CITY OF PORTLAND

BUREAU OF ENVIRONMENTAL SERVICES

Underground Injection Control Permit

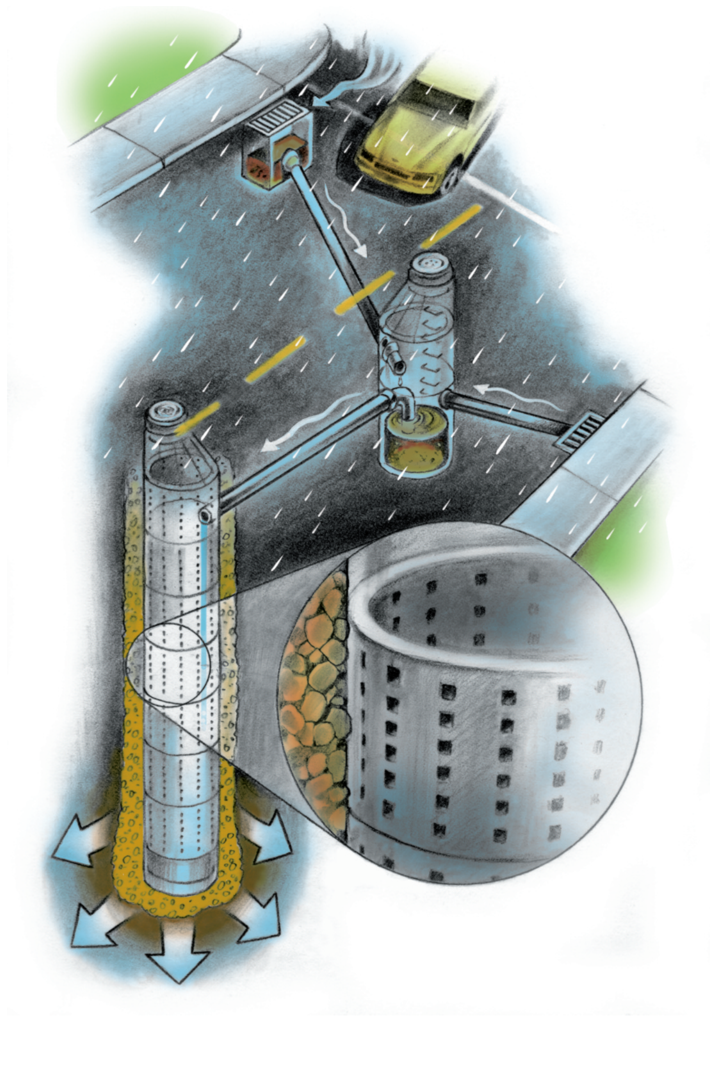
Stormwater Discharge Monitoring Plan

CONSISTS OF

Sampling and Analysis Plan

AND

Quality Assurance Project Plan



March 24, 2015

Water Pollution Control Facilities (WPCF) Permit

Class V Stormwater Underground Injection Control Systems

DEQ Permit Number 102830

Prepared by

ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Signature	
Barbara Adkins **Name**	VIC Program Manager **Title**
[signature] **Signature**	3/24/15 **Date**

City of Portland, Oregon

Water Pollution Control Facilities (WPCF) Permit For
Class V Stormwater Underground Injection Controls (UIC)

Permit Number: 102830

WPCF UIC Permit
Sampling and Analysis Plan

Stormwater Underground Injection Control Monitoring

March 24, 2015

Prepared By:
City of Portland, Bureau of Environmental Services

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BES	Bureau of Environmental Services
CFR	Code of Federal Regulations
CIP	capital improvement projects
COC	chain of custody
CSE	confined space entry
DEQ	Oregon Department of Environmental Quality
DFR	daily field report
EOP	end of pipe
EPA	U.S. Environmental Protection Agency
ERF	Extended Range Forecasting Company
FDS	field data sheet
FO	Field Operations
gpm	gallons per minute
GRTS	Generalized Random Tessellation Stratified
HASP	Health and Safety Plan
LIMS	Laboratory Information Management System
MS4	municipal separate storm sewer system
OAR	Oregon Administrative Rule
QAPP	Quality Assurance Project Plan
QC	quality control
SAP	Sampling and Analysis Plan
SDMP	Stormwater Discharge Monitoring Plan
SOP	Standard Operating Procedure
TA	Test America
UIC	underground injection control
UICMP	UIC Management Plan
WPCF	water pollution control facility
WPCL	Water Pollution Control Laboratory

Section 1

1 Introduction and Organization

1.1 Introduction and Purpose

The City of Portland (City) has prepared this Underground Injection Control (UIC) Stormwater Discharge Monitoring Plan (SDMP) in compliance with its 2015 Water Pollution Control Facilities (WPCF) permit.[1] The Oregon Department of Environmental Quality (DEQ) issued the City's second WPCF Permit Number 102830 in June 2015. The WPCF permit requires the City to prepare and submit a monitoring plan that describes how the City will monitor stormwater for the constituents provided in Table 1 in Schedule A of the permit. The City must implement the DEQ-approved SDMP and comply with permit requirements.

The SDMP describes the stormwater monitoring strategy that the City will use throughout its second WPCF permit term (June 2015-May 2025) to evaluate stormwater discharges from public rights-of-way to City-owned UICs in areas of shallow groundwater.[2] Monitoring is conducted to demonstrate that the City's UIC program protects beneficial uses of groundwater, meets WPCF permit requirements, and satisfies requirements of the federal Safe Drinking Water Act and state UIC and groundwater regulations.

The SDMP comprises this Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP). This SAP presents the overall methodology for selecting UIC sampling locations in areas of shallow groundwater, selecting target storms, and collecting stormwater samples. It will be used together with the QAPP (BES, 2015), which describes the procedures that are used to maintain quality control (QC) and consistency of the data.

The City conducted monitoring to comply with the 2005 WPCF permit (from June 2005 to May 2015), that focused on stormwater characterization. This SAP was prepared to meet the stormwater monitoring conditions established in the 2015 WPCF permit.

> This is the City's second SDMP, corresponding with the second WPCF permit.

1.2 SAP Organization

This SAP covers storm targeting, sample collection methods, analytical procedures, data analysis and reporting, and health and safety. The SAP is organized as follows:

- Section 1 Introduction and Organization

[1] The full name of the permit is the Water Pollution Facilities Permit for Class V Stormwater Underground Injection Control Systems.
[2] Areas of shallow groundwater refer to locations where UICs have < 5 feet of vertical separation distance between the bottom of the UIC and the seasonal high groundwater level (Snyder, 2008).

- Section 2 Goals and Objectives
- Section 3 Sampling Design
- Section 4 UIC Sample Location Selection
- Section 5 Storm Targeting
- Section 6 Sampling Staff
- Section 7 Field Sampling Procedures
- Section 8 References

The SAP presents the sampling design and field sampling activities to ensure that collected data are of known quality and can be used to demonstrate permit compliance. The appendices provide supporting information to the SAP:

- Appendix A UIC Location Maps and List
- Appendix B Standard Operating Procedures for Stormwater Monitoring
- Appendix C Health and Safety Plan
- Appendix D Field Sampling Forms

Section 2 of the QAPP describes project roles and responsibilities, as well as data quality objectives for stormwater monitoring.

1.3 Relationship to Other Plans

The SDMP describes the City's UIC stormwater discharge monitoring program to demonstrate permit compliance. In addition to the SDMP, the following documents have been developed to comply with the 2015 WPCF permit:

- Systemwide Assessment
- UIC Management Plan (UICMP)
- Decommissioning Procedure

Monitoring data collected in accordance with the SDMP may be used to identify corrective actions as identified in the UICMP. Data collected in accordance with spill response, operations and maintenance, UIC closure, or groundwater monitoring in accordance with the UIC program may be used to supplement the compliance monitoring data set as appropriate. All data collected under the UIC program will be used to:

- Ensure that infiltration of stormwater runoff from urban areas through City-owned UIC structures is performed in a manner that protects groundwater as a drinking water resource and protects watershed health.
- Meet regulatory mandates and permit requirements for all City-owned UICs.

1.4 SAP Modifications

Potential modifications of the SAP may be identified during sampling activities or during review and evaluation of the field and/or analytical data. Modifications will be addressed either by revising the SAP or preparing addenda to the SAP. The revised SAP or addenda will identify the need for the modifications, and describe any planned activity and how it will be implemented (e.g., sampling and analyses). Modifications to the DEQ-approved SAP will be summarized in the annual Stormwater Discharge Monitoring Report.

Modifications that do not change the basic intent of the DEQ-approved plans or modifications with low environmental and public health significance do not require DEQ to provide public notice or an opportunity for public participation. The following types of actions/modifications are considered “minor” or “Category 1” actions under Oregon WPCF rules (Oregon Administrative Rule [OAR] 340-045-0027) and will not require public notice or participation, unless determined necessary by DEQ:

- Correction of typographical errors
- Increased sampling frequency or increased analytical testing
- Incorporation of new data discovered/determined by UIC investigations/inspections, complaint responses, systemwide assessment, etc.
- Incorporation of UICs constructed after the date of the permit issuance
- Schedule changes not defined by the permit
- Changes in City data management, evaluation methods, or reporting methods
- Changes in field procedures or analytical methods
- Change in contract laboratory
- Collection and evaluation of source identification or corrective action data
- Collection and evaluation of groundwater data
- Selection of UIC panel locations
- Changes in the City program staff

The following types of actions/modifications are considered “major”, and might be considered “Category 2” actions, and may require public notice or participation, as determined by DEQ:

- Decreased sampling frequency or decreased analytical testing
- Significant change in UIC sampling program design
- Change in Action Level concentrations

When SAP addenda are prepared or updates to the SAP are made, the City will distribute copies of the new version to DEQ and to internal staff members as appropriate and save the new version to the project file. A copy of each replaced document will be archived as documentation of past procedures.

Minor modifications to the SAP will be documented in the annual monitoring report where appropriate and provided in an updated SAP. Proposed major modifications to the DEQ-approved SAP will be submitted to DEQ for review and approval, in accordance with the permit modification requirements (OAR 340-045-0055).

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Section

2

2 Goals and Objectives

The primary goals of the UIC monitoring program are to collect and evaluate stormwater data to verify groundwater protection and WPCF permit compliance, and identify where system improvements are needed.

UIC monitoring, and verifying that UICs are protective of groundwater, also support the City's compliance with its National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4) permit. The MS4 permit requires the City to establish controls on post-development stormwater runoff to the MS4 system to improve the quality of Portland's waters. Within this regulatory context, developers and municipal agencies must comply with stormwater infiltration and discharge requirements, as well as flow and volume control requirements, as specified in the stormwater hierarchy described in *Stormwater Management Manual* (SWMM) (City of Portland, 2014). UICs are included in the SWMM as stormwater discharge option.

Stormwater monitoring program objectives are to:

- Monitor the quality of stormwater discharged into UICs located in areas of shallow groundwater.
- Continue to collect and evaluate high quality data to adaptively manage the City's stormwater management program.
- Use stormwater monitoring data to provide information necessary to identify UICs that may not meet WPCF permit requirements.
- Identify potential system improvements and guide management decisions for future system management and system monitoring activities.

Monitoring also helps ensure UICs are constructed and operated in a manner that provides benefits to watersheds. UIC program goals support watershed health goals by:

- Contributing to healthy biological communities by helping to restore a more natural hydrologic cycle.
- Providing cool base flow in the summer months.
- Reducing damage to physical habitat created by peak stormwater flows.
- Controlling and treating pollutants carried in stormwater before it is discharged to the ground.

Monitoring data collected between 2005 and 2014 have demonstrated that stormwater quality from City rights-of-way generally meets levels that are protective of drinking water at the point of injection for most pollutants sampled. For the limited pollutants identified as elevated, the City conducted fate and transport modeling, using the City's UIC stormwater data and knowledge of local geology. The modeling has led to a number of groundwater protectiveness demonstrations that have shown that stormwater discharges from public rights-of-way are protective of groundwater, even in areas of shallow groundwater. UICs in areas of shallow groundwater have been selected for monitoring in the 2015 WPCF permit. The quality of stormwater discharging to these shallow UICs is not expected to be different from the quality of stormwater discharging to the general UIC population; however, these UICs are considered higher risk because of minimal separation distance between the bottom of the UIC and groundwater, and may have a potential for higher risk primarily from accidental spills or illicit discharges. City programs are in place to address spill prevention, spill response, source control, and other activities, as identified in the UICMP.

The approach outlined in this SAP will provide data to determine compliance with the 2015 WPCF permit and inform decision making for actions implemented to protect groundwater quality and support overall watershed health.

