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State of Washington

Quality Assurance Project Plan

Phase I Municipal Stormwater Permit Data Review

October 2012

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Publication Information

This project is funded by the U.S. Environmental Protection Agency's National Estuary Program (NEP), to the Washington State Department of Ecology (Ecology). Each study conducted by Ecology must have an approved Quality Assurance Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completing the study, Ecology will post the final report of the study to the Internet.

The plan for this study is available on Ecology's website at
https://fortress.wa.gov/ecy/publications/SummaryPages/1203125.html

Data for this project are owned by the municipal permittees whom are responsible for collecting and reporting the data. Permittees are also responsible for the data's entry to EIM. There was no data collected by Ecology as part of this project.

Ecology's Activity Tracker Code for this study is 13-002.

Waterbody Numbers: Statewide.

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Quality Assurance Project Plan

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October 2012

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EAP: Environmental Assessment Program
WQP: Water Quality Program

Table of Contents

List of Figures and Tables

Page

Figures

Tables

Abstract

The Washington State Department of Ecology (Ecology) will compile existing and available stormwater monitoring data collected between 2009 and 2011 by eight Permittees under Ecology's Phase I Municipal Stormwater Permit (Phase I Permit). These Permittees include: the Counties of Snohomish, King, Pierce, and Clark; the Cities of Seattle and Tacoma; and the Ports of Seattle and Tacoma. The Permittees monitored stormwater discharge locations for rainfall and runoff relationships, water quality, and stormwater sediment quality for four different land uses (commercial, industrial, low density residential and high density residential). This project will summarize the stormwater data collected under Special Condition S8.D of the 2007-2012 Phase I Permit. Evaluated contaminants include a range of conventional parameters, nutrients, total and dissolved metals, polycyclic aromatic hydrocarbons, phthalates, total petroleum hydrocarbons, pesticides, and herbicides.

Characterization of the regional stormwater discharge data will include descriptive statistics and testing for significant differences in the concentrations or loads by land use or storm event.

Background

Municipal Stormwater Permit

The Washington State Department of Ecology (Ecology) issued the "National Pollutant Discharge Elimination System and State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Stormwater Sewers" on January 17, 2007. This permit is also referred to as the "Phase I Municipal Stormwater Permit or "Phase I Permit" for this document. The March 22, 2006 Phase I Municipal Stormwater Permit Fact Sheet identifies stormwater as the "leading contributor to water quality pollution in our urban waterways. As urban areas grow, stormwater is also Washington's fastest growing water quality problem" (Ecology, 2006).

The Phase I Permit authorizes discharges of stormwater from large and medium municipal separate storm sewer systems (MS4s) in Washington State, as established by Title *40 CFR* 122.26, RCW 90.48.030, and RCW 90.48.162. Washington State Department of Transportation, however, is covered under an individual permit.

Special Conditions S8.D of the 2007-2012 Phase I Permit required the municipalities covered under the Permit as well as the Ports of Tacoma and Seattle to conduct stormwater monitoring. These Permittees were given the option of collaborating with each other on monitoring requirements or conducting the S8.D monitoring independently. If they chose to collaborate they were allowed an additional 6 months on the compliance schedule.

Figure 1 lists the Permittees that are monitoring independently and those that are collaborating. Figure 2 shows a general timeline of S8.D stormwater monitoring and data submittal to Ecology. In general the independents are further along in their monitoring programs than the collaborators.

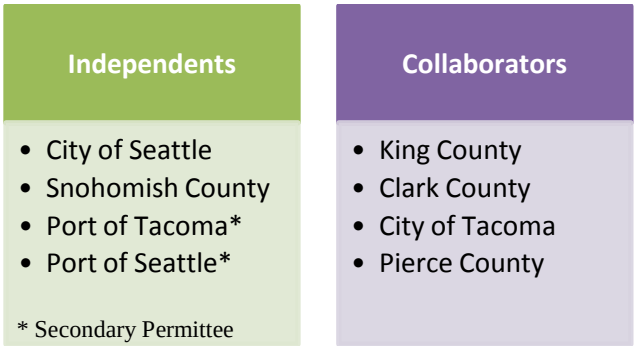

Figure 1. Phase I permittees conducting stormwater monitoring.

