequency Using Modeling

King County's fully dynamic, planning-level collection system model will be used for facilities that do not have a 20-year record of CSO overflow events. The model will predict how the new control facility would have performed under the previous 20 years of rainfall conditions. As post construction monitoring data become available, they will replace model results in the rolling 20-year average calculation. King County proposes that a commissioning period be established for each project, after which the monitoring data will be incorporated into the 20-year average. The duration of this commissioning period will be set on a case-by-case basis by Ecology. Allowing for such a period prevents initial startup issues from affecting the analysis of the level of control for the next 20 years.

Details of this collection system model are described in Appendix C of King County's 2008 CSO control plan update (King County, 2008).

3.1.2 Treatment Effectiveness

CSO treatment facilities must achieve a minimum level of treatment to comply with their discharge permit. This section describes the monitoring that will demonstrate if the minimum level of treatment has been achieved. Consistent with EPA's CSO Control Policy and Ecology's regulations for CSO Control Facilities, the CSO Control plan describes the minimum level of treatment as:

- Annual: Primary clarification equivalent to a 50% reduction in TSS and less than 0.3 mL/L/hr settleable solids. (Removal of floatables and settleable solids may be achieved by any combination of treatment technologies or methods that are shown to be equivalent to primary clarification); pH is within range of 6 to 9
- Disinfection of effluent, including removal of harmful disinfection chemical residuals, where necessary.

In addition to the prescribed minimum level of treatment, the treated discharge will be required to comply with Washington State water quality standards. Monitoring to verify compliance with water quality standards is described in Section 3.2.

Details of sampling to determine treatment effectiveness can be found in the Treated CSO Sample and Analysis Plan and Quality Assurance Project Plan, the most recent plan is attached as Appendix C.

3.1.2.1 Methods for Determining Treatment Effectiveness

Monitoring of the treated CSO effluent will be done in accordance with the current and future NPDES permits. Current requirements include collection of flow proportional composite samples for both influent and effluent TSS and settleable solids. Total residual chlorine is to be determined from the effluent chlorine analyzer or grab samples, and fecal coliforms is collected by grab samples from the effluent channel after disinfection.

3.1.2.2 Which Outfalls to Monitor

Effluent samples are currently collected at King County's four CSO treatment facilities at Alki, Henderson/MLK, Elliott West, and Carkeek. Additional treatment facilities are proposed in the current control plan for Hanford/Lander, King/Kingdome, Michigan, and Brandon.

3.1.2.3 When and How Often to Monitor

Each CSO event will be monitored, according to the sample collection requirements in the NPDES permit. Flow proportional composites are collected over the entire event duration within the sampling intervals mandated in the permit. Grab samples are also taken at specific time intervals after the discharge begins to the receiving water. These intervals are within the first three hours, within 4-8 hours, within 20-24 hours, and each following 24 hour period.

Table 4. Initiation of King County CSO Treatment and Effluent Quality Monitoring

DSN No.[a]	Facility	Flow/Frequency	Treatment Effectiveness	Effluent Quality
027b	Elliot West CSO Treatment Facility	ongoing	ongoing	ongoing
044	Norfolk Outfall and Henderson/MLK CSO Treatment Facility	ongoing	ongoing	ongoing
046	Carkeek CSO Treatment Facility Outfall	ongoing	ongoing	ongoing
051	Alki CSO Treatment Facility Outfall	ongoing	ongoing	ongoing
TBD	Michigan/Brandon CSO Treatment Facility	2022	2022	2022
TBD	Hanford/Lander/King/Kingdome CSO Treatment Facility	2031	2031	2031

[a] DSN = discharge serial number, as set in the NPDES permit.

3.1.2.4 Data Collection

The composite and grab samples will be transported to an accredited laboratory for analysis following the protocols required in the NPDES permit.

3.1.2.5 Data Evaluation

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 Facility and then permanently removed at the West Point Treatment Plant. The reported daily average(s) of TSS% removal efficiency at West Point WWTP, corresponding to the event, are to be used for calculating the total removal efficiency for the CSO Treatment Facility. Compliance with the % TSS removal is based on the yearly average as reported in the annual CSO report, although it is reported on a monthly basis. Likewise, the settleable solids discharge limit of 0.3 mL/L/hr is assessed on the annual average of the per-event flow proportional composite samples.

The disinfection effectiveness is evaluated from the average monthly value for fecal coliform in the effluent, calculated from the geometric mean for the day(s) in which a discharge(s) occurred. The average monthly value is not to exceed the level prescribed in the NPDES permit, which is either a technology based limit or a water quality based limit, depending on the CSO treatment facility.

Removal of the disinfectant is evaluated from the total residual chlorine concentration in the effluent. The average measurement over a calendar day is not to exceed the limit given for each CSO treatment facility in the NPDES permit. The total residual chlorine limit is a water-quality based value calculated by Ecology.

3.1.3 Green Stormwater Infrastructure

Green Stormwater Infrastructure (GSI) improvements that are implemented as part of the CSO Control Plan will include a detailed description of the GSI project as part of the plans and reports submitted to Ecology under the requirements in Chapter 173-245 WAC (see Section 1.2.1). This description will include the performance levels expected to be achieved with the

implementation of the GSI project and a description of any post-construction monitoring and modeling to be performed.

GSI projects will have scheduled routine maintenance of the facility. During these maintenance visits, the facility will be inspected for the parameters outlined in the City of Seattle's Green Stormwater Operations and Maintenance Manual (Seattle, 2009). The condition of the vegetation, mulch layer, hardscape and infrastructure components will be monitored through visual inspection and any defects will be corrected. Inspection and maintenance activities will be performed to Service Level A for the first two years of a project, and Service Level B for subsequent years. Projects may include underground infiltration structures, which will have initial and long-term monitoring. This monitoring may depend on the type of structure and location, and will be detailed in the description of the GSI project submitted to Ecology prior to construction.

The CSO Control plan envisions Green Infrastructure will be used as part of a larger CSO control effort. Consequentially, Green Infrastructure will be evaluated in terms of the larger CSO control approach because it is used in conjunction with other control methods. Principally, the net result of the Green Infrastructure projects plus any other CSO control measures will be evaluated on their ability meet the goals of the CSO Control Program (Section 1.4).

3.2 Monitoring to Assess Compliance with Water Quality Standards

As described in EPA's CSO Control Policy, this portion of the post construction water quality monitoring plan is intended to verify compliance with WQS and the protection of designated uses. This section and the relevant appendices detail the monitoring protocols to be followed, including the necessary effluent and ambient monitoring and sediment sampling.