Section
3

3 Sampling Design

3.1 General Considerations

The WPCF permit establishes pollutant Action Levels for stormwater and other authorized discharges to UICs to protect the beneficial use of groundwater. To comply with the 2015 WPCF permit, the City will implement a program to monitor stormwater entering the City's UIC system from a subset of UICs located in areas of shallow groundwater, compare stormwater data to permit Action Levels, and otherwise operate the UICs in a manner that is protective of the beneficial use of groundwater.

3.2 Determination of Representative Sample Size

There are approximately 120 UICs located in areas of shallow groundwater. Any reasonable sample size will result in sampling a significant proportion of the target population. When sampling more than approximately 5 percent of a finite population, a finite population correction[3] is applied to the standard error of parameter estimates (e.g., annual trends, means, or population percentiles). This correction can significantly increase the precision of parameter estimates when a large proportion of the population is sampled.

A sample of 75 UICs will be selected from the list of UICs located in shallow groundwater. With a sample size of 75, approximately 61 percent of the UICs located in shallow groundwater will be sampled. The finite population correction will reduce the width of confidence intervals associated with this design by almost 50 percent in comparison to a sample size of 75 UICs selected from a population of 10,000. This design therefore has the equivalent power of a much larger sample from the entire UIC population.

3.3 Sample Design

To achieve the monitoring objectives, five panels of 15 UICs each will be selected from the list of 120 UICs located in shallow groundwater. A different panel of UICs will be measured in each of years 1 through 5 of the 2015 WPCF permit term. Table 3.1 shows the sampling schedule. Sampling of the panels will be repeated in years 6 through 10 of the permit term for a total of two samples from each UIC during the permit term.

A Generalized Random Tesselation Stratified (GRTS) survey design (Stevens and Olsen, 2004) will be used to select the sample from the list of UICs located in areas of shallow groundwater. A GRTS design will result in a random sample that is spatially balanced (i.e., a sample with a spatial distribution that is similar to the spatial distribution of the population).

The GRTS design allows for simplifying the implementation of a sample design when some UICs are not suitable for sampling. A GRTS sample draw is an ordered list of

[3] http://en.wikipedia.org/wiki/Standard_error#Correction_for_finite_population

sample locations that can be evaluated for sampling sequentially. The first 75 UICs on the list that are suitable for sampling are used as the sample, with sequential blocks of 15 UICs making up each of the panels. For the purpose of choosing 75 UICs to sample, the entire population of UICs located in shallow groundwater areas was placed into random order using the R package spsurvey (Kincaid and Olsen, 2013).

Table 3.1. Panel Sampling Schedule

Permit Year	Panel	Wet Season
1	1	2015-2016
2	2	2016-2017
3	3	2017-2018
4	4	2018-2019
5	5	2019-2020
6	1	2020-2021
7	2	2021-2022
8	3	2022-2023
9	4	2023-2024
10	5	2024-2025

Section

4

4 UIC Sample Location Selection

4.1 Overview

This section describes the general characteristics of City-owned UICs and describes the location selection process for UIC stormwater monitoring. A total of 75 locations will be monitored for 2015 WPCF permit compliance during the course of the permit, with 15 UIC locations sampled each year (i.e., 5 panels of 15 locations).

Sampling locations (i.e., UIC identification) for each panel are finalized during the summer months before the monitoring season in which they will be sampled. UIC locations are not duplicated among panels. Before UIC locations are finalized for each panel, the UIC is investigated and field verified, as described in Section 4.3. Following field verification, the City's Bureau of Environmental Services (BES) submits a technical memorandum to DEQ that describes the final selection of the panel sample locations for the upcoming wet season and the results of the field verification.

After panel locations are defined and sampled, the same locations will be sampled again during the second half of the 2015 WPCF permit term. If one or more of the UICs used in the first 5 years for compliance monitoring are decommissioned or for other reasons cannot be sampled during the years 6 through 10 of the permit, a replacement location will be selected following the procedures described in Section 4.5.

Appendix A presents a citywide overview of all UIC locations, as well as all 120 UICs located in shallow groundwater. The final UIC monitoring locations will be selected from the existing UIC locations in shallow groundwater.

4.2 UIC Characteristics

The City *Stormwater Management Manual* requires a standard UIC system design. The design includes a sedimentation manhole upstream of the stormwater infiltration UIC (Figure 4.1). The sedimentation manhole facilitates maintenance and improves the stormwater quality before infiltration. Sedimentation manholes are not UICs. They are solid concrete cylinders, generally 3 to 4 feet in diameter and 10 feet deep, used to provide pretreatment of stormwater before discharge to the UIC. The standard design includes an oil/water separator "hood" in the sedimentation manhole over the discharge pipe to the infiltration sump to allow for withdrawal of water in the sedimentation manhole from below the water surface. Sedimentation manholes protect water quality by allowing sediment in the stormwater to settle before stormwater enters the UIC and by preventing oil and grease, which generally float on water, from flowing into the UIC.

The UICs are generally 3 to 4 feet in diameter and range in depth from a minimum of 2 feet up to 40 feet. Most of the newer UICs (early 1990s and later) in the City are approximately 30 feet deep. Older UICs are between 18 and 30 feet deep. The City became responsible for most of the older UICs as a result of annexation from Multnomah County. These Multnomah County UICs were constructed in accordance with the County's design standards, and many of them did not include sedimentation manholes.

In accordance with the 2015 WPCF permit, the monitoring compliance point (and, therefore, the point where monitoring is to be conducted to demonstrate compliance) is the end of pipe (EOP) of any pretreatment device (e.g., sediment manhole) before discharge of stormwater into the UIC.

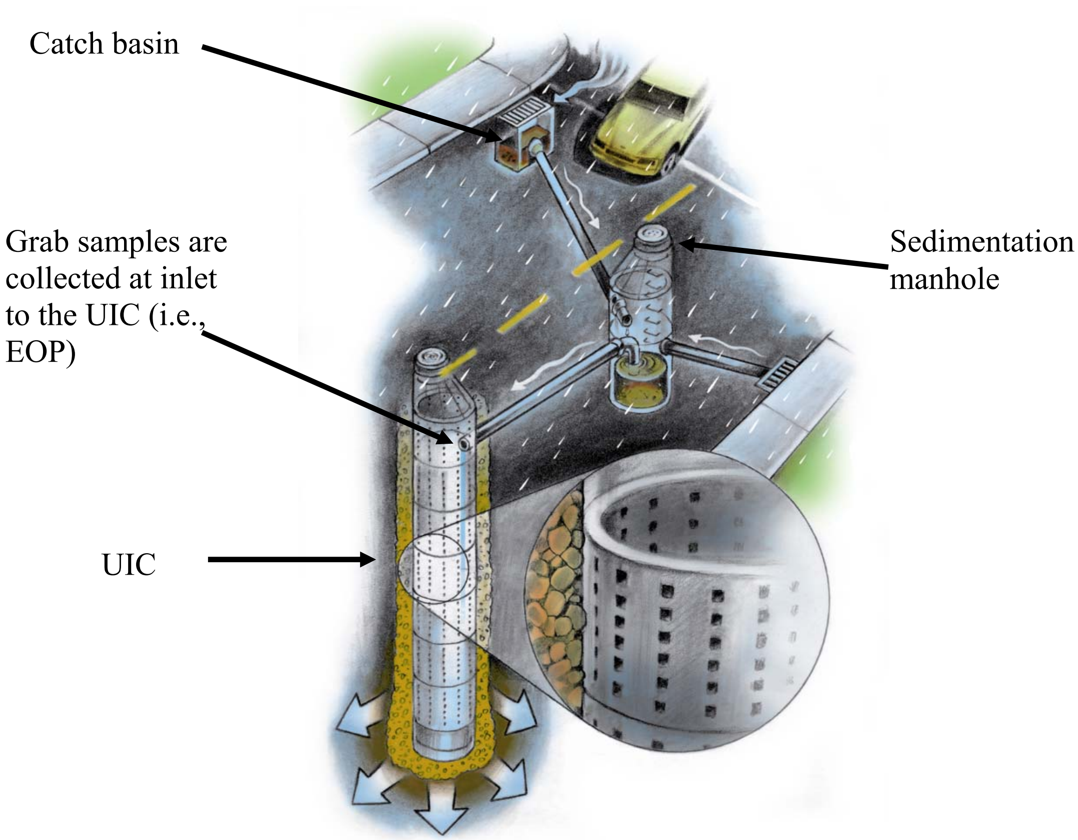

Figure 4.1 Schematic of Sedimentation Manhole and UIC

4.3 Presampling Investigation and Field Inspection

Before sampling, desktop reconnaissance and research are performed for each identified UIC sample location to determine if the UIC is suitable for sampling. The presampling investigation will obtain and/or confirm the following information:

- DEQ's UIC identification number
- The City's UIC identification number
- Street address or intersection location
- Latitude and longitude in decimal degrees
- Type of construction
- Estimated separation distance (i.e., the approximate depth in feet from the bottom-most perforation in the UIC to the approximate seasonal high groundwater level, based on BES or U.S. Geological Survey groundwater elevation maps)

- Street classification taken from the Portland Bureau of Transportation System Plan
- Predominant land use in the UIC drainage area

Presampling field inspection will identify and/or confirm the following to the extent practicable:

- UIC accessibility
- Potential health and safety concerns for sampling activities (e.g., traffic, UIC location, visibility [e.g., blind corners])
- General stormwater system condition
- Maintenance (e.g., cleaning) or repair needed before initiating sampling
- Depth of the UIC being sampled
- The type of pretreatment best management practices (if any)
- Sediment depth in sedimentation manhole or in catch basins for UICs that do not have sedimentation manholes
- Qualitative observations of traffic types (e.g., diesel vs. gas, etc.) and volume
- Potential pollutant sources (e.g., site activities, construction, unimproved street) in the estimated UIC drainage area

4.4 Sample Location Suitability

The results of either the presampling investigation or field inspection are used to determine whether a UIC location is suitable for sampling. UICs may be determined to be unsuitable for sampling, based on one of the following factors:

- Unsafe sampling conditions
- Location already included in the monitoring program
- Physical barrier or denied access to the location
- UIC has been decommissioned
- Maintenance or repair needed before initiating sampling, or conditions that prevent collection of representative samples
- UIC does not receive adequate flow during rain events
- UIC is not compliant with the permit
- UIC location could not be found or no longer exists
- UIC location is not a member of the target population (i.e., UIC does not capture drainage from rights-of-way, such as drinking fountain drains, aquifer storage and recovery wells, drains receiving potable water, trenches, roof drainage, etc.)

If a UIC is deemed unsuitable for sampling, a replacement UIC will be selected, following the process described in Section 4.5. UICs determined unsuitable for sampling will be reported in the annual Stormwater Discharge Monitoring Report.

4.5 Replacement Locations

If any UIC is determined to be unsuitable for sampling (e.g., because of surcharging, decommissioning, unsafe conditions, etc.) based on the results of the presampling investigation or field inspection described in Section 4.3, a replacement UIC location will be selected. The replacement location will be selected by choosing the next previously unselected UIC on the list of randomly ordered UIC locations in shallow groundwater. The replacement UIC will then be investigated and field verified, as described in Section 4.3, to confirm its suitability for sampling.

Section
5

5 Storm Targeting

5.1 Sampling Considerations

The City will collect stormwater samples one time annually from each of the 15 designated sampling locations between July 1 and June 30 of each year, in compliance with the 2015 WPCF permit, unless conditions are encountered that are beyond the City's reasonable control (e.g., atypical climatic conditions; see Section 7).

The City will plan to sample the first predicted storm each fall that meets the storm criteria presented in Section 5.2. Based on experience, it is expected to take more than one storm to collect samples from all 15 UIC locations. The remaining locations will be targeted for sampling based on predicted storms that meet the storm criteria. For purposes of the 2015 WPCF permit, the monitoring "event" may include numerous individual storms to obtain samples at all the sampling locations.

Storms may occur at any time; however, the City primarily will target storms during regular business hours, particularly at the start of the monitoring season. As the season progresses, the City will expand hours for targeting storms as necessary.

5.2 Storm Criteria

Adhering to target storm criteria to the extent practicable will help ensure that stormwater runoff will be adequate for sample collection, be representative of stormwater runoff, and be consistent among sampling efforts. Before initiating sampling, the storm forecast will be evaluated against the criteria listed below to assess whether a storm should be targeted for potential compliance sampling. Based on the City's extensive experience with stormwater monitoring in this region, storms meeting these criteria are expected to provide the volume, intensity, and duration of runoff necessary to collect individual samples. Smaller storms, or storms of shorter duration, are considered to have a low probability of producing sufficient runoff to warrant the extensive preparation and mobilization time required for this project.

It is likely that a storm may not meet the criteria below when sampling is completed due to the inherent uncertainty in weather prediction. The following criteria will therefore be used as general guidance to determine when forecasted storms should be targeted for sampling during this project:

- Predicted rainfall amount of ≥ 0.2 inch per storm
- Predicted rainfall duration ≥ 6 hours
- Antecedent dry period ≥ 6 hours (as defined by < 0.1 inch of precipitation during the previous 6 hours)

Storms meeting these criteria that were either unpredicted or were predicted to have less rainfall intensity or duration are not included as potential compliance sampling events.