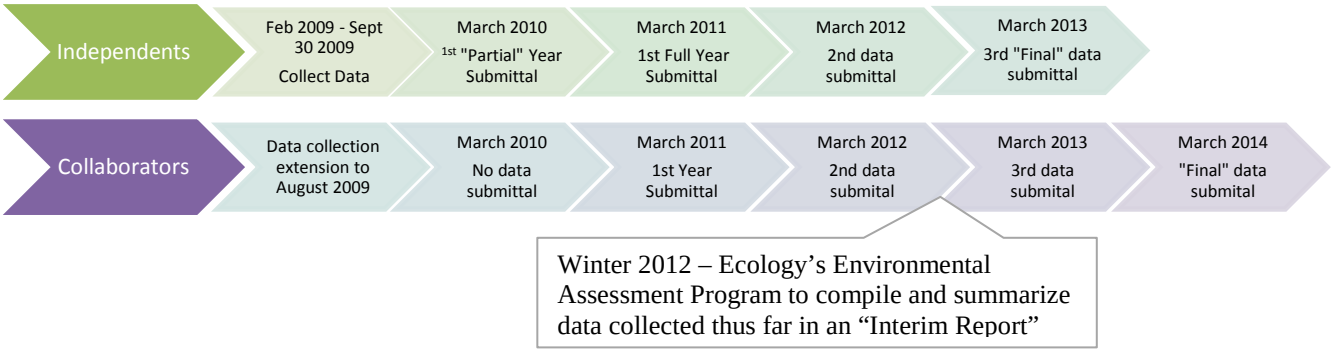

Figure 2. General monitoring data submittal timeline.

Figure 3 shows the general locations of the cities, ports, and county governments covered by the Phase I Permit.

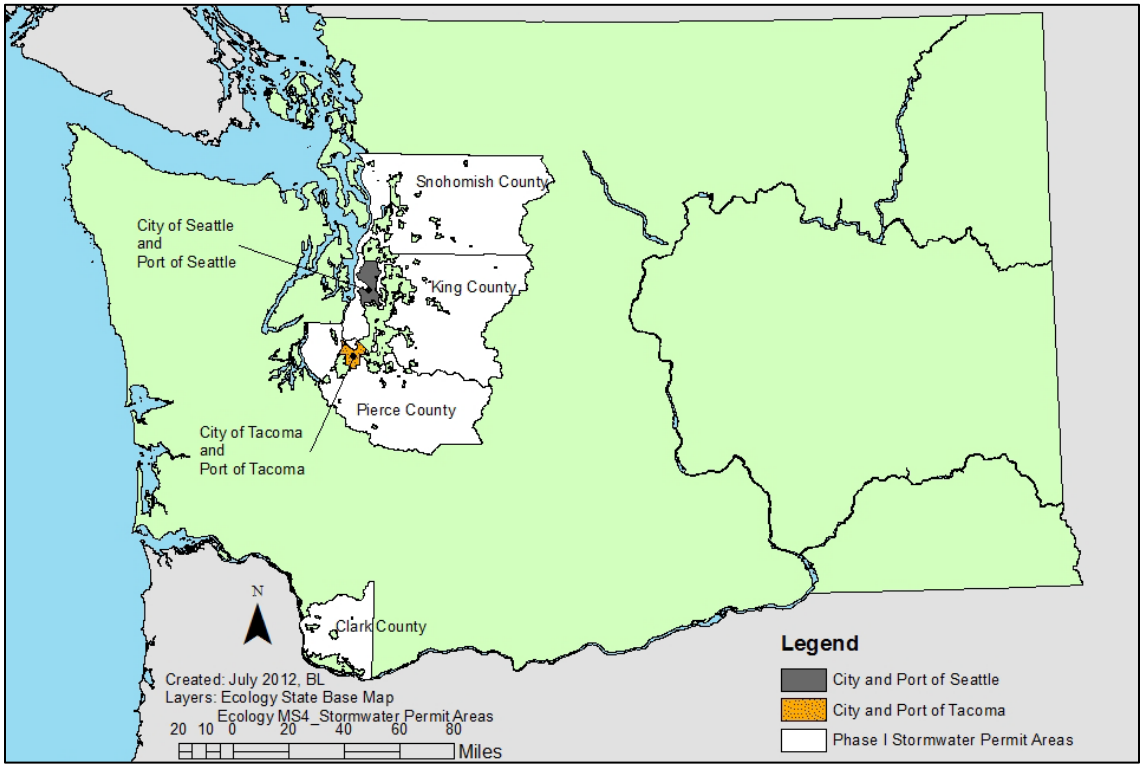

Figure 3. Map of Phase I Permit coverage and permittees.

Monitoring Requirements

Special Condition 8 (S8) of the 2007-2012 Phase I Permit consists of three main monitoring elements: stormwater monitoring (S8.D), targeted stormwater management program effectiveness monitoring (S8.F), and stormwater treatment and hydrologic Best Management Practices (BMP) evaluation monitoring (S8.E). The primary goals of each monitoring element are described below:

- (S8.D) Stormwater discharges are monitored from four different land uses (high and low density residential, commercial and industrial) and results are described as event mean concentrations (EMCs), dry and wet season loadings, annual loadings, and annual storm solids (e.g., in-system sediment) quality.
- (S8.E) Stormwater management program effectiveness studies are conducted to evaluate the effects of different management actions (such as street sweeping or public education about bacteria) on water quality.
- (S8.F) Treatment and flow reduction facility effectiveness evaluations are made to understand the performance of individual BMPs/facilities and provide feedback regarding design standards.