The County will assess compliance with state surface water quality standards by conducting a reasonable potential analysis as described in the permit writer's manual (Ecology, 2010). The analysis will be based on the post construction monitoring of treated effluent quality data and on existing ambient quality data. This analysis is extremely protective of water quality standards. It uses the 95th percent confidence level of the 95th percentile concentration and then combines these concentrations with the 90th percentile concentration of ambient water quality samples and the calculated outfall dilution ratio to estimate a maximum concentration at the point of compliance. The point of compliance is either the discharge point or the boundary of an approved mixing zone. When the maximum reasonable potential concentrations are below state water quality standards, the analysis demonstrates that the treated CSO discharge has met receiving water quality standards. Where a reasonable potential to violate water quality standards at the edge of the mixing zone is predicted, the county will assess whether the maximum measured concentration, which may be less than the reasonable potential concentration, has the potential to violate water quality standards. Where the potential exists to exceed water quality standards, it is assumed that Ecology will set site-specific effluent limits and monitoring requirements to prevent violation.

The County will continue to maintain and advertise methods for providing comments, concerns, or complaints related to CSO discharges, such as the CSO Information Line, web pages, and email contact information. Concerns received will be used to assess compliance with the narrative portion of the state surface water quality standards.

3.2.1 Effluent Monitoring

Effluent monitoring is intended to characterize the parameters in the treated effluent that will be evaluated in the reasonable potential analysis. As described below and in Appendix C, effluent quality samples are typically collected during one overflow per year as flow proportional composites, or if more appropriate for a parameter, as a grab or continuous measurement. Details of sampling to characterize the treated CSO discharges can be found in the Treated CSO Sample and Analysis Plan and Quality Assurance Project Plan, the most recent plan is attached as Appendix C.

3.2.1.1 What will be Monitored

Monitoring of the treated CSO effluent will be done in accordance with the current and future NPDES permits. Current requirements include measurement of volume, duration, precipitation, BOD_5, TSS, TSS removal, settleable solids, total residual chlorine, fecal coliform, and pH for each discharge event. Measurement of effluent temperature, salinity, alkalinity, oil and grease, hardness, cyanide, total phenols, nutrients, EPA priority pollutants, and some Ecology priority toxic chemicals is required. The current monitoring requirements are detailed in Appendix C, including sampling parameters and methods. Monitoring of the influent to, or the recycle from, the CSO treatment facilities will be conducted to allow estimation of the removal rates of TSS and BOD_5.

King County will continue monitoring the West Point WWTP effluent, including CSO-related bypass durations and volumes and final effluent parameters, as required by current and future NPDES permits. Compliance with secondary permit limits will continue to be reported in monthly DMRs to Ecology.

3.2.1.2 Where Monitoring will be Performed

Samples will be collected from the effluent stream of King County's four CSO treatment facilities at Alki, Henderson/MLK, Elliott West, and Carkeek. Additional treatment facilities are proposed in the current control plan for Hanford/Lander, King/Kingdome, Michigan, and Brandon.

3.2.1.3 When Monitoring will occur

Monitoring will occur for one event per year, or as directed in the NPDES permit.

3.2.1.4 How Monitoring will be conducted

Monitoring of the treated CSO effluent will be done in accordance with the current and future NPDES permits. Current requirements include collection of most parameters in flow proportional composite samples, and grab samples or continuous analyzers for other parameters.

3.2.2 Ambient Water Quality Monitoring

King County conducts extensive monitoring of the ambient water quality in numerous water bodies throughout the County. A subset of this monitoring is relevant to characterizing water quality in locations potentially affected by the combined sewer system.

The County's ongoing ambient monitoring program does not analyze for trace metals or organic compounds, and such analyses are not proposed. King County has analyzed for these constituents multiple times. The most recent sampling occurred to comply with part of the 2009 West Point NDPES permit renewal, in which King County must conduct sampling and submit a receiving water characterization report to Ecology by June 30, 2013, that describes background conditions for use in future reasonable potential calculations. The requirement includes analysis for metals and some organics in the vicinity of each CSO treatment facility. Prior to this, the CSO Water Quality Assessment (King County, 1999) conducted extensive sampling, including wet weather events with CSO discharges. These and previous sampling events show that concentrations of ambient metal and organic compounds are low compared to the acute water quality standards applicable to CSO discharges. With the results of the current analysis, ambient conditions will be well characterized. King County anticipates that sampling for trace metals and organics will be conducted on a periodic basis to verify and document ambient conditions.

The following sections summarize the relevant portion of King County's ongoing ambient monitoring program for post construction monitoring. Additional details can be found in Appendix D, Receiving Water Characterization Study Sampling and Analysis Plan and Quality Assurance Project Plan, Appendix E, Major Lakes Sampling and Analysis Plan, and Appendix F, Freshwater Swimming Beach Monitoring Sampling and Analysis Plan.

3.2.2.1 What will be Monitored

Open water samples will be analyzed for the following parameters:

- Field measurements are taken for dissolved oxygen and temperature
- Fecal Coliforms
- Ammonia-Nitrogen
- Nitrite/Nitrate Nitrogen
- Ortho Phosphorus
- Total Suspended Solids

Marine intertidal (beach) samples will be analyzed for the following parameters:

- Field measurement for temperature
- Fecal Coliforms
- Ammonia-Nitrogen
- Nitrite/Nitrate Nitrogen
- Ortho Phosphorus

Swimming Beach (freshwater) samples will be analyzed for:

- Field measurement for temperature
- Fecal Coliforms

3.2.2.2 Where Ambient Monitoring will be Performed

Ambient monitoring will be conducted at the ambient monitoring stations described below in Table 5.