Hourly and daily rainfall records are available for more than 20 sites on the east side of Portland. These data are maintained in BES's HYDRA Data Report System and are available on the Internet at: http://or.water.usgs.gov/non-usgs/bes/raingage_info/clickmap.html. Storm characteristics for each storm during which samples are collected will be documented and summarized in the annual Stormwater Discharge Monitoring Report. If not all samples can be collected because of atypical climatic conditions, representative climatic data will be provided to document these conditions.

5.3 Weather Forecasting

The Storm Monitoring Coordinator for this project is the BES Field Operations (FO) supervisor or a designated alternate (see Section 6). The Storm Monitoring Coordinator is responsible for tracking storms and reviewing consultant weather forecasts to determine if a predicted storm is likely to meet the criteria for initiating compliance sampling. If the weather forecast predicts that the storm criteria will be met, the Storm Monitoring Coordinator is responsible for mobilizing the BES sampling teams and ultimately making the "go/no go" decision.

Extended Range Forecasting (ERF) Company, Inc., a private Portland weather forecasting service, is the City's weather consultant. The Storm Monitoring Coordinator receives daily weather forecasts from ERF that have a 10-day forecast including quantity of precipitation forecasts for each day. ERF is available on an as-needed, on-call basis for telephone consultations regarding pending storms. When a candidate storm approaches, the Storm Monitoring Coordinator will communicate frequently with ERF to determine whether to mobilize sampling teams to begin sampling operations.

Other forecasting resources used include online resources such as National Weather Service predictions, Doppler radar, and smartphone weather applications. Refer to Standard Operating Procedure (SOP) D-1, provided in Appendix B, for more weather tracking information.

Section

6

6 Sampling Staff

6.1 General

Sampling staff refers to all personnel who are involved in logistical support, sample collection, traffic control, and safety during the actual storm event being monitored. At a minimum, the sampling staff will include:

- Storm Monitoring Coordinator (one person; can be remote)
- Field sampling teams

6.2 Storm Monitoring Coordinator

The Storm Monitoring Coordinator is responsible for tracking weather patterns and selecting the storms to be monitored. The Storm Monitoring Coordinator will work directly with ERF to obtain the latest weather forecasts and updates and make the “go/no go” decision.

The Storm Monitoring Coordinator should attempt to notify the sampling teams and the analytical laboratory 72 hours in advance of a potential qualifying storm. The Storm Monitoring Coordinator directs sampling activities by tracking real-time weather conditions and using dependable two-way communication with ERF and sampling teams (via cell phone). The Storm Monitoring Coordinator for this project will be the FO Supervisor, or a designee.

6.3 Field Sampling Teams

Multiple teams are sometimes used during a single stormwater sampling effort to decrease the length of field time and the number of individual storms needed to collect samples from all UIC locations. Sampling teams comprise two people, primarily from the City’s FO staff. Generally, multiple sampling teams will be used as the season progresses, particularly if samples have been difficult to collect.

Field staff members are required to read, understand, and follow all procedures documented in the SAP. At a minimum, field sampling personnel will be responsible for the following:

- Inspecting field sampling equipment before use to ensure that it is in proper working order and calibrated
- Ensuring that all field sampling collection forms (e.g., chain of custody [COC] forms, field data sheets [FDS], daily field reports [DFR]) are properly and completely filled out
- Ensuring that samples are collected, stored, and delivered to the laboratory in accordance with the SAP

Field staff members also are responsible for performing all the field sampling activities in accordance with the procedures and standards established in the project Health and Safety Plan (HASP) (see Appendix C) and the QAPP.

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Section

7

7 Field Sampling Procedures

Guidelines for sample collection procedures have been developed for this project to provide data of sufficient quality to demonstrate 2015 WPCF permit compliance and/or evaluate potential risks to human health and the environment associated with stormwater discharges from public rights-of-way. SOPs were developed for tasks that are routinely performed by BES staff (Appendix B). Adherence to the procedures described in this SAP and the project QAPP will help ensure consistency among stormwater sampling events and for the duration of the permit and will prevent sample contamination caused by field activities. This section focuses primarily on field sampling procedures, including:

- Personal safety
- Sample collection location
- Sampling analytes
- Sampling equipment preparation and decontamination
- Sample container preparation
- Clean sampling techniques
- Sampling location access procedures
- Sample collection, labeling, handling, and documentation
- Field QC sample collection
- Sample transport and delivery to the laboratory
- Change notification and sampling waivers

7.1 Personal Safety

Appendix C provides the approved project-specific HASP. For this project, all sampling locations are in urban areas, typically requiring traffic control. In addition, sample collection typically requires prolonged field work hours and occasionally is performed throughout the night and on weekends. Sleep deprivation, fatigue, increased exposure to drunken drivers, etc., are all increased risk factors associated with this type of work. Personal safety is of primary concern while conducting all stormwater sampling-related activities. Given the hazardous nature of performing this type of stormwater sampling, at least one member of each sampling team should have the following certifications (at a minimum) to be able to identify and avoid hazards:

- 40-hour Hazmat training and annual 8-hour refreshers
- Confined Space Entry and Work Practices certification
- Traffic Control and Flagging certification
- First aid and cardiopulmonary resuscitation certification

Persons involved in sampling will be made aware of the hazards associated with the fieldwork and be given the opportunity to freely voice any concerns. If potential hazards become apparent and personal safety is an issue, sampling will be terminated. The following list provides basic health and safety recommendations specific to this project to minimize risks to sampling personnel:

- Before initiating field activities, turn on vehicle hazard lights and overhead yellow warning lights.
- Do not access sampling stations until traffic control has been established, if required. Sampling teams will develop a traffic control plan for each location requiring traffic control.
- At certain times of day or during certain traffic scenarios (e.g., rush hour, delivery zone, police activity, etc.), it may not be possible to safely access a sampling location. If a location cannot be accessed safely or becomes unsafe during sampling, proceed to other locations and return to the location later during the storm or a subsequent storms.
- Remove and replace manhole covers using a manhole cover puller. Sampling teams should always wear steel-toed boots in the field.
- Never leave an open manhole unattended.
- Avoid confined space entries (CSEs). Because only grab sampling is required for this project, no CSE should be required. Break the manhole plane with equipment only. Sampling staff will not enter any UIC or sediment manhole unless the sampling consists of two FO personnel who are properly trained and have all of the necessary CSE equipment.

7.2 Sample Collection Location

The sampling collection point is the EOP. For UICs with no pretreatment device and more than one discharge pipe (e.g., drainage from two catch basins), the compliance sample will be collected from the discharge pipe with the highest estimated flow volume. If more than one discharge pipe is present, the location of the pipe sampled will be documented and described in sampling team field folders.

7.3 Analytical Schedule

Each sample will be measured and analyzed annually for the pollutants listed in Table 7.1.

Table 7.1 UIC Stormwater Analytes

Benzo(a)pyrene	Copper (Total)
Pentachlorophenol	Lead (Total)
Di(2-ethylhexyl)phthalate[1]	Zinc (Total)

Table note:
[1] Di(2-ethylhexyl)phthalate is also known as Bis(2-ethylhexyl)phthalate or DEHP.

7.4 Sampling Equipment Preparation

The equipment required for collecting stormwater discharge grab samples includes:

- Stainless-steel beakers (decontaminated at the WPCL)
- Swing sampler with telescoping pole
- Laboratory-provided sample containers

- Disposable gloves (latex or nitrile)
- Cooler with “blue ice”
- Manhole cover puller
- Traffic control equipment
- Sample collection documentation (DFR, FDS, and COC forms)
- Field file with checklist, location maps, location photos, traffic control plans and HASP

Refer to SOP D-2 (Appendix B) for details about sampling equipment preparation.

7.5 Sampling Equipment Decontamination

Strict adherence to correct decontamination procedures is a vital link in the integrity of the sampling process and will help ensure that equipment used during the sampling process is free from pollutants that could bias analytical results.

The only equipment that will contact the sample media (stormwater) is the stainless steel beaker used to collect the grab samples. The stainless-steel beakers will be decontaminated, dried, and wrapped in aluminum foil at the WPCL before initiating fieldwork. Each sampling team will take a sufficient number of beakers for the planned UIC sampling. Refer to SOP D-3, provided in Appendix B, for sampling equipment decontamination procedures.

7.6 Sample Container Preparation

All sample containers for this project will be provided pre-cleaned and, if required, pre-preserved from the laboratory. Table 7.2 provides the required sample volumes, containers, and preservatives required for laboratory analyses, based on standard U.S. Environmental Protection Agency (EPA)-approved methodologies. If additional sample volume is necessary (e.g., matrix QC samples), additional sample containers will be prepared. Refer to SOP D-4 (Appendix B) for container preparation information.

Table 7.2 Stormwater Quality Analytes

Analyte	Method [a]	Analytical Laboratory	Minimum Sample Volume/ Bottle	Preservation	Maximum Holding Time
Pentachlorophenol	EPA 515.4	TA[b]	250 mL / Amber Glass	Na_2SO_3; Cool to 4°C	14 days
Bis(2-ethylhexyl) phthalate Benzo(a)pyrene	EPA 8270 - SIM	TA	500 mL / Amber Glass	Cool to 4°C	7/40 days
Total Copper Total Lead Total Zinc	EPA 200.8	WPCL	500 mL Poly	HNO_3 to pH<2; Cool to 4° C	6 months

Table notes on following page.

Table Notes:

[a] Method preparation procedures are presented in the QAPP.
[b] TA = Test America

Bottles will be transported in coolers with "blue ice" to keep chilled and to prevent breakage.

7.7 Clean Sampling Techniques

Field personnel will follow clean sample collection techniques based on EPA Method 1669 to minimize the potential for introducing contamination to stormwater discharge samples.

Care must be taken during all sampling operations to avoid contamination of the stormwater samples by human, atmospheric, or other potential sources of contamination. The sampling team should prevent contamination of stainless steel beakers, sample bottles, lids, and sample media. Whenever possible, samples should be collected upstream and upwind of sampling personnel to minimize contamination potential. Gloves used during sampling also can be a source of contamination. Sampling teams will use new latex or nitrile gloves when sampling for all analytes. Refer to SOP D-5, provided in Appendix B, for clean sampling rules.

7.8 Sampling Location Access Procedures

During field work activities, sampling teams should use the following procedure to access each sampling location:

- Set up location-specific traffic control as shown in project field file.
- Observe and document conditions in UIC drainage basin that may affect stormwater discharge quality, such as:
    - System integrity (e.g., catch basins or inlets operational, "gooseneck" intact and operational)
    - Debris (e.g., litter, plastic, leaves), sheen, etc., in catch basins, along curbs, or in surface water sheet flow
    - Traffic volume (e.g., light, medium, heavy, unusual traffic conditions), type (e.g., gasoline or diesel engines)
    - Road conditions (e.g., unimproved streets, streets with unimproved shoulders, new asphalt, numerous potholes)
    - New asphalt or sealant on roads or nearby parking lots
    - Potential pollutant sources (e.g., parked cars, sheen, landscaping, commercial/industrial activity, construction/renovation/demolition, etc.)
- Remove manhole cover with manhole cover puller.
- Determine if flow rate at EOP is sufficient to sample (i.e., greater than 0.1 gallon per minute [gpm]).

The flow rate will be estimated by recording the time it takes to fill a container of known volume and converting it to gpm. If the flow rate is sufficient (> 0.1 gpm), a grab sample will be collected. If the flow rate is insufficient, the sampling team will note that on the

DFR, close the manhole cover, and proceed to next sampling station. The field notes should indicate flow rate and describe general flow characteristics (e.g., color, turbidity, debris, variation in flow, sheen) during sampling. Refer to SOP D-6, provided in Appendix B, for sampling location access procedures.

7.9 Sample Collection and Handling

Grab samples will be collected using decontaminated stainless steel beakers connected to telescoping poles by swing samplers. To eliminate the need for field decontamination, a separate decontaminated beaker will be dedicated to each sample location. The sampling team will take care not to place the decontaminated beaker on the ground or to hit the side of the UIC during sampling activities.

The beaker will be positioned at the sample point to collect EOP discharge and brought to the surface grade to fill sample containers. To the extent practicable, the beaker will be filled and emptied slowly and carefully to avoid degassing the sample. Samples will be placed in precleaned bottles provided by the analytical laboratory, as specified in Table 7.2.

Samples will be placed in ice chests and will be iced ("wet" ice or "blue ice") immediately after sample collection and labeling, pending transport to the WPCL. Refer to SOP D-7, provided in Appendix B, for stormwater grab sample collection.