The purpose of S8.D monitoring, as part of the overall data collection effort, is described by the permit as:

> Stormwater monitoring which is intended to characterize stormwater runoff quantity and quality at a limited number of locations in a manner that allows analysis of loadings and changes in conditions over time and generalization across the Permittees' jurisdiction. (Ecology, 2007)

An overall objective of the stormwater discharge monitoring required in the 2007 permit is to develop a single stormwater data set for multiple urban areas in western Washington. With the required standardized monitoring program through the permit, Permittees are conducting monitoring based on land use type, and they are collecting storm event data using similar field procedures and similar laboratory methods. Ecology wanted this consistency in methodology to create the advantage of a consistent data set across jurisdictions.

Ecology's intent was to use this consistent data set and baseline information to get more empirical information about local stormwater quality. Ecology also intended to use this data and empirical information to help determine problem areas that could benefit from additional stormwater management practices or solutions. To date, Ecology has compiled a limited data set from a couple partial years of monitoring from a few Permittees.

Compilation and analysis of the stormwater data as collected under S8.D of the Phase I Permit will help fill a data gap identified by a recent Ecology study. In 2011, the Toxic Chemicals in Puget Sound: Phase 3 Data and Load Estimates study (Ecology, 2011) monitored instream pollutant loads from different land uses. This study is commonly known as the Toxics Loading Study, which identified stormwater as the largest pathway for toxic chemicals to enter Puget Sound. The study found the major data gap was regional stormwater quality information from conveyance systems, particularly those that discharge directly to the receiving water, Puget Sound.

Project Description

Collectively, the Phase I Permit's S8.D stormwater monitoring data represents the largest local data set to characterize municipal stormwater discharge quality. Only a portion of this data (2009-2010 partial years) from some of the Permittees has been compiled and analyzed. Nevertheless, results of this initial analysis suggest that loads of several toxics were underestimated in the toxics loading assessment. This is most likely due to the fact that in-stream concentrations, rather than discharge information, were used in the Puget Sound assessment to calculate loading. For example, dissolved copper, a metal that affects salmon, may be up to 5 times higher than concentrations found in the Toxics Loading Study. Chrysene, a polycyclic aromatic hydrocarbon that is a human carcinogen and toxic to fish, may be up to 20 times higher than concentrations found in the Toxics Loading Study (Ecology, 2011).

Stormwater discharge characterization was identified as a priority for grant funding from the National Estuary Program (NEP). Ecology's Environmental Assessment Program (EAP) has received NEP funding to compile and review the S8.D monitoring data collected between 2009 and 2012. Additionally, this project supports the original intent of the Phase I Permit. The Fact Sheet prepared for the 2007-2012 Phase I Permit issuance describes the reason for requiring Permittees to conduct stormwater monitoring:

> Knowledge of pollutant loads and of average EMCs from representative areas drained by the municipal storm sewer systems are necessary to gauge whether the comprehensive stormwater management programs are making progress towards the goal of reducing the amount of pollutants discharged and protecting water quality....The number of samples per year… is intended to establish a sufficient data base from which to discern annual and seasonal loading trends over a long time period. (Ecology 2006)

Results from this project will be useful in identifying the regional ranges of stormwater discharge concentrations which, in turn, will decrease our reliance on national averages that may not be representative of western Washington.

Goals

Specific goals will be to refine EMCs and loading data for stormwater discharges from the monitored land uses. Technical goals of this study are to:

1. Create a single electronic data set of stormwater monitoring data generated from each of the Permittees to date (generally 2009 to September 2011).
2. Establish a baseline understanding of (characterize) western Washington stormwater discharges and stormwater sediments.
3. Evaluate data attributes in terms of spatial and temporal scales, types of storms sampled, land uses or regional factors.
4. Summarize data quality, based on Permittees' QC reviews.
    a. Identify parameters with high incidence of matrix interference, below detection limits, and/or parameters that are often non-detect.

5. Determine "typical" stormwater conditions, such as EMC by land use and parameter for sampled storms that met storm event criteria. Calculate summary statistics such as: mean, median, standard deviation, 25^{th}-75^{th} percentiles.
    a. Evaluate EMCs; test for significant differences between the land uses, seasons, or storms.
6. Non-detects will be evaluated using non-substitution techniques like Maximum Likelihood Estimation or Kaplan-Meier, if data sets with explicit detection limit data are obtained.
7. Compare and contrast the land use loading rates (commercial, industrial, low and high density residential) to the Toxic Loading Study national averages used for computation, if storm flow records are obtained.
    a. Commercial and industrial stormwater loads would represent discharges direct to Puget Sound and will fill a data gap identified by the Phase 3 Toxic Loading study (Ecology, 2011).

These evaluations and summaries aim to provide a better understanding on the state of western Washington's municipal stormwater. It will serve as the best available science for western Washington stormwater quality, for use by stormwater managers at local governments, state agencies, and EPA.