Table 5. PCMP Ambient Sampling Locations

Description	Locator	East Coordinate	North Coordinate	Type
Point Jefferson	KSBP01	1248062	275439	Open Water (marine)
Dolphin Point	LSNT01	1245197	198653	Open Water (marine)
Elliott Bay	LTED04	1264675	223909	Open Water (marine)
Duwamish River	LTXQ01	1278053	190313	Open Water (marine)
Ship Canal/above Locks	0512	1255339	246408	Open Water (freshwater)
Lake Union/depth profile station, near west shore	A522	1269458	234484	Open Water (freshwater)
Ship Canal / Montlake Bridge	0540	1277624	239584	Open Water (freshwater)
Lake Washington / mid-lake north off Sandpoint	0826	1295117	253655	Open Water (freshwater)
Lake Washington / S of I-90 Bridge	0890	1286489	213199	Open Water (freshwater)
Madrona Park	SD007SB	1282939	225430	Swimming Beach
Mathews Beach Park	0818SB	1285991	257467	Swimming Beach
Alki Beach	LSHV01	1253532	216852	Intertidal (Beach)
Carkeek Park	KSHZ03	1259784	263736	Intertidal (Beach)
Magnolia	KSYV02	1254488	234547	Intertidal (Beach)
Me-Kwa-Mooks Park (Barton CSO)	LSLT02	1251892	209683	Intertidal (Beach)
SAM Sculpture Park Beach (Elliott West)	LTBD27	1264297	228851	Intertidal (Beach)

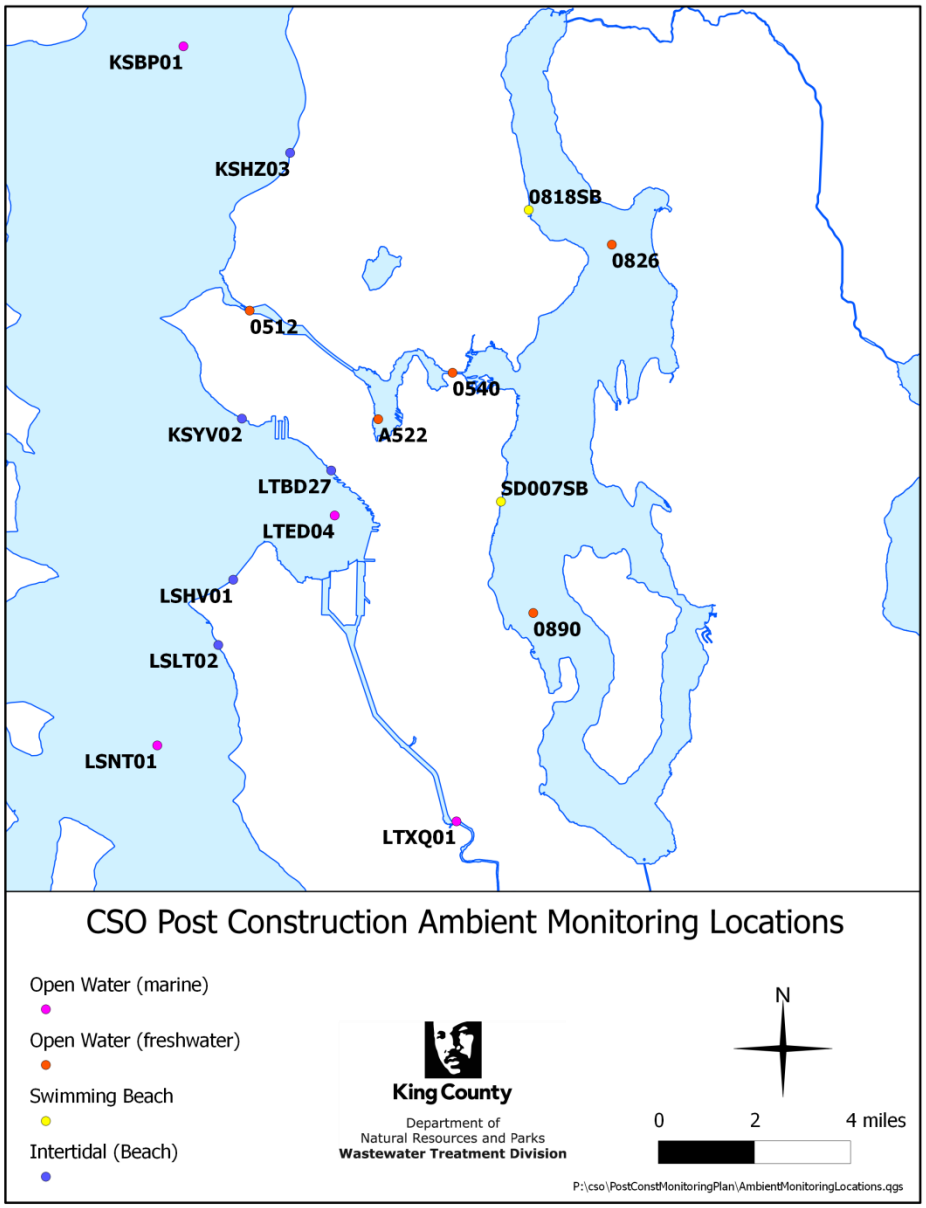

Figure 2. PCMP Ambient Monitoring Locations

3.2.2.3 When Ambient Monitoring will occur

Ambient monitoring at the open water and intertidal stations listed in Table 5 is conducted on a monthly schedule. Sampling may be delayed or cancelled due to weather conditions or equipment problems.

The swimming beach stations in Table 5 (Madrona Park, Mathews Beach Park) are sampled on a weekly basis from mid-May through mid-September by collecting a single grab sample. Time of day of sampling is determined by field and lab requirements. If the bacterial results from the initial sampling at a beach is above the criteria for closing a beach (geometric mean >200

cfu/100ml or single sample >1000 cfu/100ml), an additional sample will be immediately collected from the same location using the same sampling protocols. The rationale for immediate re-sampling is based on lack of statistical sampling power with a single grab and the possibility of collecting a false high count from a small localized source not representative of the overall bacterial water quality or human health concern.

3.2.2.4 How Ambient Monitoring will be conducted

Electronic in situ data are collected at the open water stations using a CTD (conductivity, temperature, depth) sensor array or Hydrolab® instrument deployed from the County's research vessels R/V Liberty or R/V Chinook, with the exception of the Duwamish River station (LTXQ01). Samples from the Duwamish River station are collected using a modified van Dorn-style sampling bottle that is lowered from the bridge mid-channel.

Discrete water samples are collected from between one and seven depths at each offshore station, depending on the total station depth. Laboratory analytes for discrete samples include fecal coliform, suspended solids, and nutrients (ammonia, nitrite/nitrate nitrogen, orthophosphate). Bacteria samples are collected from the surface sampling depth, with the exception of Duwamish River samples. Bacteria samples are collected from two depths at each Duwamish River station. All other laboratory parameters are analyzed on samples collected from every depth.