If a given UIC is slow draining and fills quickly during a storm so that the water level in the UIC rises above the EOP, the sampling team will collect a grab sample from standing water within the UIC by dipping the sample beaker into the standing water.

If a sampling location develops maintenance issues (e.g., no flow to UIC, clogged inlets, plugged inlet covers or pipes), the sampling team may collect a grab sample at an alternative location as close to the EOP as possible (e.g., water discharging into the sedimentation manhole, flowing into a catch basin, etc.). Departure from the procedures previously discussed in this SAP will be documented (see Section 7.14) and described in the annual Stormwater Discharge Monitoring Report. DEQ will be notified if unusual sampling conditions are encountered.

7.10 Field Quality Control Sample Collection

Field QC samples are used to assess sample collection procedures, environmental conditions during sample collection and shipment, and the adequacy of equipment decontamination. Field QC samples for this project include equipment blanks, field decontamination blanks, duplicate samples, and trip blanks. Refer to Section 6.2 of the QAPP for a description of the field QC samples and SOP D-8, provided in Appendix B, for field QC sample collection procedures. Minimum field QC samples are:

- Equipment blank - 1 per compliance season
- Field decontamination blank - 1 per event
- Field duplicate - 1 in 10

7.11 Sample Labeling

Sample labels are necessary to prevent misidentification of samples. Each sample collected will have a unique sample point code applied in the field and a unique sample identification code applied upon receipt at the WPCL. Each sample that is collected in the field will be labeled with the sample point code on a sample cooler tag; sample bottles are transported in individual coolers, stocked one site per cooler. Upon receipt at the WPCL, the unique sample identification code is affixed directly onto the sample bottles. This number also is recorded on the COC and FDS forms. The sample point code is assigned before sample collection and includes the UIC panel number followed by the sample site number in the order generated through the sampling design process, as follows:

SGN_X

Where: SG = denotes UICs in shallow groundwater

N = 1-5

X = 1-15

Appendix A provides sample point codes and BES UIC database identification numbers. Confirmed sample point codes will be provided to DEQ by July 1 for each subsequent monitoring year.

7.12 Sample Collection Documentation

Each sampling team will complete three separate documents while performing sampling activities: DFR, FDS, and COC forms (see Appendix D). All times on field sampling documents are recorded in current local time. Refer to SOP D-9, provided in Appendix B, for sampling documentation procedures.

7.12.1 Daily Field Reports

DFRs serve as a general log of the field activities for each sampling team. Each DFR has a title block area for project name, date, author, and page number. Required information to be recorded on the main body of the DFRs includes:

- Name of the person(s) on each sampling team
- Location and times of each sampling site visited
- Summary of sampling activities and significant unusual observations (list specific sample details on the FDS)

Information recorded should be detailed enough to allow the sampling event to be reconstructed without having to rely on memory and to allow the sampling team at subsequent sampling events to recognize or identify any changes in the immediate proximity of the UIC that may impact the quality of stormwater quality. The sampling team should photo-document significant site features and/or changes.

7.12.2 Field Data Sheets

An FDS will be completed for each sample collected. The FDS details specific observations pertaining to each sample. Required information to be recorded on the FDS includes:

- Date, arrival time, departure time, and personnel present for each sample collected
- Sample site address and sample point code
- Weather and flow conditions at each sampling location
- Flow rate estimate at EOP
- Presence of floatable objects, oily sheens, catch basin conditions, potential pollution sources, or other conditions that that may impact stormwater quality observed at the time of sample collection
- UIC system integrity (e.g., “gooseneck” intact and operational)
- General traffic conditions and type
- Sample collection start time and end time
- Sample collection point, if multiple EOPs
- Deviations to sampling procedure
- Collection of field QC samples

7.12.3 Chain of Custody

A COC form is a legal document designed to track samples and the persons responsible during preparation of the sample container, sample collection, sample delivery, and sample analysis. Chain of custody refers to both the form and the documented account of changes in possession that occur for samples. For each sample collected, sample information must be recorded on the sampling event-specific COC form. Required information on the COC includes:

- Sampling event
- Sample date and time (collection start time)
- Name of person(s) collecting the samples
- Sample point code
- Analysis requested
- Printed name, signature, date, and time for each person relinquishing or receiving the samples

To ensure that all necessary information is documented, a COC form must be completely filled out and accompany each set of samples. COC forms will be printed on “Rite in the Rain” paper. They will be photocopied after the laboratory personnel have signed off on sample receipt so that all personnel handling the samples may maintain a copy. When transferring custody of samples, the transferee will sign and record the date and time of each transfer. Each person who takes custody will complete the appropriate portion of the COC form.

7.12.4 Photographic Documentation

In addition to the DFR, FDS, and COC documents, the sampling teams will take digital photographs if unusual or noteworthy conditions are present at the sampling sites (i.e., vehicle leaking fluids into a catch basin, etc.) during sample collection. Site photographs are not necessary for every site visit if reasonably normal site conditions seem to exist while the sampling team is onsite. If digital photographs are taken, they must be documented on the FDS. Upon return to the laboratory, digital photographs must be downloaded, labeled, and electronically filed in accordance with the data management plan described in the QAPP.

7.13 Sample Transport and Delivery to the Laboratory

Immediately following sample collection, sample containers will be placed on ice in coolers and protected from breakage. The sampling team will submit samples to the WPCL under strict COC procedures. The Sample Custodian or designated alternate will assign a unique sample identification code to each sample. The code consists of a unique identification number generated by the WPCL Laboratory Information Management System (LIMS) software. These codes are printed during sample log-in on gummed labels with bar codes and are affixed to the sample containers during the sample receiving and log-in process. Samples analyzed at both the WPCL and any contract laboratories are labeled with these unique codes.

Each sample collected will have a unique sample point code and sample identification code. These codes will be included on the sample label and COC forms and will be used by the laboratory to identify the analytical data.

The sampling team will deliver samples to the WPCL within 6 hours of sampling. After log-in, sample containers destined for Test America (TA) will be stored on a designated shelf in the temperature-controlled and monitored sample receiving refrigerator. The Sample Custodian will generate a subcontract order from the WPCL LIMS and schedule a pick-up by TA. Samples will be retrieved from the WPCL by the TA courier, transported in coolers containing "blue ice" packs, and delivered to TA following standard COC procedures. Samples may be shipped by TA for analyses performed by other labs in TA's network. (EPA Method 515.4 currently is performed at TA's drinking water laboratory in Irvine, California.) Refer to SOP D-10, provided in Appendix B, for sample transport and delivery procedures.

When sample collection occurs after normal business hours, the sampling team will sign and date the COC form and place the samples in the sample-receiving refrigerator. The laboratory will accept samples as soon as possible, following COC procedures.

7.14 Change Notification

7.14.1 Field Procedures

All field changes to sampling procedures, including the reason for the change, will be recorded on field documentation maintained by sampling teams. The City will notify DEQ of significant changes to field procedures identified in this SAP. If substantial modifications are identified for future sampling events, the City will prepare SAP addenda for approval by the BES UIC Program Manager. Updates will be documented in the annual monitoring report and provided to the DEQ WPCF Permit Manager.

7.14.2 Sample Waivers

The 2015 WPCF permit requires the City to collect stormwater samples as outlined in this SAP, unless conditions are encountered that are beyond the City's reasonable control that prevent monitoring of the required storms (e.g., atypical climatic conditions, weather conditions that would make collection or analysis of samples unsafe or impracticable, unavoidable equipment failure, or other conditions determined by DEQ to be beyond the City's control). The permit (Schedule B) includes a sampling waiver to be used if conditions occur beyond the City's reasonable control. If a sampling waiver is needed, the City will notify the DEQ WPCF Permit Manager to discuss the basis for a waiver, or alternative methodologies to obtain the required data, and request a written waiver from DEQ.

In accordance with Permit Schedule F.4(b) and (h), the City will (1) notify DEQ in advance of anticipated noncompliance with permit conditions that occur during the reporting period, and (2) report instances of noncompliance in the annual UICMP report for that period. The reports will contain:

1. A description of the noncompliance and its cause
2. The period of violation or noncompliance
3. The estimated time the violation or noncompliance is expected to continue if it has not been corrected
4. Steps taken or planned to reduce, eliminate, and prevent recurrence of the violation or noncompliance

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Section

8

8 References

City of Portland. 2014. *Stormwater Management Manual*.

City of Portland, Bureau of Environmental Services (BES). 2015a. *Quality Assurance Project Plan – Stormwater Underground Injection Control System Monitoring*. Version 3.

City of Portland, Bureau of Environmental Services (BES). 2015b. *Stormwater Discharge Monitoring Plan* (consists of *Sampling and Analysis Plan* and *Quality Assurance Project Plan*). Version 3.

Kincaid, T. M. and A.R. Olsen. 2013. *spsurvey: Spatial Survey Design and Analysis*. R package version 2.6. URL: http://www.epa.gov/nheerl/arm/.

Snyder, D.T. 2008. *Estimated Depth to Groundwater and Configuration of the Water Table in Portland, Oregon Area*. U.S. Geological Survey Scientific Investigations Report 2008-5059.

Stevens, Jr., D.L., and A. R. Olsen. 2004. *Spatially Balanced Sampling of Natural Resources*. Journal of the American Statistical Association 99.465: 262-278.