Data Compilation

In the 2007 permit, Ecology required data to be collected under an approved Quality Assurance Project Plan (QAPP) and submitted to Ecology as part of the annual monitoring report. Permittees' QAPPs are referenced in Appendix A. For the 2007 permit, Ecology did not require data to be submitted electronically. However, Ecology informally asked Permittees to submit data electronically to Ecology's Environmental Information Management System (EIM) database and provided guidance for this.

The Phase I Permit, issued August 1, 2012 and effective September 1, 2012, requires Permittees to enter all S8.D data into EIM by July 31, 2013. Some of the permittees will not have all their data in EIM for use under this project. Table 1 shows the Permittee data held in the EIM database to date.

Table 1. Permittee data in EIM as of August 2012.

Permittee	EIM Study ID	Locations Entered into EIM?	Years of Results Data Entered into EIM
Snohomish County	WAR044502_S8.D	No	None
King County	None	No	None
Pierce County	None	No	None
Clark County	None	No	None
City of Seattle	WAR044503_S8.D	Yes	2009-2011
City of Tacoma	None	No	No
Port of Seattle	WAR044701_S8.D	Yes	2009
Port of Tacoma	WAR-04-4200_S8.D	No	No

Ecology will request data to be either sent directly to the project manager or submitted to Ecology's EIM database. As such, some of the goals may not be achievable, based on the availability of the data obtained.

Schedule and Organization

Ecology will lead a project review team. Table 2 presents the proposed schedule and tasks for this project.

Schedule and Tasks

The following tasks were identified in the grant proposal to NEP.

Tasks

Task 1: Develop a Quality Assurance Project Plan (QAPP)

Prepare a QAPP to describe the project for review and approval prior to initiating work. Include all components outlined in Ecology Guidelines for preparation of QAPPs.

Task 2: Gather and Summarize Phase 1 Stormwater Monitoring Data

Sub-task A: Collect data submitted by each permittee under the Phase I Stormwater permit, as written annual reports. Section S8.D of the Phase I Permit monitoring data will be requested (in electronic form) from each Permittee if data is not already in EIM. Format and compile this electronic data into one coordinated data set. Store flow and precipitation data as the storm event flow or precipitation.

Sub-task B: Perform statistical analysis of S8.D data. However, do not include toxicity data results in the analysis for this project.

Task 3: Prepare Project Report

Prepare a draft and final report for the years of data (2009-2012) available to date. These reports will document work performed under this project and describe study findings.

Task 4: Distribute Data and Findings

Present and distribute data and reports to Ecology and Permittees. Publish to Ecology's webpage or other central public websites. Publish a Fact Sheet.

Table 2. Timeline of tasks for the Phase I stormwater data review.

Task	Title	Description	Deliverable	Due Date
1	QAPP	Prepare draft QAPP	Internal review	7/31/12
		Final QAPP	Final QAPP posted on website	10/15/12
2A, B	Data analysis	A. Screen and compile data submitted prior to October 31, 2012, electronically. B. Conduct data analysis of Phase 1 stormwater discharge monitoring data.	Electronic data in database. Draft results of conventional, metal, and organic analysis for internal review.	1/30/13
3	Prepare draft and final report	Draft report due to supervisor		4/30/13
		Draft due to client/peer review		5/31/13
		Draft due to external reviewers		6/30/13
		Final due to publications coordinator		7/31/13
		Final report due on web		8/31/13
4	Distribute findings	Prepare final data set, presentation and focus sheet	Electronic data, presentation and focus sheet	9/30/13

Staff

Table 3 lists the Ecology staff involved in this project. All are employees of the Washington State Department of Ecology. This study will benefit from assistance from the Water Quality Program municipal stormwater permit management staff. The Ecology permit managers will be a part of the team and will coordinate with Permittees.

Table 3. Project staff and responsibilities.