Intertidal (marine beach) water samples are collected as grab samples by wading into the water to a depth of approximately one meter and collecting a single sample from a depth of approximately one-half meter.

Samples at swimming beach locations are collected as grab samples within one foot of the surface of the water where the swimming area is three to six feet deep. Samples are collected using the dip method.

Additional details are provided in the respective SAP/QAPP attached in the Appendices.

3.2.3 Sediment Monitoring

King County has collected sediment quality data at the majority of its CSO outfall discharge locations, both as part of its NPDES sediment monitoring program and for special environmental studies. Section 2.4 provides a brief overview of the data; results were discussed and provided in King County's comprehensive sediment quality report (King County 2009).

The County's Sediment Management Plan (King County 1999) develops remedial strategies for correcting short- and long-term hazards associated with contaminated sediments near King County CSO sites. Sediment quality data is being collected at 10 CSO discharge locations for the current update to the SMP. This data will be used to calibrate and validate a near-field sediment model developed by the County primarily to evaluate recontamination potential for CSOs, following control and sediment remediation projects. Analysis of the model output will provide one line of evidence to characterize the sediment quality in areas around other County CSOs.

Many of the County's CSOs are situated in areas that will likely be the subject of an area-wide sediment remediation project in the future. The County expects to participate in area-wide remediation projects that encompass the Lower Duwamish Waterway, East Waterway, Ship Canal and Lake Union. Following completion of the area-wide remediation, the County will

assess if the sediments in the vicinity of its CSO discharges have been adequately characterized, or if additional monitoring or modeling is required.

Post construction sediment monitoring comprises a combination of modeling and sediment quality samples that provide a site characterization. King County, in consultation with Ecology, will determine what comprises an adequate site characterization on a site specific basis. Based on the site characterization, certain CSO discharge locations may exceed Sediment Management Standards (SMS). For these locations, a site-specific sediment cleanup plan will be developed. Cleanup plans will contain actions required to meet the Sediment Management Standards (SMS) as well as a sampling program to ensure the outcome has been achieved and recontamination is not occurring.

3.2.3.1 What will be Monitored

Monitoring of sediments near CSO discharges will be done according to the priorities and needs identified by King County's Sediment Management Program and through consultation with Ecology and EPA. The sediment quality samples at each CSO location will typically involve sampling surficial sediments at three to seven sites (depending on site-specific conditions) for metals and priority pollutants, using the most current Puget Sound Estuarine Program (PSEP) protocols. The Sampling and Analysis Plan (SAP) included in Appendix G was developed for sampling sediments around 10 CSO locations for the current SMP update. King County anticipates that the SAPs developed to conduct additional site-assessments around its CSO discharges would be similar to this document in terms of the sampling methodology, analytical parameters and detection limits, data analysis, and QA/QC controls. Individual SAPs will vary by sampling objectives and sample design based on site-specific issues.

Chemical analysis for metal and priority pollutants in surficial sediments is the only type of sediment quality monitoring proposed to characterize sediments near CSO discharges. Initial sampling results, site specific information, and consultation with Ecology and EPA may suggest that other types of monitoring be conducted on a case by case basis. A sampling and analysis plan will be developed prior to implementing any other types of monitoring.

3.2.3.2 Where Sediment Monitoring will be Performed

Sediment quality will be characterized at all CSO discharge locations through a combination of monitoring and modeling. Beyond the existing data, additional sediment quality sampling or modeling is anticipated to characterize specific CSO locations depending upon the CSO control status, existing sediment characterization, and the status of area-wide cleanup projects. King County, in consultation with Ecology, will assess the sediment data and modeling results to ensure the sediment quality is adequately characterized.

The anticipated sampling is discussed below.

No further sediment monitoring is planned at sites that have previously been characterized as not having SMS exceedances and where source conditions have not changed. It is assumed that if there were no exceedances at an uncontrolled CSO, there would be no exceedances after the site is controlled. Thus no additional sediment sampling is proposed at:

- Alki CSO (DSN 051)
- Carkeek CSO (DSN 046)
- 63rd Avenue (DSN 054)
- SW Alaska (DSN 055)

Additionally, no additional sediment sampling is proposed at the Norfolk Outfall and Henderson/MLK CSO Treatment Facility (one location). Sediment remediation was completed here in 1999, and the post-cleanup sediment monitoring did not indicate sediment recontamination from the CSO discharges. Additional sediment concerns from other contaminant sources at this location will be addressed through the current Lower Duwamish Waterway sediment clean-up.

Sediment sampling being conducted for the current SMP update is expected to provide sufficient data to characterize the following CSO discharge locations:

- Magnolia (DSN 006)
- 3rd Ave. W. (DSN 008)
- Montlake (DSN 014)
- University (DSN 015)
- Chelan Avenue (DSN 036)
- Brandon Street (DSN 041)
- North Beach (DSN 048a, 048b)
- 53rd Ave (DSN 052)
- Murray (DSN 056)
- Barton (DSN 057)

If this data and modeling results do not indicate SMS exceedances, no future sediment monitoring will occur at these sites. If SMS exceedances exist, a site-specific cleanup-plan will be developed. If site-specific cleanup plans are needed for 3rd Ave. W. or Brandon Street, they will be developed following completion or in coordination with the relevant area-wide cleanup project.

The SMP update process will use existing samples, near-field modeling, and additional sediment verification samples to evaluate sediment quality at the following controlled CSOs:

- East Pine (DSN 011)
- shared outfall: Belvoir (DSN 012) and 30th Ave NE Pump Station (DSN 049)
- shared outfall: Martin Luther King Way Trunkline Overflow (DSN 013) and Henderson Pump Station (DSN 045)
- Mathews Park Pump Station Emergency Overflow (DSN 018)
- Rainier Ave Pump Station Emergency Overflow (DSN 033)

If the data and modeling support an adequate characterization, a site-specific cleanup plan will be developed if SMS exceedances exist. At locations with other contributing sources (Table 2),

King County will develop the cleanup plan in partnership with the other entities that have contributed to the contamination. No additional sampling for post construction monitoring will be proposed if the sediments meet SMS standards and there is adequate characterization.