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Appendices

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Appendix A

UIC Location Maps and List

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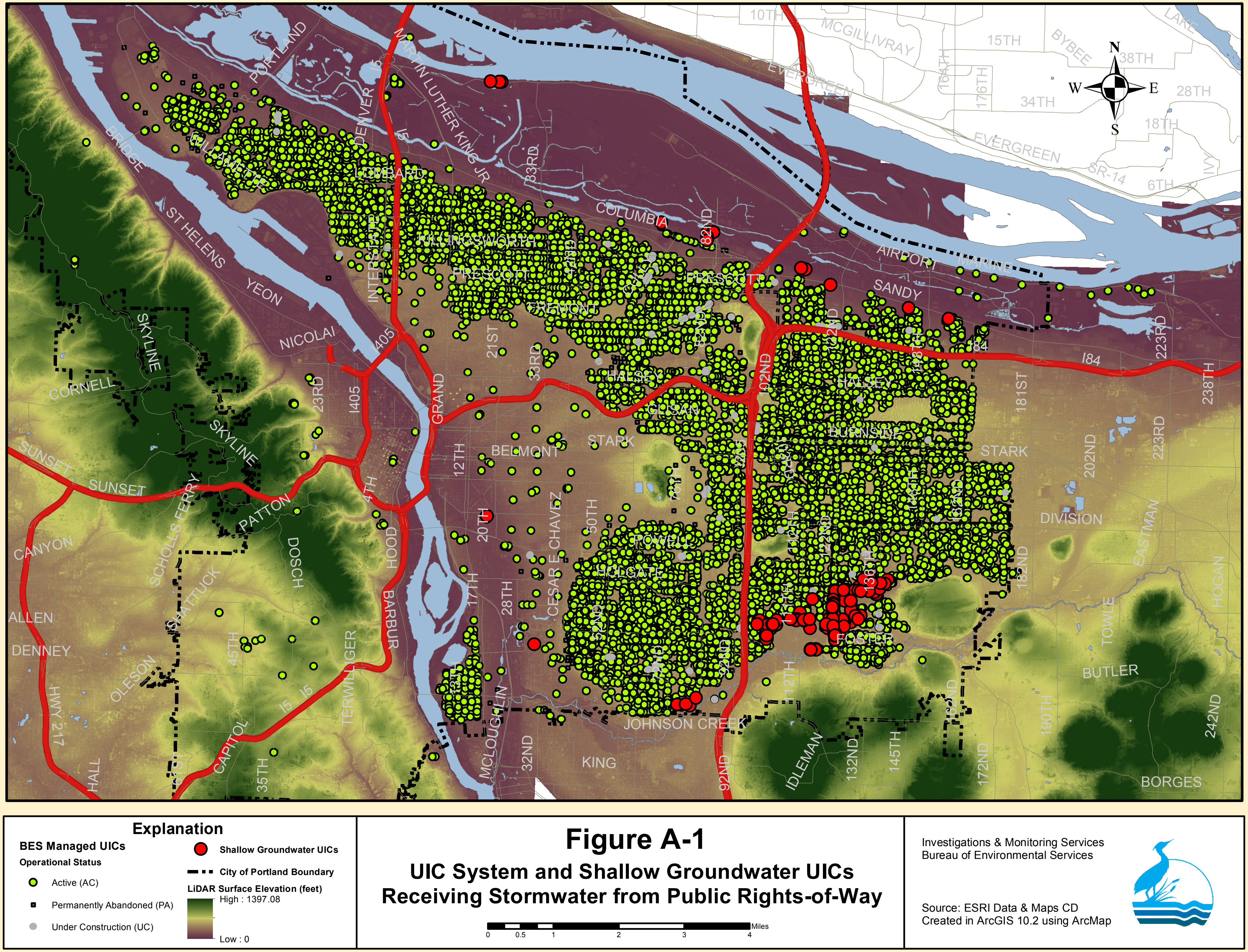
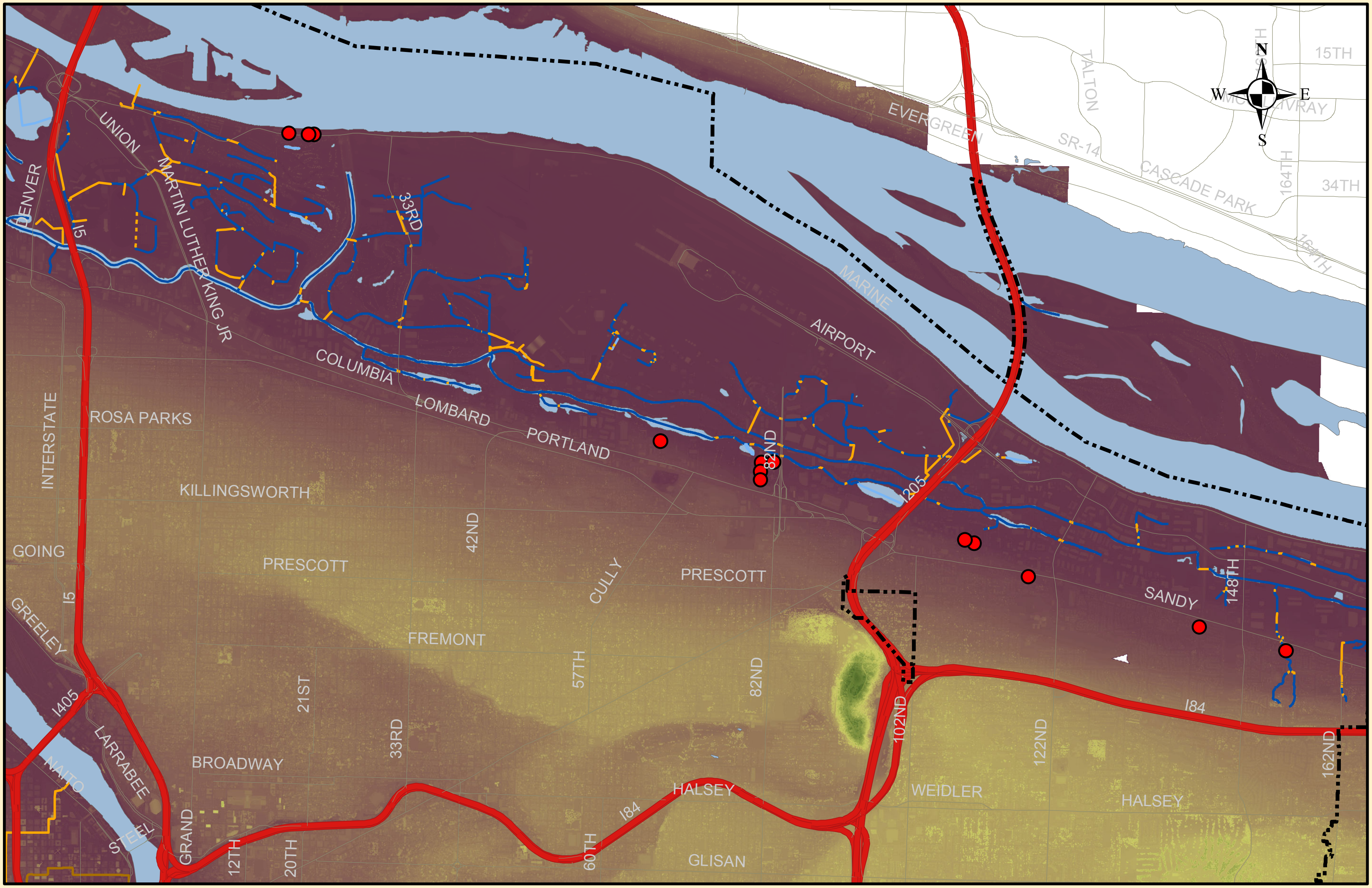


Figure A-1

UIC System and Shallow Groundwater UICs Receiving Stormwater from Public Rights-of-Way

Investigations & Monitoring Services
Bureau of Environmental Services

Source: ESRI Data & Maps CD
Created in ArcGIS 10.2 using ArcMap



Explanation

- Shallow Groundwater UICs
- City of Portland Boundary

LiDAR Surface Elevation (feet)
High : 1397.08
Low : 0

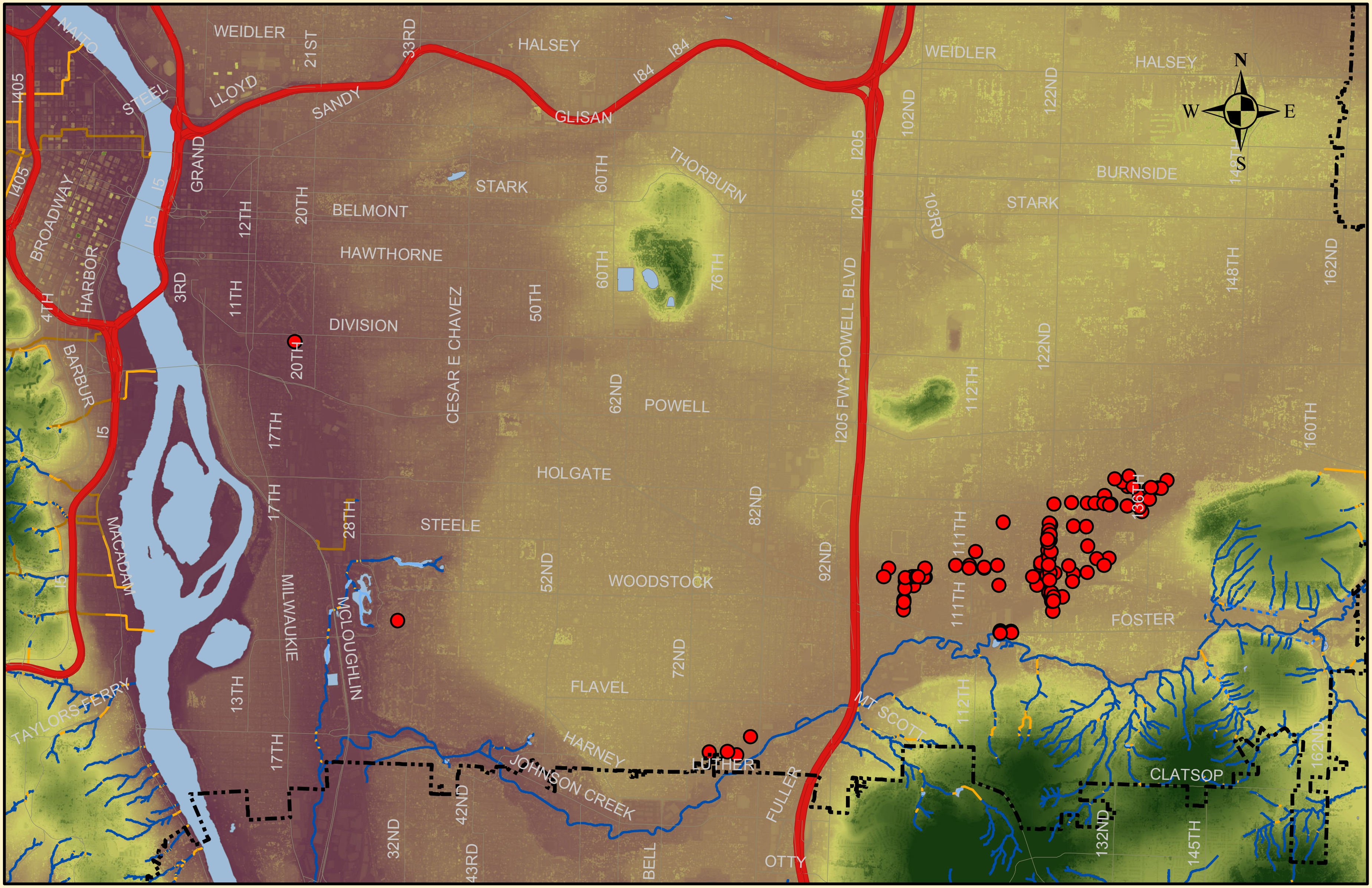
Miles: 0, 0.25, 0.5, 1, 1.5, 2

Figure A-2

Shallow Groundwater UICs Located in Public Rights-of-Way - North

Investigations & Monitoring Services
Bureau of Environmental Services

Source: ESRI Data & Maps CD
Created in ArcGIS 10.2 using ArcMap



Explanation

- ● Shallow Groundwater UICs
- ‑ · ‑ City of Portland Boundary

LiDAR Surface Elevation (feet)
High : 1397.08
Low : 0

0 | 0.25 | 0.5 | 1 | 1.5 | 2 Miles

Figure A-3

Shallow Groundwater UICs Located in Public Rights-of-Way - South

Investigations & Monitoring Services
Bureau of Environmental Services

Source: ESRI Data & Maps CD
Created in ArcGIS 10.2 using ArcMap

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Appendix A: City of Portland UICs in Shallow Groundwater - Monitoring Locations

Site ID	Approximate Address	Estimated Trips per Day (TPD)	Traffic Category (TPD)	DEQ UIC ID	BES UIC ID	Latitude	Longitude	UIC Depth (feet)	Pretreatment System	Separation Distance(ft)	Distance to Nearest Well (ft)	Within Two-year Time of Travel from public drinking water well?
SG-001	2542 SE 18TH AVE	2315	< 1000	10102-9640	APR303	45.50400000	-122.64800000	23'	No Sed MH	2	2635	NO
SG-002	12140 SE RAMONA ST	11195	> 1000	10102-5319	ADT716	45.48055267	-122.53763580	28'	Sed MH	-11	1482	NO
SG-003	5980 SE 102ND AVE	688	< 1000	10102-5429	ADV146	45.47930145	-122.55857086	22'	Sed MH	3	1987	NO
SG-004	5031 SE 128TH AVE	1544	< 1000	10102-5921	ADU738	45.48538970	-122.53224182	30'	Sed MH	-11	761	NO
SG-005	12524 SE SCHILLER ST	416	< 1000	10102-5925	ADU744	45.48737716	-122.53431701	16'	Sed MH	2	513	NO
SG-006	5710 SE 115TH AVE	521	< 1000	10102-5267	ADV193	45.48116302	-122.54491424	24'	Sed MH	-1	313	NO
SG-007	8312 SE 75TH PL	501	< 1000	10102-120	ADV951	45.46345520	-122.58612823	30'	Sed MH	2	2515	NO
SG-008	4332 SE 130TH AVE	1606	> 1000	10102-822	ADT455	45.49054336	-122.53001403	20'	Sed MH	1	1256	NO
SG-009	5000 SE 122ND AVE	12138	> 1000	10102-5896	ADW266	45.48593139	-122.53773498	20'	No Sed MH	0	691	NO
SG-010	10298 SE ELLIS ST	1051	< 1000	10102-5463	ADV187	45.48181533	-122.55730438	23.5'	Sed MH	0	1427	NO
SG-011	11540 SE FOSTER RD	25775	> 1000	10102-5280	ADW312	45.47639083	-122.54454803	18'	No Sed MH	-6	1292	NO
SG-012	13250 SE HOLGATE BLVD	4710	> 1000	10102-711	ANA590	45.48958969	-122.52693939	Unknown	Sed MH	-1	1024	NO
SG-013	12122 SE HAROLD ST	11646	> 1000	10102-5904	ADW275	45.48316955	-122.53810882	22'	No Sed MH	1	1160	NO
SG-014	10357 SE ELLIS ST	279	< 1000	10102-5460	ACP889	45.48178482	-122.55604553	19'	Sed MH	2	1104	NO
SG-015	6245 NE 80TH AVE	2900	> 1000	10102-870	ANB185	45.56816482	-122.58040618	Unknown	No Sed MH	-11	1978	NO
SG-016	13236 SE CORA ST	419	< 1000	10102-6324	ADT463	45.49154663	-122.52667236	23.3'	Sed MH	-1	1543	NO
SG-017	5403 SE 122ND AVE	11646	> 1000	10102-5900	ADW271	45.48409271	-122.53801727	21'	No Sed MH	-4	1048	NO
SG-018	5803 SE 122ND AVE	11133	> 1000	10102-5288	ADT682	45.48019409	-122.53735351	27'	Sed MH	-11	1615	NO
SG-019	5905 SE 102ND AVE	553	< 1000	10102-165	ADV144	45.47944641	-122.55856323	20.6'	Sed MH	4	1961	NO
SG-020	13030 SE MITCHELL ST	178	< 1000	10102-5934	ADU753	45.48421096	-122.52912139	30'	Sed MH	2	1010	NO
SG-021	4754 SE 122ND AVE	12363	> 1000	10102-5888	ADW257	45.48746490	-122.53768920	22'	Bioswale	1	682	NO
SG-022	11246 SE HAROLD ST	3295	> 1000	10102-263	AMY402	45.48283767	-122.54711151	Unknown	No Sed MH	-8	928	NO
SG-024	12830 SE HOLGATE BLVD	5035	> 1000	10102-6315	ADT454	45.48972702	-122.53241730	20.6	Sed MH	0	1045	NO
SG-025	12010 SE REEDWAY ST	205	< 1000	10102-5269	ADV196	45.48127365	-122.53939056	28'	Sed MH	-13	962	NO
SG-026	5712 SE 103RD AVE	1109	> 1000	10102-117	AMT874	45.48089981	-122.55725097	21.2'	Bioswale, Sed MH	0	1457	NO
SG-027	11501 SE FOSTER RD	25775	> 1000	10102-5272	ADW303	45.47650909	-122.54454040	19'	No Sed MH	-9	1249	NO
SG-028	13515 SE HOLGATE BLVD	4568	> 1000	10102-1908	AMR622	45.48900985	-122.52449035	21'	Sed MH	2	960	NO
SG-029	5500 SE 121ST AVE	4885	> 1000	10102-5914	ADU735	45.48327636	-122.53894805	30'	Sed MH	-9	955	NO
SG-030	10402 SE ELLIS ST	279	< 1000	10102-169	ADV190	45.48177337	-122.55564880	21'	Bioswale, Sed MH	-1	1003	NO
SG-031	8111 NE HOLMAN ST	0	< 1000	10102-3106	ADV384	45.56826782	-122.57869720	14'	No Sed MH	-10	2314	NO
SG-032	13658 SE CORA ST	413	< 1000	10102-6334	ADT474	45.49146270	-122.52229309	19.7'	Sed MH	1	610	NO
SG-033	5423 SE 121ST AVE	806	< 1000	10102-5912	ADU734	45.48351287	-122.53894042	30'	Sed MH	-8	981	NO
SG-034	12319 SE RAMONA ST	1089	> 1000	10102-5300	ADT696	45.48014068	-122.53573608	20.2'	Sed MH	0	1545	NO