Project Team Members	Project Title	Responsibilities
Signatory Members		
Andrew Kolosseus Water Quality Program Phone: (360) 407-7543	EAP Client	Provides internal review of the QAPP and approves the final QAPP. Reviews draft data analysis and draft and final report.
Kathleen Emmett Water Quality Program Phone: (360) 407- 7386	Water Quality Review	Provides internal review of QAPP and approves final report.
Bill Moore, PE Water Quality Program Phone: (360) 407- 6460	Water Quality Review	Provides internal review of QAPP and approves final report.
Brandi Lubliner Toxics Studies Unit, EAP Phone: (360) 407-7140	Project Manager	Writes the QAPP. Conducts review of data, analyzes and interprets data. Writes the draft report and final report.
Dale Norton Toxics Studies Unit, EAP Phone: (360) 407-6765	Unit Supervisor for the Project Manager	Provides internal review of the QAPP, approves the budget, and approves the final QAPP.
Will Kendra Statewide Coordination Section, EAP Phone: (360) 407-6698	Section Manager for the Project Manager	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Thomas Gries EAP Phone: (360) 407-6327	NEP Quality Assurance Coordinator	Reviews the draft QAPP and draft report.
William Kammin Ecology Phone: (360) 407-6964	Ecology Quality Assurance Officer	Approves final QAPP.
Additional Core Staff (WQP)	**Permittees Covered**	**Location and Responsibilities**
Carrie Graul (360) 407-7221	Phase I Permit Writer, Statewide	Headquarters Office - Municipal Stormwater Planner. Reviews draft QAPP and draft report.
Rachel McCrea (425) 649-7223	City of Seattle, Port of Seattle, King County, Snohomish County	Northwest Regional Office - Municipal Stormwater Permit Manager. Reviews draft QAPP and draft report.
Vince McGowan (360) 407-7320	City of Tacoma, Pierce County, Port of Tacoma	Southwest Regional Office - Municipal Stormwater Permit Manager. Reviews draft QAPP and draft report.
Lisa Cox (360) 690-7120	Clark County	Vancouver Field Office - Municipal Stormwater Permit Manager. Reviews draft QAPP and draft report.
Andrew Smith, PE Toxic Cleanup Program (425) 649-7138	NA	Northwest Regional Office – Lower Duwamish Waterway Project Coordinator. Reviews draft QAPP and draft report.

EAP: Environmental Assessment Program

Study Process Design

The study covered under this QAPP will work entirely with secondary data as reported by the Permittees to Ecology up to the March 2012 data submittal deadline. This project will involve compilation, evaluation, and analysis of existing data. Data will be uploaded to Microsoft Excel data spreadsheets. Data statistics will be computed using Microsoft Excel and readily available statistical software such as R.

The Phase I stormwater data review will provide information and documentation sufficient to support land use-based stormwater EMCs and ranges of loadings by storm rainfalls and basin size. The data review will also identify pollutants of concern entering receiving waters from stormwater discharges. Sources of the pollutants will be described generally, such as land use types, and probable primary sources for those land uses. This information will come from Permittee annual reports and QAPPs. Specific source identification of pollutants is not part of this project.

Data Analysis

To gain an appreciation of the potential size of the data set, a hypothetical but plausible scenario is used. If each of the 6 city/county Permittees monitored 11 storms each year for 3 years to date, and each Permittee monitored 3 land uses, then 594 storms will have been monitored. If the monitoring by the 2 Ports is added to this estimate, another 66 storms (1 land use for the last three years for each Port) would be added. In total the data set potentially consists of 660 storm events monitored. This represents a substantial data set, approximately 5 times larger in captured storm events than the Phase 3 Toxics Loading Study.

Table 4 shows the land uses monitored by each Permittee.

EAP will perform the following analyses using the data compiled through the monitoring activities described above and the data obtained from the Permittees and EIM. Note that these statistics and computations may be developed for only a subset of the parameters tested if the data are not adequate to support the effort for all the parameters (e.g., if there are too many non-detect values for a given parameter). Analyses, dependent on available data, may include:

- Calculating summary statistics for chemical concentrations by monitoring location, land use, watershed, and storm season (e.g., wet vs. dry).
- Calculating the range of storms (e.g., precipitation) and pollutant concentrations typical of western Washington. This improves confidence in the estimates of average concentrations for each land use type. The averages can be scaled up to cover similar land uses across the region.
- Using statistical analysis to evaluate differences in chemical concentrations by land use, watershed, and/or storm season. Statistics would include standard analysis dependent on distribution such as t-test, ANOVA, or Kruskal-Wallis.
- Computing storm event loads for the land uses monitored and comparing them to the land use loads found by the Toxics Loading Study.

Table 4. Phase I S8.D sites summary.

Permittee	Land Use			
	Low Density Residential	High Density Residential	Commercial	Industrial
Clark County	43 acres 100% residential 7% TIA	239 acres 99% residential 1% open space 52% TIA	27 acres 83% commercial 17% residential 76% TIA	NA
Pierce County	219 acres 43% residential 55% open space 2% other 5% TIA	125 acres 62% residential 16% commercial 14% roadway 8% open space 28% TIA	11 acres 96% commercial 4% open space 96% TIA	NA
City of Tacoma	NA	1821 acres 83% residential 10% commercial 5% open space 1% industrial 65% TIA	181 acres 68% commercial 32% residential 80% TIA	36 acres 100% industrial 85% TIA
Port of Tacoma	NA	NA	1.3 acres 100% commercial 82% TIA	NA
King County	43 acres 100% residential 17% TIA	5 acres 100% residential 50% TIA	5 acres 80% commercial 20% residential 80% TIA	NA
City of Seattle	NA	85 acres 95% residential 5% commercial 50% TIA	152 acres 61% commercial 37% residential 2% open space 61% TIA	137 acres 37% industrial 32% residential 18% open space 13% commercial 51% TIA
Port of Seattle	NA	NA	1.3 acres 100% commercial 95% TIA	NA
Snohomish County	68 acres 85% residential 15% school 26% TIA	20 acres 100% residential 40% TIA	34 acres 100% commercial 77% TIA	NA

NA: Not applicable
TIA: Total impervious area

Sampling and Measurement Procedures

There are no samples or measurements (primary data collection) described by this QAPP. Appendix 9 of the 2007-2012 Phase I Permit lists the analytical methods and reporting limits for water quality and sediment quality parameters monitored by the Permittees under S8.D. Table 5 lists these water quality and sediment quality parameters.