Sediment characterization is ongoing and an interim cleanup plan has been developed for:

- Elliot West CSO Treatment Facility (DSN 027b)
- Denny Way Regulator (DSN 027a)

Sediment quality samples will be collected for the remaining locations following completion of the respective CSO control project or of the area-wide cleanup project unless adequate recent data exists. These CSO locations are:

- Ballard Siphon Regulator (DSN 003)
- 11th Avenue NW (DSN 004)
- Canal Street Overflow (DSN 007)
- Dexter Avenue Regulator (DSN 009)
- King Street Regulator (DSN 028)
- Kingdome Regulator (replaced Connecticut Street Regulator)
- Lander Street Regulator (DSN 030)
- Hanford #1 Overflow (DSN 031)
- Hanford #2 Regulator (DSN 032)
- East Duwamish Pump Station Overflows (DSN 034)
- West Duwamish Siphon Forebay Overflow (DSN 035)
- Harbor Avenue Regulator (DSN 037)
- Terminal 115 Overflow (DSN 038)
- Michigan Regulator (DSN 039)
- 8th Avenue S Overflow (DSN 040)
- West Michigan Regulator (DSN 042)
- East Marginal Pump Station (DSN 043)

3.2.3.3 When Sediment Monitoring will occur

When sediment monitoring is proposed to occur is described below and summarized in Figure 3 and Table 6. The County expects to participate in area-wide sediment remediation projects that incorporate sediments off CSO discharges. Following completion of the area-wide remediation, the County will assess if the sediments in the vicinity of its CSO discharges have been adequately characterized, or if additional monitoring or modeling is required.

Any in-water work associated with CSO control projects will involve collection of pre-construction and post-construction sediment samples. These samples will serve to document any change in sediment quality from construction activities as well as to characterize the sediment quality.

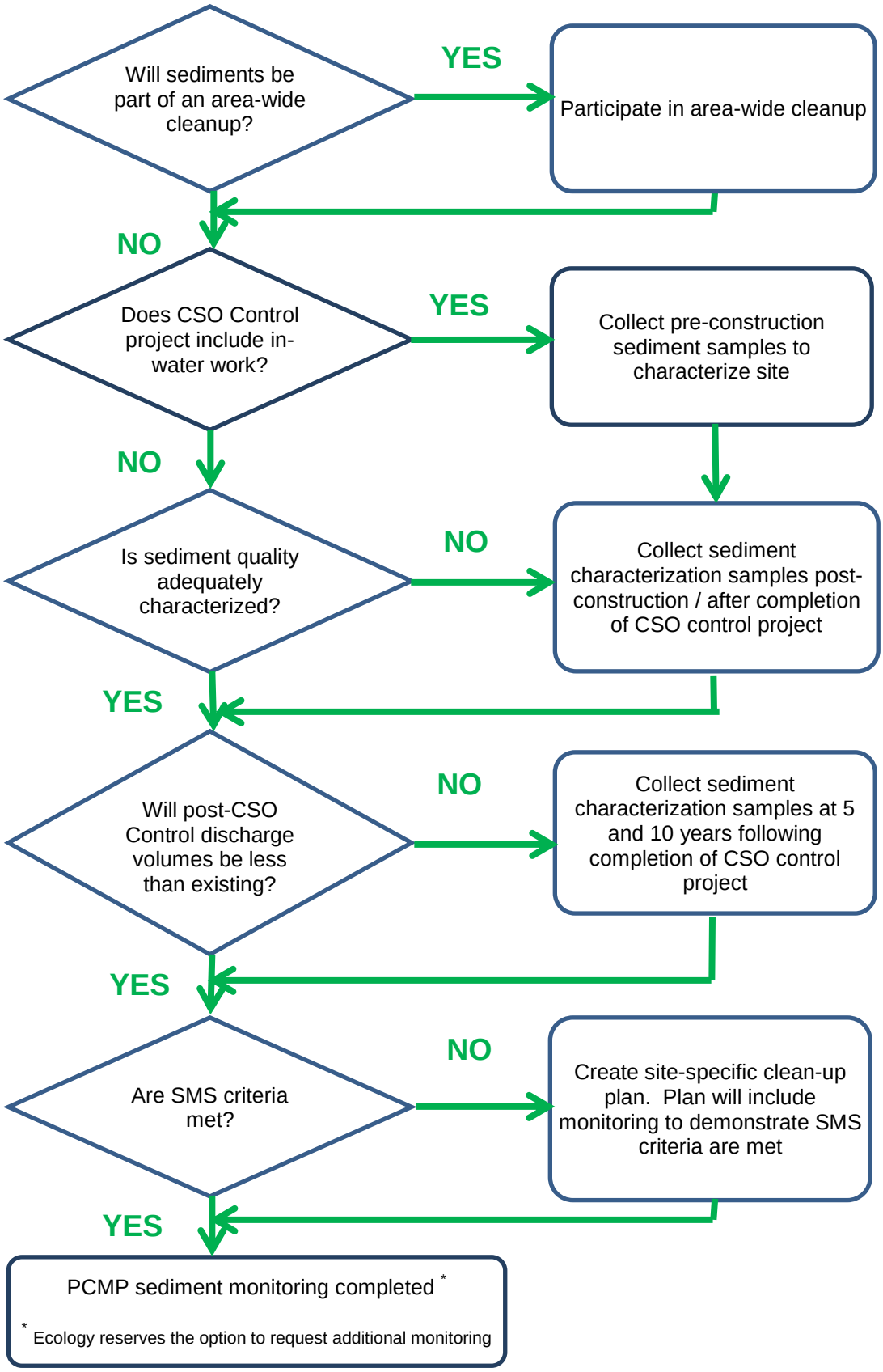

Figure 3. PCMP Sediment monitoring flowchart

For CSO control projects that will reduce the CSO discharge volume, one set of sediment quality samples will be collected to characterize the sediment quality. Sediment quality samples were collected in 2011 for 10 CSO locations (identified in Table 2). If existing samples provide adequate characterization and have no exceedances of SMS standards, no additional samples will be collected. Otherwise, one set of sediment quality samples will be collected following the completion of each CSO control project. If these samples indicate exceedances of SMS standards, a site-specific cleanup plan will be developed. The additional monitoring required as part of the site-specific cleanup plan will be described and documented in that plan. Sediment monitoring associated with any cleanup plan will be designed to demonstrate compliance with SMS.

CSO control projects that create or relocate a discharge location, or increase the volume of CSO discharge (such as combining flows to a CSO treatment facility), sediment quality sampling will happen three times. Initial sampling will occur prior to discharge to provide a pre-discharge characterization of the sediment quality. Sediment monitoring will be repeated at 5 and 10 years after completion of the CSO control project to ensure SMS standards are met. Should a trend indicating natural recovery not be observed at the 5-year sampling, or SMS standards not be met at the 10 year sampling, a site-specific cleanup plan will be developed.