Site ID	Approximate Address	Estimated Trips per Day (TPD)	Traffic Category (TPD)	DEQ UIC ID	BES UIC ID	Latitude	Longitude	UIC Depth (feet)	Pretreatment System	Separation Distance(ft)	Distance to Nearest Well (ft)	Within Two-year Time of Travel from public drinking water well?
SG-036	5544 SE 128TH AVE	1298	> 1000	10102-5294	ADT689	45.48270797	-122.53215789	30'	Sed MH	-8	1781	NO
SG-037	4918 SE 122ND AVE	12138	> 1000	10102-5892	ACK357	45.48641204	-122.53774261	20'	Sed MH	1	988	NO
SG-038	11134 SE STEELE ST	173	< 1000	10102-5910	ADU731	45.48452758	-122.54837036	30.1'	Sed MH	-2	1074	NO
SG-039	5918 SE 122ND AVE	10908	> 1000	10102-5286	ADV203	45.47868728	-122.53705596	30'	No Sed MH	-1	1096	NO
SG-040	12920 SE HOLGATE BLVD	4814	> 1000	10102-6314	ADT453	45.48973464	-122.53133392	19.6'	Sed MH	0	1112	NO
SG-041	5601 SE 122ND AVE	11400	> 1000	10102-5281	ADW313	45.48228073	-122.53800201	24'	Sed MH	0	1181	NO
SG-042	5635 SE 102ND AVE	440	< 1000	10102-164	ADV130	45.48136520	-122.55846405	22'	Sed MH	2	1734	NO
SG-043	11020 NE MARX ST	1714	> 1000	10102-791	ANB108	45.56054306	-122.54932403	16'	No Sed MH	2	1784	NO
SG-044	4406 SE 135TH AVE	186	< 1000	10102-925	AMX686	45.49053573	-122.52488708	25.4'	Sed MH	-9	1003	NO
SG-045	12532 SE ELLIS ST	236	< 1000	10102-5293	ADT688	45.48248672	-122.53414154	30'	No Sed MH	-8	2137	NO
SG-046	5736 SE 102ND AVE	426	< 1000	10102-5422	ADV135	45.48060989	-122.55849456	20.7'	Bioswale, Sed MH	3	1791	NO
SG-047	4022 NE 142ND AVE	426	< 1000	10102-9474	AAV769	45.55256271	-122.51643371	Unknown	Sed MH	-1	809	NO
SG-048	4241 SE 136TH AVE	10104	> 1000	10102-6335	ADT475	45.49134826	-122.52353668	27'	Sed MH	-8	798	NO
SG-049	5211 SE 122ND AVE	11953	> 1000	10102-574	ADW269	45.48487472	-122.53798675	22'	No Sed MH	1	1297	NO
SG-050	4736 SE 115TH AVE	821	< 1000	10102-6110	AMR771	45.48759078	-122.54449462	31'	Sed MH	3	449	NO
SG-051	9956 SE HAROLD ST	3892	> 1000	10102-855	ANA841	45.48259353	-122.56085968	30'	No Sed MH	4	2354	NO
SG-052	13033 SE HOLGATE BLVD	4710	> 1000	10102-714	ANA596	45.48972320	-122.52897644	Unknown	Sed MH	-16	928	NO
SG-053	4919 SE 122ND AVE	12138	> 1000	10102-5891	ADW261	45.48643875	-122.53794097	21'	No Sed MH	0	937	NO
SG-054	5440 SE 111TH AVE	1848	> 1000	10102-5765	ADW230	45.48312759	-122.54922485	19'	No Sed MH	3	792	NO
SG-055	11741 SE FOSTER RD	25775	> 1000	10102-5273	ADW304	45.47650909	-122.54300689	19'	No Sed MH	2	1281	NO
SG-056	13250 SE HOLGATE BLVD	4710	> 1000	10102-713	ANA592	45.48958969	-122.52688598	Unknown	No Sed MH	-1	1067	NO
SG-057	5500 SE 122ND AVE	11646	> 1000	10102-5903	ADW274	45.48321151	-122.53783416	20.2'	No Sed MH	1	1231	NO
SG-058	10304 SE ELLIS ST	1051	> 1000	10102-5458	ACP887	45.48181152	-122.55709075	20.5'	Sed MH	2	1372	NO
SG-059	4656 NE 118TH AVE	436	< 1000	10102-3576	ADQ418	45.55727005	-122.54135131	30.1'	No Sed MH	3	1472	NO
SG-060	4144 SE 132ND AVE	0	< 1000	10102-6287	ADT426	45.49193954	-122.52745056	30'	Sed MH	-2	1399	NO
SG-061	12246 SE ELLIS ST	224	< 1000	10102-5292	ADT687	45.48254776	-122.53687286	25'	Sed MH	-4	1463	NO
SG-062	6034 SE 102ND AVE	894	< 1000	10102-5435	ADV154	45.47859573	-122.55861663	26.1'	Sed MH	0	2130	NO
SG-063	13820 SE GLADSTONE ST	430	< 1000	10102-6333	ADT473	45.49227905	-122.52095794	20.9'	Sed MH	4	240	NO
SG-064	1839 NE MARINE DR	11064	> 1000	10102-1042	ANA900	45.60036468	-122.64641571	10.2'	Sed MH	2	1694	NO
SG-065	4745 SE 122ND AVE	12363	> 1000	10102-5887	ADW256	45.48761749	-122.53787994	20'	Sed MH	3	661	NO
SG-066	8318 SE 78TH AVE	86	< 1000	10102-4830	ADV950	45.46357727	-122.58353424	27.5'	No Sed MH	-13	1849	NO
SG-067	10246 SE ELLIS ST	1051	> 1000	10102-5462	ACP891	45.48181915	-122.55750274	20.4'	No Sed MH	3	1478	NO
SG-068	13250 SE HOLGATE BLVD	4710	> 1000	10102-712	ANA591	45.48958969	-122.52690887	Unknown	Sed MH	-1	1062	NO
SG-069	12210 SE ELLIS ST	11461	> 1000	10102-5291	ADT686	45.48255157	-122.53763580	17'	Sed MH	4	1268	NO

Site ID	Approximate Address	Estimated Trips per Day (TPD)	Traffic Category (TPD)	DEQ UIC ID	BES UIC ID	Latitude	Longitude	UIC Depth (feet)	Pretreatment System	Separation Distance(ft)	Distance to Nearest Well (ft)	Within Two-year Time of Travel from public drinking water well?
SG-070	6135 NE 80TH AVE	2900	> 1000	10102-869	ANB182	45.56728363	-122.58050537	17'	Sed MH	-16	2178	NO
SG-071	5404 SE 122ND AVE	11646	> 1000	10102-5901	ADW272	45.48406600	-122.53781890	17.9'	Sed MH	1	1323	NO
SG-072	4490 SE 125TH AVE	5249	> 1000	10102-6312	ADT451	45.48973846	-122.53472900	20'	No Sed MH	3	487	NO
SG-073	4857 SE 122ND AVE	12261	> 1000	10102-5889	ADW258	45.48686599	-122.53791046	21'	No Sed MH	1	884	NO
SG-074	8100 SE CRYSTAL SPRINGS BLVD	895	< 1000	10102-5347	AMR553	45.46509552	-122.58024597	30'	Sed MH	-13	1136	NO
SG-075	5610 SE 102ND AVE	490	< 1000	10102-5412	ADV127	45.48170852	-122.55844116	21'	No Sed MH	4	1720	NO
SG-076	13515 SE HOLGATE BLVD	4568	> 1000	10102-352	AMY600	45.48942947	-122.52488708	21'	Sed MH	-2	1009	NO
SG-077	12500 SE HAROLD ST	1477	> 1000	10102-232	AMS283	45.48330688	-122.53488159	25'	Sed MH	-5	1986	NO
SG-078	6457 NE 66TH AVE	439	< 1000	10102-9478	ANW740	45.57010269	-122.59515380	18'	Sed MH	4	1089	NO
SG-079	12204 SE STEELE ST	11953	> 1000	10102-5931	ADU751	45.48472213	-122.53757476	20.4'	Sed MH	0	1408	NO
SG-080	5608 SE 99TH AVE	557	< 1000	10102-5407	ACP660	45.48171615	-122.56162261	30'	No Sed MH	4	2534	NO
SG-081	11080 SE HAROLD ST	3791	> 1000	10102-5468	ADV191	45.48280334	-122.54930877	22.9'	Sed MH	-3	711	NO
SG-082	4406 SE 136TH AVE	9961	> 1000	10102-558	AMX688	45.49026870	-122.52355194	22.75'	Sed MH	-4	647	NO
SG-083	10310 SE ELLIS ST	1051	> 1000	10102-5464	ADV188	45.48180389	-122.55689239	22'	Sed MH	0	1322	NO
SG-084	4100 SE 133RD AVE	389	< 1000	10102-6326	ADT466	45.49257659	-122.52648925	30'	Sed MH	-1	1286	NO
SG-085	12506 SE REEDWAY ST	187	< 1000	10102-5296	ADT691	45.48175430	-122.53427124	25'	No Sed MH	-4	2151	NO
SG-086	3734 NE 154TH AVE	0	< 1000	10102-4041	ADR048	45.55039215	-122.50386047	30.2'	Sed MH	3	734	NO
SG-087	5021 SE 122ND AVE	11953	> 1000	10102-5897	ADW267	45.48545837	-122.53794860	20'	Sed MH	1	1097	NO
SG-088	3039 SE TOLMAN ST	1503	> 1000	10102-5590	ADW286	45.47599411	-122.63162994	30.2'	Sed MH	-2	3443	NO
SG-089	5436 SE 109TH AVE	461	< 1000	10102-5764	ADW229	45.48305511	-122.55123901	20.5'	No Sed MH	2	451	NO
SG-090	13250 SE HOLGATE BLVD	4710	> 1000	10102-710	ANA589	45.48958969	-122.52696228	Unknown	No Sed MH	0	1054	NO
SG-091	5436 SE 122ND AVE	11646	> 1000	10102-5902	ADW273	45.48338317	-122.53783416	17.5'	No Sed MH	4	1244	NO
SG-092	6015 NE 80TH AVE	6658	> 1000	10102-868	ANB179	45.56639480	-122.58049774	19.5'	Sed MH	-7	2423	NO
SG-093	5825 SE 122ND AVE	11031	> 1000	10102-267	ADV204	45.47970199	-122.53723907	25'	No Sed MH	-6	1460	NO
SG-094	12908 SE MITCHELL ST	178	< 1000	10102-5938	ADU758	45.48411178	-122.53086853	21'	No Sed MH	3	1173	NO
SG-095	5732 SE 122ND AVE	11195	> 1000	10102-5311	ADW321	45.48059082	-122.53733062	20'	Sed MH	-3	1544	NO
SG-096	12780 SE SCHILLER ST	1778	> 1000	10102-5924	ADU743	45.48738098	-122.53247070	15.4'	Sed MH	1	898	NO
SG-097	11305 SE HAROLD ST	3295	> 1000	10102-1036	ANA889	45.48294830	-122.54711151	Unknown	No Sed MH	-8	920	NO
SG-098	4425 SE 130TH AVE	4814	> 1000	10102-715	ANA598	45.48972702	-122.53005981	15.6'	Sed MH	-2	970	NO
SG-099	5605 SE 120TH AVE	192	< 1000	10102-5270	ADV197	45.48211669	-122.54003906	26'	No Sed MH	-5	680	NO
SG-100	11540 SE FOSTER RD	25775	> 1000	10102-5280	APV741	45.47600000	-122.54500000	18'	No Sed MH	-1	1300	NO
SG-101	10398 SE ELLIS ST	279	< 1000	10102-5466	ADV189	45.48178100	-122.55584716	20'	Sed MH	0	1054	NO
SG-102	13722 SE CORA ST	413	< 1000	10102-6332	ADT472	45.49144363	-122.52182769	19'	Bioswale, Sed MH	1	551	NO
SG-103	12230 SE RAMONA ST	11133	> 1000	10102-5289	ADT683	45.48014068	-122.53694915	19.5'	Sed MH	-3	1592	NO