Table 5. Permittee-monitored parameters for rainfall, flow, water quality, and sediment quality.

Hydrology		
Continuous precipitation		
Continuous stormwater flow monitoring		
Water Quality		
Conventional Parameters	***Bacteria***	***Organics***
Total suspended solids	Fecal coliform	PAH compounds
Turbidity	***Metals***	Phthalates
Conductivity	Total recoverable zinc	Herbicides (2,4-D, MCPP, triclopyr, dichlobenil, pentachlorophenol)
Chloride	Dissolved zinc	Pesticides, nitrogen (Prometon)
BOD_5	Total recoverable lead	Pesticides, organophosphates (Diazinon)
Particle size distribution	Dissolved lead	
Grain size	Total recoverable copper	***Petroleum Hydrocarbons***
pH	Dissolved copper	NWTPH-Dx
Hardness as CaCO3	Total recoverable cadmium	NWTPH-Gx
Methylene Blue Activated Substances (MBAS)	Dissolved cadmium	
	Total mercury	
Nutrients	Dissolved mercury	
Total phosphorus		
Orthophosphate		
Total kjeldahl nitrogen		
Nitrate-nitrite		
Sediment Quality		
Conventional Parameters	***Metals***	***Organics***
Total solids	Total recoverable zinc	PAH compounds
Total organic carbon	Total recoverable lead	Phthalates
Grain-size	Total recoverable copper	Phenolics
Total phosphorus	Total recoverable cadmium	PCBs
Total volatile solids	Total recoverable mercury	Pentachlorophenol
		Diazinon
		Chlorpyrifos and malathion
		Petroleum Hydrocarbons
		NWTPH-Dx

Field Sampling and Lab Handling

The Permittees followed Ecology's Quality Assurance Project Plans (QAPPs) guidelines (Lombard and Kirchmer, 2004) for development of their QAPPs and planned monitoring activities. Permittee QAPPs referenced for this project are listed in Appendix A. Sample collection, field measurement methods, and laboratory analytical methods were specified by the Permit and are believed to be reasonably comparable among the Permittees.

Quality Objectives

To gain approval from Ecology the QAPPs provided a section outlining the quality control (QC) and quality assurance (QA) of their stormwater monitoring program. These terms are described below.

- Quality control (QC) is often confused with the term quality assurance (QA). QC refers to a set of standard operating procedures for the field and laboratory that are used to evaluate and control the accuracy of measurement data. QA is a decision-making process, based on all available information that determines whether the data are usable for all intended purposes (Lombard and Kirchmer, 2004).

The goal of this QAPP is to ensure that secondary data gathered under this study effort come directly from the Permittees or EIM and are understood to be usable as received. This assures that the data collected by the Permittees meet Permittees' individual QAPP objectives, and that the data are scientifically and legally defensible. Permittees own and review their own data.

The following two sections present the quality objectives described in Permittees' QAPPs. See Reference section for references. Ecology's WQP has copies of all Permittees' approved QAPPs on file and will reference them as needed in this project. *EAP is not conducting a QA/QC review of the data* but instead is generally summarizing the Permittees' QC experiences and QA processes.

Data Quality Objectives

Data quality objectives (DQOs) were discussed in all Permittees' QAPPs. DQOs are qualitative and quantitative statements developed using a process which clarifies study objectives and defines the appropriate type of data and tolerable levels of potential errors. The DQOs for the Permittees' stormwater monitoring projects are as follows:

- The data are generated according to set criteria and procedures for field sampling, sample handling and processing, laboratory analysis, and record keeping.
- The data are as representative as possible of the monitoring site and are of known precision, bias, and accuracy. For example, the samples are collected by flow-weighted compositors for most of the parameters.

- Data reporting and analytical sensitivity are clearly established and adequate for stormwater management program decisions and endpoints.

As established in the Permittees' QAPPs, DQOs become the basis for measurement quality objectives (MQOs), which are discussed for both hydrological and chemistry data under each heading in this section.

Measurement Quality Objectives

MQOs are the acceptance thresholds for data, based on the data quality indicators, and are specifically used to address instrument and analytical performance.