Sediment remediation and monitoring may be performed prior to the completion of CSO control projects at locations where sediment recontamination modeling indicates that recontamination will not occur under existing conditions. Otherwise, sediment remediation will be performed after the CSO control project is completed.

At all CSO discharge locations, Ecology reserves the option to require additional sediment monitoring if evidence suggests there are new sources within the combined sewer basin, CSO discharge conditions have changed, or to determine continued compliance with the SMS.

Table 6. Sediment characterization schedule

DSN No.[a]	Facility	CSO Control Project Complete	Area-Wide Cleanup Anticipated	Year of sediment characterization
003	Ballard Siphon Regulator	2013	Yes	TBD[b]
004	11th Avenue NW (also called East Ballard)	2030	Yes	TBD[b]
006	Magnolia Overflow	2015	No	2011
007	Canal Street Overflow	Controlled	Yes	TBD[b]
008	3rd Ave W and Ewing Street	2025	Yes	TBD[b]
009	Dexter Avenue Regulator	[c]	Yes	TBD[b]
011	E Pine Street Pump Station Emergency Overflow	Controlled	No	2012
012	Belvoir Pump Station Emergency Overflow	Controlled	No	2012
013	Martin Luther King Way Trunkline Overflow	Controlled	No	2012
014	Montlake Overflow	2027	No	2011
015	University Regulator	2027	No	2011
018	Matthews Park Pump Station Emergency Overflows	Controlled	No	2012
027b	Elliot West CSO Treatment Facility	Controlled	No	ongoing
027a	Denny Way Regulator	[c]	No	ongoing

DSN No.[a]	Facility	CSO Control Project Complete	Area-Wide Cleanup Anticipated	Year of sediment characterization
028	King Street Regulator	2030	No	2031
029	Kingdome Regulator (replaced Connecticut Street Regulator)	2030	No	2031
030	Lander Street Regulator	2030	Yes	2031
031	Hanford #1 Overflow (Bayview N, Bayview S, and Hanford at Rainier)	2018	Yes	ongoing
032	Hanford #2 Regulator	2030	Yes	2031
033	Rainier Avenue Pump Station Emergency Overflow	Controlled	No	2012
034	East Duwamish Pump Station Emergency and Siphon Aftbay Overflows	Controlled	Yes	TBD[b]
035	West Duwamish Siphon Forebay Overflow	Controlled	Yes	TBD[b]
036	Chelan Avenue Regulator	2024	No	2011
037	Harbor Avenue Regulator	[c]	Existing	2012
038	Terminal 115 Overflow	2024	Yes	TBD[b]
039	Michigan Regulator (also called South Michigan Regulator)	2021	Yes	2022
040	8th Avenue S Regulator and West Marginal Way Pump Station Emergency Overflow	Controlled	Yes	TBD[b]
041	Brandon Street Regulator	2021	Yes	2022
042	West Michigan Regulator (SW Michigan Street Regulator)	2024	Yes	TBD[b]
043	East Marginal Pump Station	Controlled	Yes	TBD[b]
044	Norfolk Outfall and Henderson/MLK CSO Treatment Facility	Controlled	Yes	completed
045	Henderson Pump Station	Controlled	Yes	2012
046	Carkeek CSO Treatment Facility Outfall	Controlled	Yes	completed
048b	North Beach Pump Station Emergency Overflow (inlet structure)	2015	Yes	2011
048a	North Beach Pump Station Emergency Overflow (wet well)	2015	Yes	2011
049	30th Avenue NE Pump Station	Controlled	Yes	2012
051	Alki CSO Treatment Facility Outfall	Controlled	Yes	completed
052	53rd Avenue SW Pump Station Emergency Overflow	Controlled	Yes	2011
054	63rd Avenue SW Pump Station Emergency Overflow	Controlled	Yes	completed
055	SW Alaska Street Overflow	Controlled	Yes	completed
056	Murray Avenue Pump Station Emergency Overflow	2016	Yes	2011
057	Barton Street Pump Station Emergency Overflow	2015	Yes	2011
TBD	Michigan/Brandon CSO Treatment Facility	2021	Yes	2021, 2026, 2031
TBD	Hanford/Lander/King/Kingdome CSO Treatment Facility	2030	Yes	2030, 2035, 2040

[a] DSN = discharge serial number, as set in the NPDES permit.
[b] TBD = To Be Determined, depending on schedule of area-wide cleanup.
[c] Control project was completed; currently refining system operation and control strategies.

3.2.3.4 How Sediment Monitoring will be conducted

Prior to sampling at a site, King County will develop a Sampling and Analysis Plan (SAP) for that site. Each SAP will be prepared according to the guidance provided in the Sediment Source Control Standards User Manual, Appendix B: Sediment Sampling and Analysis Plan (Ecology, 2008). The purpose of the plans is to determine whether the sediment at a site exceeds the SMS and, if so, to delineate the exceedances. A SAP from the current CSO sediment sampling is included in Appendix G to illustrate the methods and sampling details typically employed.

3.3 Quality Control and Data Management

Activities under the plan will be implemented with appropriate quality control standards. The county has standard operating procedures (SOPs) in place for CSO outfall flow monitoring and for water and sediment quality sampling. In general, quality control procedures are as follows:

- A dedicated CSO crew manages CSO flow monitoring by following SOPs for maintenance, equipment replacement, data downloads, and associated field activities. A data analyst reviews the flow data for validity and representativeness.
- Trained staff at the county's certified environmental laboratory performs ambient water and sediment quality sampling. Standard sampling procedures and documentation, including use of chain-of-custody forms and appropriate sample preservation techniques, are a required part of the program.
- Environmental laboratory staff analyze water quality samples, following standard and required methods, protocols, and documentation.
- Rainfall data are recorded and archived by the county's SCADA system. Rain gauge calibration and maintenance are performed every three months, as scheduled and tracked by the county's computerized maintenance management system.

Data on controlled untreated and treated CSO discharges are currently being collected as part of the county's ongoing monitoring program; the post construction monitoring data will be integrated into existing data validation, archival, retrieval, and management tools.

Details on King County's quality control and data management procedures and protocols can be found in the NPDES permit sampling requirements and the sampling and analysis plans included in the Appendices.