Site ID	Approximate Address	Estimated Trips per Day (TPD)	Traffic Category (TPD)	DEQ UIC ID	BES UIC ID	Latitude	Longitude	UIC Depth (feet)	Pretreatment System	Separation Distance(ft)	Distance to Nearest Well (ft)	Within Two-year Time of Travel from public drinking water well?
SG-104	13000 SE HAROLD ST	1341	> 1000	10102-5936	ADU755	45.48346710	-122.52983856	29'	Sed MH	-3	1307	NO
SG-105	12221 SE REEDWAY ST	11400	> 1000	10102-5295	ADT690	45.48181915	-122.53762054	27'	Sed MH	-7	1308	NO
SG-106	10900 NE MARX ST	1714	> 1000	10102-1316	ADV974	45.56085205	-122.55072784	16.3'	Sed MH	-2	1758	NO
SG-107	5500 SE 104TH AVE	4096	> 1000	10102-5768	ADW233	45.48270797	-122.55564117	Unknown	No Sed MH	0	1045	NO
SG-108	13612 SE CORA ST	10104	> 1000	10102-6331	ADT471	45.49146652	-122.52326202	21'	No Sed MH	-1	778	NO
SG-109	5906 SE 122ND AVE	11031	> 1000	10102-5287	ADV205	45.47969436	-122.53704833	28'	Sed MH	-7	1442	NO
SG-110	13110 SE GLADSTONE CT	0	< 1000	10102-6289	ADT428	45.49228286	-122.52851867	30'	Sed MH	1	1220	NO
SG-111	4908 SE 122ND AVE	12138	> 1000	10102-5915	ADU725	45.48645782	-122.53776550	19'	Sed MH	2	974	NO
SG-112	11716 SE FOSTER RD	25775	> 1000	10102-5279	ACQ013	45.47637176	-122.54296875	20'	No Sed MH	4	1333	NO
SG-113	6036 SE 102ND AVE	894	< 1000	10102-5436	ACP693	45.47846221	-122.55862426	22'	No Sed MH	4	2160	NO
SG-114	1801 NE MARINE DR	11064	> 1000	10102-1041	ANA899	45.60034179	-122.64723968	10'	Sed MH	1	1579	NO
SG-115	5450 SE 114TH PL	3642	> 1000	10102-5894	ADW264	45.48316574	-122.54518127	Unknown	No Sed MH	-5	419	NO
SG-116	13008 SE HOLGATE BLVD	4710	> 1000	10102-709	ANA587	45.48961257	-122.52936553	Unknown	No Sed MH	-3	884	NO
SG-117	12150 SE RAYMOND ST	12138	> 1000	10102-5895	ADW265	45.48594665	-122.53807830	16.5'	No Sed MH	4	1006	NO
SG-118	11540 SE FOSTER RD	25775	> 1000	10102-9680	APV742	45.47600000	-122.54500000	13'	No Sed MH	-1	1312	NO
SG-119	10324 SE ELLIS ST	142	< 1000	10102-5465	ACP892	45.48179626	-122.55660247	21'	Sed MH	0	1247	NO
SG-120	13326 SE CORA ST	418	< 1000	10102-6325	ADT464	45.49151229	-122.52593231	25'	Sed MH	-4	1363	NO
SG-121	5988 SE 102ND AVE	688	< 1000	10102-5431	ACP682	45.47921752	-122.55857849	21.8'	Bioswale, Sed MH	3	2004	NO
SG-122	1445 NE MARINE DR	11064	> 1000	10102-1919	AAC311	45.60037994	-122.65004730	14.9'	No Sed MH	-4	1413	NO

Appendix B

Standard Operating Procedures for Stormwater Monitoring

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Appendix B

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<u>SOP-D1 Weather Tracking and Monitoring Preparation</u>

The Storm Event Coordinator will review the daily (Monday through Friday) weather forecast obtained from the project weather consultant, Extended Range Forecasting (ERF) Company, Inc., throughout the wet season to determine which predicted storm events might meet project targets. When a candidate storm is within 72 hours of occurring, the Storm Event Coordinator will communicate directly with ERF via telephone on an as-need basis.

Stormwater sampling is performed at any time of day or night, including weekends, and fieldwork is based on the timing and duration of the targeted event.

If an event being tracked has a 75% or greater probability of generating 0.2 inches of rainfall and last at least six hours following a six hour dry period, the Storm Event Coordinator may select it as a candidate storm for this project. The Storm Event Coordinator will inform the Sampling Teams and the laboratory 72 hours before the candidate storm's predicted arrival (referred to as "Stand-By Mode").

During "Stand-By Mode," the Storm Event Coordinator will maintain frequent contact with ERF and if the forecast still predicts a target magnitude event at 24 hours before its arrival, the Sampling Team will be placed in an "Alert mode." The Sampling Team should consider "Alert Mode" as meaning that sampling is imminent, and should prepare sampling equipment accordingly.

Sampling Team "Alert Mode" activities:

- Prepare sampling equipment per *SOP D-2;*
- Decontaminate field equipment per *SOP D-3;*
- Assemble sample containers per *SOP D-4;*
- Identify Sampling Team members and arrange schedules for field activities; and
- Load vehicles to conduct sampling activities.

At 12 hours before a targeted storm event is scheduled to arrive, a "Go/No-Go" decision on sampling will be made by the Storm Event Coordinator based on current information from ERF:

Sampling Team "Go"

- Mobilize Sampling Teams to be deployed when precipitation is imminent or has begun.

Sampling Team "No-Go"

- Unload and organize sampling equipment for next event.

If "Go," once precipitation has begun the Sampling Teams will go into "Sample Mode"

Sampling Team "Sample Mode"

- Begin field sampling activities per *SOPs D-5 through D-10.*

SOP-D2 Sampling Equipment Preparation

Each Sampling Team will use a vehicle that is pre-equipped with basic tools, cell phones and/or two-way radios, and traffic control equipment. During the “Alert Mode” of each storm, each Sampling Team shall ensure that the vehicles are stocked with the following equipment and any other equipment that may be determined to be necessary for fulfilling the sampling requirements of this plan:

- Stainless steel beakers (pre-cleaned) – a minimum of one per sample location,
- Swing sampler with telescoping pole,
- Sample containers,
- Volatile organic compound trip blank,
- Disposable gloves (latex or nitrile),
- Cooler with blue ice,
- Manhole cover puller,
- Traffic control equipment,
- Sampling Documentation (Daily Field Report, Field Data Sheet, Chain of Custody),
- Field folder with containing SAP, HASP, station maps, location photos, and traffic control plans, and
- Digital camera.

SOP-D3 Sampling Equipment Decontamination

The only equipment that will contact the sample media (stormwater) is the stainless steel beaker used to collect stormwater grab samples. Before use, each beaker will be decontaminated using the following procedure:

1: Wash with phosphate-free detergent solution;
2: Rinse with tap water;
3. Wash with 5 percent acetone solution;
4: Wash with 10 percent methanol solution;
5: Rinse with deionized water; and
6: Rinse with ultrapure deionized water.

Air dry the beakers and cover with foil for transport to the field. To eliminate field decontamination, at least one beaker per potential sampling location will be decontaminated prior to each event.

SOP D-4 Sample Container Preparation

- The Sampling Team(s) should assemble pre-cleaned and, if required, pre-preserved analyte-specific sample containers provided by the WPCL and TA at least 24 hours prior to the sampling event. Containers should be inventoried and checked against the bottle list in the field file for each sampling station.
- Empty containers may be loaded into vans in the coolers or in boxes or packaging they were received in, with the exception of VOC vials. All VOC vials per team must be stored together in a cooler adjacent along with a trip blank.
- Containers should not be pre-labeled since each Sampling Team may visit any project station during each storm. *SOP D-8* discusses sample container labeling protocol.

SOP-D5 Clean Sampling Rules

Sample collection personnel should adhere to the following rules while collecting stormwater samples to reduce potential contamination.

- Do not eat, drink or smoke during sample collection.
- Do not park vehicles in immediate sample collection area, do not sample near a running vehicle.
- Always wear clean, disposable, powder-free latex or nitrile gloves when handling all sampling equipment and sample bottles. At a minimum, gloves will be changed prior to sampling at each location.
- Never touch the inside surface of a sample container or lid to be contacted by any material other than the sample water.
- Do not breathe, sneeze, or cough in the direction of an open sample container.
- Never allow any object or material to fall into or contact the collected sample water.
- Avoid allowing rainwater to drip from rain gear or other surfaces into sample bottles.

SOP-D6 Sampling Location Access

During sampling activities, use the following procedure to access each sampling station:

- Set up location-specific traffic control, if needed, as shown in field file;
- Remove manhole cover with manhole cover puller; and
- Determine if flow rate at EOP is sufficient to sample.

Flow rate is estimated by a modified bucket and stopwatch method, which entails recording the time it takes to fill a container of known volume and converting to gallons per minute. If flow rate is sufficient (typically greater than 0.1 gallon per minute), proceed with grab sample collection. If flow rate is insufficient, close manhole cover and proceed to next sampling station.

SOP-D7 Stormwater Grab Sampling

Set up a two-person clean Sampling Team: one “dirty hands” to move equipment, remove manhole cover, handle telescoping pole and swing sampler, and document sampling activities; and one “clean hands” to handle sampling beakers and fill sample containers.

The stormwater grab sampling technique is as follows:

- Using a new pair of latex or nitrile gloves, “clean hands” removes foil from two decontaminated beakers and places one in swing sampler. “Dirty hands” secures beaker in sampler with hook and loop strap. “Clean hands” places second beaker on clean sampling surface.
- “Dirty hands” lowers beaker on swing sampler/pole to just below the EOP inside the UIC sump. Do not touch manhole or UIC sump walls with beaker.
- Rinse beakers with stormwater by filling with stormwater discharge and emptying into second beaker. Empty second beaker into UIC. Repeat.
- Fill beaker on swing sampler/pole again from the middle of the EOP discharge.
- Slowly pour contents into the second beaker. “Clean hands” handles only the second beaker.
- Fill all containers by continually filling beakers and bringing to the surface. “Dirty hands” continues to handle swing sampler on pole while “clean hands” handles all sampling containers.
- If sampling for VOCs, fill vials directly from the beaker attached to the swing sampler. Do not transfer stormwater to the second beaker to avoid degassing the sample. The VOC vials are filled until there is no headspace and a positive meniscus is visible. Secure lid on each vial and invert. If air bubbles are present, repeat process.
- Label sample coolers containing filled sample containers with sample station point code and place samples in the cooler with blue ice using the following labeling convention.

  - Immediately following sample collection, each sample cooler will be labeled with a unique sample "point code" (*e.g.*, PN-X). Refer to the project CHAIN OF CUSTODY for a list of location addresses and sample point codes.
  - Duplicate sample containers will be labeled. Note on the FDS which location the duplicate was collected at since the duplicate sample will be relinquished "blind" to the laboratory. On the CHAIN OF CUSTODY form the duplicate samples will be listed as "DUP" only with no reference to where they were collected.
- Fill out Daily Field Report, Field Data Sheet, and Chain of Custody form per *SOP D-10.*
- Close manhole cover, break down traffic control and proceed to next location.

SOP D8 Field QC Sample Collection

Field Blank Collection

Field blanks are used to check the effectiveness of the decontamination procedure and, if collected in the field, to quantify contamination from atmospheric or field sampling activities. Two field blanks will be generated for this project: the equipment blank and the field decontamination blank.