The QA decision-making process relies on measurable values such as MQOs that specify how good the data must be to meet the objectives of the study. MQOs established for stormwater permit monitoring are based on guidance from multiple sources that include EPA, Ecology, the Permittee, laboratory experience, and best professional judgment.

MQOs are the performance or acceptance thresholds or goals for the study's data, based primarily on the performance measures expressed in terms listed below. These terms are described in Appendix B.

- Sensitivity
- Bias
- Representativeness
- Precision
- Accuracy
- Completeness
- Comparability

Measurements to address these performance measures were described in all Permittees' QAPPs for S8.D monitoring and represent the criteria with which they evaluate their own data. Failure to meet the MQOs may result in data being qualified or rejected. EAP will request a reviewed, useable, and complete data set from each Permittee where data is not already available in EIM. A complete data set will include (1) all rainfall and (2) flow and chemistry data for monitored storm events that are un-flagged, qualified as an estimate, or non-detect. However, EAP is not requesting any data that was rejected.

EAP may discuss DQOs and MQOs with the Permittees to better understand their data quality experiences. Ecology's copies of Permittee QAPPs and Annual Monitoring reports for S8.D permit monitoring will be referenced to answer any data quality questions. For example, certain chemical parameters may have been difficult to quantify due to undetectable concentrations or severe interferences. Findings may be included in the report for this project.

Data Management Procedures

EAP will lead a collaborative team, made up of Ecology's Water Quality Program (WQP) and Toxics Cleanup Program (TCP), for the project. This data compilation project supports the Water Quality Program's (WQP) municipal stormwater permit program. The team will review the draft QAPP, data package, and the draft report prepared by EAP. The data review project outcomes will provide the necessary information to influence stormwater management actions and future monitoring decisions. Both programs are interested in preventing stormwater entrainment and delivery of contaminants to receiving waters.

EAP will also consult with Permittees during the process of compilation and analysis and, along with Ecology's WQP, will present findings at meetings. Products and data can be given to Permittees and posted to a publically available website.

Electronic data are sought from the Permittees and will be stored in electronic files on Ecology's servers.

Audits and Reports

A draft and final report will be prepared. The stormwater monitoring data will be compiled in a Microsoft Office Excel© database. The draft report and draft data analysis will be sent to the staff listed in Table 3 for review. Based on staff recommendations an external review process may also be included.

Data Verification and Validation

Data Verification

Project Data Quality Review

Ecology did not collect the data that will be used for this project. The data are owned by the Phase I Permittees. This data set is considered secondary data, from Ecology's point of view, and the Permittees will provide for the quality of the data. *EAP will solicit from the Permittees the data collected under S8.D that has already undergone a Q3 data quality review as defined as:*

- Data collected under a QA program (QAPP).
- Data reviewed by data owners for quality control (QC) objectives as described in their S8.D QAPP.
- Data reported as useable for the purposes described under their S8.D QAPPs.

Each Permittee is known to be collecting data under an Ecology-approved QAPP. A data usability statement will be solicited from each Permittee as part of the data collection process. The usability statement is presumed to be implied if the data is sent to Ecology. This means that any data in EIM or sent directly to Ecology (including EAP), is believed to be usable for the purposes collected under the Permittees' QAPPs.

EAP will not provide a QC data review on raw data. Here are some clarifying examples:

- Rejected data should not be sent to EAP. Data may be rejected due to poor laboratory control samples, contamination, or equipment error.
- Non-detect data are valid and usable data. Non-detect data should be accompanied by the laboratory method reporting limit and, optionally, detection limits for use of the non-detect data in statistical analyses.

Data Validation

Data validation goes beyond data verification to examine the data for usability and is not required for this project. Validation is defined as:

> An analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the usability of a specific data set. It involves a detailed examination of the data package, using both professional judgment, and objective criteria, to determine whether the MQOs for precision, bias, and sensitivity have been met. It may also include an assessment of completeness, representativeness, comparability and integrity, as these criteria relate to the usability of the dataset. (Kammin, 2010)

Ecology considers the following three key criteria to determine whether data validation has actually occurred:

- Use of raw or instrument data for evaluation
- Use of third-party assessors
- Use of EPA National Functional Guidelines (USEPA, 2008 and 2010), or the equivalent, for review

EAP will not provide validation or solicit validated data (a review level beyond Q3 as described above) as part of this project. However, if validated data is shared with EAP, EAP will use it.

Data Quality (Usability) Assessment

As part of each Permittee's QAPP, a section on Data Quality Assessment (Usability) described how well the data met the objectives as stated in the QAPP. Permittees stated that usability means the data met the data quality objectives (DQOs) and are useable for project objectives, such as drawing conclusions on stormwater quality and writing annual reports. Each annual stormwater monitoring report includes the Permittee's assessment of data quality.

Ecology will solicit Permittee data and will understand their submission to EIM or directly to Ecology to mean that the data are QA reviewed and usable for compilation purposes.