4 Data Evaluation and Progress Reporting

King County will evaluate the post construction monitoring data to assess CSO control effectiveness and compliance with water quality standards and will report progress in the annual CSO report. Each CSO control plan update submitted with the West Point NPDES permit renewal application will consolidate the information relevant to each project; document the performance of the fully implemented CSO control measures, both by individual CSOs and systemwide; and provide further assessment of long-term trends.

If a CSO control project has been completed, but has not met performance goals, supplemental compliance plans will be developed as described in 2011 CSO Control Program Review Summary of Technical Memorandum, Section 9.0. On-going monitoring meeting PCMP needs will continue, and any special studies identified to support the review of project effectiveness will be implemented. The schedule for data review, conclusions and reporting will be defined in the supplemental compliance plan.

4.1 Discharge Frequency

Ecology has directed that the control standard of no more than one untreated event per year be assessed as a 20-year moving average of monitored event data. Where 20 years of monitored data are not available, such as for a new control facility, the missing years are to be predicted using modeled data. The model will predict how the new control facility would have performed under the previous 20 years of rainfall conditions. As post construction monitoring data become available, they will replace model results in the rolling 20-year average calculation. King County proposes that a commissioning period be established for each project, after which the monitoring data will be incorporated into the 20-year average. Allowing for such a period would prevent initial startup issues from affecting the analysis of the level of control for the next 20 years.

The modeled data will come from King County's fully dynamic, planning-level collection system model that has been continually refined since its development in the late 1980s. Details of this collection system model are described in Appendix C of King County's 2008 CSO control plan update (King County, 2008). The county will use this model to simulate up to 20 years of overflow events to fill in any missing years of data, using the following steps:

1. Use the model as calibrated and configured during a CSO control project's design phase to run a continuous simulation of CSO discharges for a representative 20-year period.
2. Replace successive years of the model run with monitored post construction CSO discharges, as actual overflow data becomes available.
3. Used this combination of model results and monitored data each year to assess compliance with the control standard.
4. If the modeled average annual overflow frequency is one or less under the mixing zone rules, the CSO will be deemed to be in compliance with Washington State surface water quality standards, Section 173-201A, if an unlimited mixing zone is approved once per year on average.

4.2 Compliance with Surface Water Quality Standards

The county will assess compliance with state surface water quality standards by conducting a reasonable potential analysis as described in the permit writer's manual (Ecology, 2010). The analysis will be based on the post construction monitoring of treated effluent quality data and on existing ambient quality data. This analysis is extremely protective of water quality standards. It uses the 95th percent confidence level of the 95th percentile concentration and then combines these concentrations with the 90th percentile concentration of ambient water quality samples and the calculated outfall dilution ratio to estimate a maximum concentration at the point of compliance. The point of compliance is either the discharge point or the boundary of an approved mixing zone. When the maximum reasonable potential concentrations are below state water quality standards, the analysis demonstrates that the treated CSO discharge has met receiving water quality standards. Where a reasonable potential to violate water quality standards at the edge of the mixing zone is predicted, the county will assess whether the maximum measured concentration, which may be less than the reasonable potential concentration, has the potential to violate water quality standards. Where the potential exists to exceed water quality standards, it is assumed that Ecology will set effluent limits and monitoring requirements to prevent violation.

As part of the 2009 West Point NDPES permit renewal, King County must submit a receiving water characterization report to Ecology by June 30, 2013, that describes background conditions for use in future reasonable potential calculations. The requirement includes analysis for metals and some organics in the vicinity of each CSO treatment facility. With the results of this analysis combined with sampling King County has conducted in marine and fresh waters, ambient conditions will be well characterized and no additional receiving water sampling, other than ongoing ambient monitoring programs, is proposed under this post construction monitoring plan.

The discharge from CSOs controlled to no more than one untreated event per year will be assumed to comply with the numeric surface water quality standards with the application of the mixing zone exemption in WAC 173-201A-400. A reasonable potential analysis will not be conducted for these discharges.

The County will continue to assess compliance with the narrative portion of the state surface water quality standards by monitoring and responding to complaints received about CSO discharges. Existing uncontrolled CSO discharges do not appear to adversely affect existing or designated uses, and implementation of the CSO control plan should only reduce the impact of CSO discharges.

4.3 Compliance with Sediment Management Standards

Sediment chemistry data will be evaluated by comparison with SMS sediment chemical criteria from Tables I and III of Chapter 173-204 WAC. Sediment data for some organic compounds are generally normalized to organic carbon content for comparison to SMS criteria. Normalization to organic carbon can produce biased results, however, when the organic carbon content of the sample is very low (Ecology, 1992). When the organic carbon content of a sample is near 0.1 or 0.2 percent (1,000 to 2,000 mg/kg dry weight), even background concentrations of certain organic compounds can exceed sediment quality criteria.

If the organic carbon content at any particular station is below 0.5 percent dry weight, then dry weight-normalized results for non-ionizable organic compounds will be compared to Lowest

Apparent Effects Threshold (LAET) or Second Lowest Apparent Effects Threshold (2LAET) criteria (EPA, 1988), rather than SMS criteria. The LAET and 2LAET are considered equivalent to the SQS and CSL, respectively.

The chemistry data will be submitted to Ecology in EIM format (latest version), and exceedances of SMS will be summarized in the annual CSO report.

If the sediment sampling confirms exceedances of the SMS, a project-specific sediment cleanup plan will be developed for approval by Ecology. The plan will identify remediation measures and the subsequent sediment monitoring program. It may also include sediment recontamination modeling to assess the potential for recovery or recontamination. The extent and frequency of the subsequent sediment monitoring will depend on the type and extent of existing contamination and the expected recovery or recontamination rate. Sediment monitoring associated with any cleanup plan will be designed to demonstrate compliance with SMS.

4.4 Influence of Other CSOs

In S.18.K.3 of the West Point NDPES permit, Ecology requested that the post construction monitoring plan address the following:

> …a discussion of controlled outfalls that may be influenced by other County or City of Seattle uncontrolled outfalls that may adversely influence or interfere with the water quality assessment of controlled outfalls. The Permittee must provide adequate justification for not performing post construction monitoring for controlled CSO outfalls where water quality may be impacted by nearby outfalls.

For untreated CSOs controlled to an average of one or fewer events per year, it is assumed that surface water quality standards will have been met by requesting and being granted the once per year unlimited mixing zone. The presence of nearby uncontrolled CSOs will not influence the ability to achieve water quality standards under this scenario. As a result, no additional monitoring other than the post construction monitoring described previously, is proposed to evaluate the influence of nearby CSOs on the control status of King County CSOs.

CSOs that treat and discharge could be impacted by nearby uncontrolled CSOs affecting the ambient water quality conditions. The Elliott West discharge (DSN 027b) is located 340 feet offshore of the Denny CSO (DSN 027a), which is not fully controlled (see Table 1). However, the Elliott West discharge terminates at a depth of 60 feet and primarily mixes with ambient water at depth as it rises to the surface. The Denny CSO discharges at a depth of 20 feet and will reach the surface before it could reach the mixing zone for the Elliott West discharge. As a result, it is unlikely that the Denny CSO would affect compliance with water quality standards at Elliott West. No other treated CSO discharges have a nearby CSO discharge. King County believes that the ambient water quality sampling conducted during its ongoing program and the wet-weather sampling that occurred during the 1999 Duwamish/Elliott Bay WQA are sufficiently comprehensive to include the effects of other discharges, particularly since the reasonable potential analysis uses the 90th percentile ambient concentration (King County, 1999). The WQA includes samples taken during periods of CSO overflow events.

Sediment quality near CSOs can be affected by sediment deposition from historical activities and other sources. Cleanup plans developed to address area-wide sediment quality exceedances will address sediment deposition from all nearby outfalls. In many cases, there is wide spread

sediment contamination and cleanup activities are expected to be integrated with an area-wide cleanup.

5 References

Ecology. 1988. *Sediment Quality Values. Refinement: 1988 Update and Evaluation of Puget Sound AET.* Prepared for the U.S. Environmental Protection Agency, Region 10, by PTI Environmental Services. Seattle, WA.

Ecology. 1992. Technical Information Memorandum, Organic Carbon Normalization of Sediment Data. Prepared by Teresa Michelsen for the Washington State Department of Ecology, Sediment Management Unit. Olympia, WA.

Ecology. 2002. *Water Cleanup Plans – Total Daily Maximum Loads.* Publication Number 02-10-038. http://www.ecy.wa.gov/pubs/0210038.pdf.

Ecology. 2007. *Agreed Order DE 5068, Exhibit D: Sediment Management Standards Interim Action Work Plan: Denny Way Combined Sewer Overflow Site Seattle, Washington.* http://www.ecy.wa.gov/programs/tcp/sites/denny_way/dw_hp.htm.

Ecology. 2008. *Criteria for Sewage Works Design* (Orange Book). Publication Number 98-37. http://www.ecy.wa.gov/biblio/9837.html.

Ecology. 2011. *Development of Benthic SQVs for Freshwater Sediments in Washington, Oregon, and Idaho.* Publication Number 11-09-054. Prepared by Avocet Consulting.

EPA. 2011. *CSO Post Construction Compliance Monitoring Guidance*. Publication Number EPA-833-K-11-001, April 2011.

Ecology. 2009. *National Pollutant Discharge Elimination System Waste Discharge Permit No. WA-002918-1* (West Point Wastewater Treatment Plant), http://www.ecy.wa.gov/programs/wq/permits/permit_pdfs/west_point/2009/WestPointWWTP_Permit.pdf.

Ecology. 2010. *Water Quality Program Permit Writer's Manual.* Publication Number 92-109. originally issued June 1989, revised November 2010. http://www.ecy.wa.gov/biblio/92109.html.

Ecology, 2011. *Draft Revisions Sediment Management Standards (SMS) (Part V and Definitions)*. Discussion Materials Prepared for the Sediment Cleanup Advisory Committee. November 2011. http://www.ecy.wa.gov/programs/tcp/regs/2011-SMS/adv-comm/mtg-111209/SMS_Revisions_Advisory_Group_Preliminary%20Draft_Nov_2011.pdf

King County. 1999. *King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay*. King County Department of Natural Resources and Parks, Wastewater Treatment Division. Seattle, WA. http://www.kingcounty.gov/environment/wastewater/CSO/Library/WaterQuality.aspx.

King County, 2001. *1999/2000 Water Quality Status Report for Marine Waters*. King County Department of Natural Resources and Parks, Water and Land Division. Seattle, WA. http://green.kingcounty.gov/marine/Reports.aspx.

King County. 2002. *2001 Water Quality Status Report for Marine Waters.* King County Department of Natural Resources and Parks, Water and Land Division. Seattle, WA. http://green.kingcounty.gov/marine/Reports.aspx.

King County. 2008. *Combined Sewer Overflow Program, 2008 CSO Control Plan Update.* King County Department of Natural Resources and Parks, Wastewater Treatment Division. Seattle, WA. http://www.kingcounty.gov/environment/wastewater/CSO/Library.aspx.

King County. 2009a. *Comprehensive Sediment Quality Summary Report for CSO Discharge Locations*. King County Department of Natural Resources and Parks, Wastewater Treatment Division. Seattle, WA. http://www.kingcounty.gov/environment/wastewater/CSO/Library/PlanUpdates.aspx.

King County. 2009b. *Regional Wastewater Services Plan, 2008 Annual Report.* King County Department of Natural Resources and Parks, Wastewater Treatment Division. Seattle, WA. http://www.kingcounty.gov/environment/wtd/Construction/planning/rwsp/Library/AnnualReport.aspx.

King County, 2009c. *King County Surface Water Design Manual.* King County Department of Natural Resources and Parks. Seattle, WA. http://www.kingcounty.gov/environment/waterandland/stormwater/documents/surface-water-design-manual.aspx

Seattle Public Utilities, 2009. *Green Stormwater Operations and Maintenance Manual*, Seattle, WA.

Post Construction Monitoring Plan for King County CSO Controls

March 2012

Appendices

Appendix A. Water Quality Standards

Appendix B. Flow Measurement Sampling and Analysis Plan and Quality Assurance Project Plan

Appendix C. Treated CSO Sampling and Analysis Plan and Quality Assurance Project Plan

Appendix D. Receiving Water Characterization Study Sampling and Analysis Plan and Quality Assurance Project Plan

Appendix E. Freshwater Lakes Sampling and Analysis Plan and Quality Assurance Project Plan

Appendix F. Beaches Sampling and Analysis Plan and Quality Assurance Project Plan

Appendix G. Marine Water Column and Nearshore Sampling and Analysis Plan and Quality Assurance Project Plan

Appendix H. Sediment Sampling and Analysis Plan and Quality Assurance Project Plan