This statement of usability pertains to the data being acceptable for the purposes under which they were collected; the statement does not cover uses outside of the original intent. The intent of the Permittee stormwater monitoring is characterization of stormwater quality. The intent of this compilation and data analysis project is also stormwater characterization on a regional scale; therefore, the data will continue to be used in an appropriate context.

References

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USEPA, 2008. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Raw Data Review. USEPA-540-R-08-01. June 2008.

USEPA, 2010. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Raw Data Review. USEPA-540-R-10-011. January 2010.

WAC 173-201A. Water Quality Standards for Surface Waters in the State of Washington Washington State Department of Ecology, Olympia, WA. www.ecy.wa.gov/laws-rules/ecywac.html

Appendices

Appendix A. Permittees' QAPPs on File with WQP

Snohomish County

Quality Assurance Project Plan (QAPP) Stormwater Characterization Monitoring S8.D Final. December 2008. Prepared by Snohomish County Public Works, Surface Water Management Division, 3000 Rockefeller Ave, Everett, Washington, 98201.

King County

Quality Assurance Project Plan For King County Stormwater Monitoring Under the NPDES Phase 1 Municipal Permit WAR04-4501 (Issued February 2007). Updated November 2010. King County Department of Natural Resources and Parks, Water and Land Resources Division, Science Section. King Street Center, KSC-NR-0600, 201 South Jackson Street, Suite 600. Seattle, WA 98104.

Pierce County

Quality Assurance Project Plan. Pierce County Phase I Municipal Stormwater NPDES Permit Section S8.D – Stormwater Characterization. November 5, 2009. Prepared for Pierce County Surface Water Management, 2702 South 42nd Street, Suite 201, Tacoma, Washington 98409-7322. Prepared by Herrera Environmental Consultants.

Clark County

Quality Assurance Project Plan for Stormwater Characterization Monitoring. Conducted Under Section S8.D of the Phase I Municipal Stormwater Permit by Clark County. Prepared by U.S. Geological Survey, Oregon Water Science Center. Revised March 2011 by Clark County Department of Environmental Services, Clean Water Program.

City of Tacoma

Section S8.D – Stormwater Characterization Quality Assurance Project Plan, Phase I Municipal Stormwater NPDES Permit, Permit No.: WAR04-4003. Revision: S8.D-003 (Final). Revision Date: 08/16/2009. City of Tacoma, Tacoma, Washington.

City of Seattle

Section S8.D - Stormwater Characterization Quality Management System Planning Document, Quality Assurance Project Plan. NPDES Phase I Municipal Stormwater Permit, Permit No.: WAR04-4503. Revision: R2D0(FINAL). Draft revised on: 03/31/2011

Port of Tacoma

Quality Assurance Project Plan for Stormwater Monitoring Conducted Under the Phase I Municipal Stormwater Permit by Port of Tacoma. Final August 2009.

Quality Assurance Project Plan for Stormwater Monitoring Conducted Under Section S8.D of the Phase I Municipal Stormwater Permit. Addendum #1. November 2011. Port of Seattle Marine Division. Prepared by TEC Inc. and Otak, Inc, for Port of Seattle.

Quality Assurance Project Plan for Stormwater Monitoring Conducted Under Section S8.D of the Phase I Municipal Stormwater Permit. February 20, 2009. Port of Seattle Marine Division. Prepared by TEC Inc. and Otak, Inc, for Port of Seattle.

Appendix B. Glossary, Acronyms, and Abbreviations

Glossary

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Fecal coliform: That portion of the coliform group of bacteria which is present in intestinal tracts and feces of warm-blooded animals as detected by the product of acid or gas from lactose in a suitable culture medium within 24 hours at 44.5 plus or minus 0.2 degrees Celsius. Fecal coliform are "indicator" organisms that suggest the possible presence of disease-causing organisms. Concentrations are measured in colony forming units per 100 milliliters of water (cfu/100 mL).

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities. This includes, but is not limited to, atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Nutrient: Substance such as carbon, nitrogen, and phosphorus used by organisms to live and grow. Too many nutrients in the water can promote algal blooms and rob the water of oxygen vital to aquatic organisms.

Parameter: A physical chemical or biological property whose values determine environmental characteristics or behavior.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Percentile: A statistical number obtained from a distribution of a data set.

Point source: Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Total suspended solids (TSS): Portion of solids retained by a filter.

Turbidity: A measure of water clarity. High levels of turbidity can have a negative impact on aquatic life.

Acronyms and Abbreviations

BMP	Best management practices
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
et al.	And others
MQO	Measurement quality objective
NPDES	(See Glossary above)
PCB	polychlorinated biphenyls
QA	Quality assurance
RCW	Revised Code of Washington
TIA	Total impervious area
TCP	Toxics Cleanup Program (Ecology)
TSS	(See Glossary above)
WAC	Washington Administrative Code
WQP	Water Quality Program (Ecology)