The equipment blank will test the decontamination procedure used for the stainless steel beakers. It is intended to isolate contamination originating from the sampling equipment without the influence of field sampling activities. For this reason, the equipment blank is collected under controlled conditions in the laboratory. It is created prior to field sampling activities by pouring analyte-free water ("blank water") into a cleaned stainless steel beaker used by FO for UIC sampling then into analyte-specific containers and are processed following the same procedures as with the environmental samples. Record the time and date that the equipment blank is collected on the Chain of Custody.

The field decontamination blank will test both the decontamination procedure used for the stainless steel beakers *and* test for contamination introduced by atmospheric conditions or field sampling activities. For this reason, the field decontamination blank is collected in the field at an actual sampling location using the same methods and equipment as are used for stormwater sample collection (per *SOP D-8*) with the exception that the sampling equipment will not be lowered into a UIC but filled at street level. The field decontamination blank is created by pouring blank water into a cleaned stainless steel beaker secured in the swing sampler used by FO for UIC sampling. This water is then poured slowly into a second beaker. This beaker is then used to fill analyte-specific containers. The samples are processed with the environmental samples. Record the time and date that the field decontamination blank is collected on the Chain of Custody and the sample location on the Field Data Sheet.

Duplicate Sample Collection

Duplicate sampling locations for quality control are to be determined by the Storm Event Coordinator prior to the event. The Storm Event Coordinator shall select duplicate sampling locations on a random basis. The same sampling procedures described in *SOP D-8* should be followed for the duplicate with the duplicate sample containers filled along side the sample containers in a corresponding manner related to analysis (*e.g.*, grab metals bottle with duplicate grab metals bottle). Primary and duplicate sampling containers should be filled in an alternating fashion until all containers are filled.

SOP-D9 Sample Collection Documentation

Three separate documents will be completed by each Sampling Team per sampling event: Daily Field Report, Field Data Sheet, and Chain of Custody. These documents should be completed in the field concurrent with sampling activities. Blank copies of these forms are included in the Attachments section of this SAP.

Daily Field Report

Daily Field Reports serve as a general log of the field activities for each Sampling Team and are used continuously during sampling activities. Each Daily Field Report has a title block area for project name, project number, date, author, and page number, which should be fully completed on each page as needed. Additional pages should be numbered sequentially per each Sampling Team. At a minimum, the following information is required on the main body of the Daily Field Reports:

- Name of the person(s) on each Sampling Team;
- Location and times of each sampling event;
- General weather conditions; and
- Summary of sampling activities and observations (list specific sample details on the Field Data Sheet).

Field Data Sheet

A Field Data Sheet details specific observations pertaining to each sample collected. One Field Data Sheet per sample collected is required. Required information to be recorded on the Field Data Sheets include:

- Date, arrival time, departure time, and personnel present for each sample collected;
- Sample site address and sample point code;
- Weather and flow conditions at each sampling location;
- Flow rate estimate at EOP at the start and end of sample collection;

- Presence of floatable objects, oily sheens, catch basin conditions, potential pollution sources, or other conditions that that may impact stormwater quality observed at the time of sample collection;
- Sample collection point;
- Start and end time of sampling;
- Deviations to sampling procedure; and
- Collection of Field QC samples.

Chain of Custody

The Chain of Custody form tracks the sampling path from origin through laboratory analysis, and it also presents the requested analysis and any special instructions for the analytical laboratory. After containers labeled with sample point codes are placed in coolers, fill out information on the project-specific Chain of Custody form. The following information is preprinted on the Chain of Custody:

- Project Name;
- Type of sample (*e.g.*, grab);
- Matrix (*e.g.*, stormwater); and
- Requested analytes.

The following information must be completed in the field after collecting each sample:

- Date and time sampling was initiated (use start time of sample collection from the Field Data Sheet);
- Initials of person(s) collecting sample;
- Sample point code;
- Field parameter measurements;
- Comments or special instructions including the metals list for the duplicate sample; and
- Additional Chain of Custody issues.

Additional information regarding the Chain of Custody is provided in Section 4.3 of the QAPP.

SOP-D10 Sample Transport and Delivery to the Laboratory

Sample Handling and Transport

- Pack samples well in cooler to prevent breakage or leakage. Ensure that each cooler with samples contains a temperature blank and that the cooler with samples for VOC analysis also contains a trip blank.

- Sample should be packed in ice or an ice substitute (e.g., blue ice) to maintain a sample temperature of 4°C during shipping. Ice (or substitute) should be placed in double wrapped watertight bags to prevent leaking during transport.
- Hand deliver samples to WPCL at the end of each storm event.

Relinquishing Samples

Upon arrival at the WPCL, affix sample identification stickers to each container. Each sample receives a unique sample identification code. When relinquishing samples to the WPCL sample custodian:

- Sign and date Chain of Custody;
- Have sample custodian sign and date;
- Relay any special instructions;
- Make one copy of Chain of Custody for the sampling records and the sample custodian retains the original Chain of Custody; and
- File copy of Chain of Custody and original Field Data Reports and Field Data Sheets in project file.

After Hours Procedures

The WPCL maintains standard business hours Monday through Friday and reduced business hours on weekends. If the Sample Custodian or designated alternate is not present at the time the Sampling Team arrives at the laboratory, the Sampling Team will sign and date the Chain of Custody form and place the samples in the temperature-controlled and monitored refrigerator located in the secured, controlled-accessed, sample receiving room. The laboratory will accept samples as soon as possible. Laboratory staff may also be available on call to work outside of normal business hours if sample hold times are set to expire prior to the next scheduled shift.

Appendix C

Health and Safety Plan

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City of Portland, Oregon

Water Pollution Control Facilities (WPCF) Permit For
Class V Stormwater Underground Injection Control Systems

Permit Number: **102830**

Health and Safety Plan
Stormwater Underground Injection Control System Monitoring

2015

Prepared By:
City of Portland, Bureau of Environmental Services

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List of Figures

HASP Signature Page

This Health and Safety Plan (HASP) has been prepared to meet the requirements of: Occupational Safety and Health Administration (OSHA) standards, 29 CFR Part 1910 and 29 CFR Part 1926, including the “Hazardous Waste Operations and Emergency Response” regulation (29 CFR 1910.120 and 29 CFR 1926.65) and other regulations that are referred to or cross referenced in these standards.

Approved By:

Section 1

1 Introduction

1.1 Introduction

The Underground Injection Control (UIC) program was enacted in 1974 as part of the Safe Drinking Water Act, which is administered under 40 Code of Federal Regulations part 144. The Oregon Department of Environmental Quality (DEQ) regulates this program under Oregon Administrative Rules Chapter 340, Division 144. The intent of the program is to protect groundwater from contamination.

The City of Portland (City) is classified as a large municipality with more than 50 City-owned or operated Class V UICs. Therefore, DEQ issued a second Water Pollution Control Facilities (WPCF) Permit to the City for Class V Stormwater UIC Systems, for the permit term June 2015 through May 2025. A Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) were prepared to meet the stormwater monitoring requirements established in the WPCF permit. Those documents will guide the monitoring efforts conducted by the City to ensure that quality control and consistency are maintained. This Health and Safety Plan (HASP) has been prepared to address the hazards associated with collecting stormwater samples for this project. The HASP will be reviewed and signed by all field personnel before the sampling operations begin.

1.2 UIC Overview

The City's standard design for UIC systems includes a sedimentation manhole upstream of the stormwater infiltration UIC. The sedimentation manhole provides pretreatment of stormwater prior to discharge into the UIC. Sedimentation manholes are solid concrete cylinders generally three to four feet in diameter and 10 feet deep. The standard design includes a "bent elbow" or "goose neck" drainpipe that leads from the sedimentation manhole to the infiltration sump to allow for withdrawal of water in the sedimentation manhole from below the water surface. This drainpipe design prevents litter, oil, and grease, which typically float on water, from flowing into the UIC.

The UICs are generally three feet to four feet in diameter. Most of the newer UICs (early 1990s and later) in the City are approximately 30 feet deep. Older UICs are between 18 feet and 30 feet deep. The City became responsible for most of the older UICs as a result of annexation from Multnomah County. These UICs were constructed in accordance with the County's design standards and many of these UICs did not include sedimentation manholes.

1.3 Location of Sites

A total of 75 locations will be monitored for permit compliance over the course of the permit, with fifteen UIC locations sampled each year (i.e., 5 panels of 15 locations). A map is provided in Appendix A of the 2015 SAP.

Sampling locations (*i.e.*, UIC identification) for each panel are finalized during the summer months prior to the monitoring season (July 1 through June 30) in which they will be sampled. Prior to finalizing UIC locations for each panel, the UIC is investigated and field verified, as described in Section 4.3 of the SAP. Following field verification, BES submits to DEQ a technical memorandum describing the final selection of the panel sample locations for the upcoming wet season and the results of the field verification.

1.4 Scope of Work

The City will attempt to collect one stormwater sample from each designated sampling location between July 1 and June 30 of each year, as required by the WPCF permit. Grab samples will be collected at the end of pipe (EOP) discharge point into the UICs, downstream of any pretreatment control device. If there is no pretreatment device and multiple discharge points, the sample will be collected from the EOP draining the largest catchment, as determined in the field. Samples will be collected by using decontaminated stainless steel beakers connected to telescoping poles by swing samplers. The beaker will be positioned at the sample point to collect EOP discharge and brought to the surface grade to fill sample containers.

The City will plan to sample the first predicted storm event occurring each fall in order to investigate any water quality differences that may be associated with the first large rain event of the fall season. Since storm events often fall short of predicted rainfall amounts and/or duration, there is a possibility that rainfall or runoff may cease prior to the collection of samples from all locations. If all locations cannot be sampled during a targeted event, the remaining locations will be sampled during the next storm meeting pre-specified criteria.

Section

2

2 Key Personnel

2.2 Project Personnel

Storm Event Coordinator	Randy Belston
Project Manager	Beth Hiscott
Monitoring Team Crew Leader	Matt Sullivan
Monitoring Team Personnel	Field Operations Staff

2.3 Health and Safety Personnel

2.3.1 Storm Event Coordinator

The Storm Event Coordinator is the Field Operations Section Supervisor and is responsible for the creation and implementation of this HASP. The Storm Event Coordinator must ensure that all project personnel have read and signed this HASP prior to conducting stormwater sampling. The Storm Event Coordinator is ultimately responsible for the health and safety of all project personnel.

2.3.2 Project Manager

The Project Manager (PM) directs all stormwater sampling activities. The PM is responsible for disseminating sampling site locations, site specific health and safety information including traffic control, and assigning sampling locations to Monitoring Team Crew Leaders and personnel prior to stormwater sampling. The PM also acts as a liaison between the Storm Event Coordinator and Monitoring Team Crew Leaders. The PM has the authority to terminate sampling activities if site conditions become unsafe.

2.3.3 Monitoring Team Crew Leaders

Monitoring Team Crew Leaders (Crew Leaders) are directly responsible for maintaining worker health and safety at sampling locations. Crew Leaders are responsible for establishing safe work zones and properly implementing traffic control measures (if applicable) for each sampling location. Crew Leaders must report any unsafe site conditions or unsafe work practices to the PM immediately. Crew Leaders have the authority to terminate sampling activities if site conditions become unsafe.

2.3.4 Monitoring Team Personnel

Monitoring Team Personnel are responsible for their own health and safety during stormwater sampling activities and are obligated to follow the safety policies described in this HASP. In addition, Monitoring Team Personnel are expected to ensure the health and safety of their coworkers by doing their part working safely as a team, and to inform their coworkers of any potentially unsafe actions they observe. Monitoring Team Personnel reserve the right to refuse to conduct sampling activities if they feel site conditions are unsafe. If site conditions become unsafe, or if injuries occur, Monitoring Team Personnel must report to the Crew Leader immediately.

Section

3

3 Required Health and Safety Training

3.2 Required Training

All BES employees that participate in stormwater sampling activities must be adequately trained to perform their job in a manner that ensures health and safety. Employees should be trained concerning potential hazards associated with their duties and procedures necessary to minimize risk. To accomplish training goals, BES conducts in-house training, hires consultants to conduct specialized training or seminars, and sends personnel to training programs sponsored by other organizations. Employees must carry proof of successful completion of all required training courses.

3.2.1 First Aid/Cardio Pulmonary Resuscitation (CPR)/Automatic External Defibrillator (AED) Training

All City of Portland personnel are required to have current Red Cross First Aid and CPR/AED training. First Aid training is required to be completed once every three years, and CPR/AED training must be completed annually. All employees must present their updated, certified, Red Cross First Aid and CPR/AED cards prior to stepping on site.

3.2.2 Driver Training

All BES employees that drive City vehicles are required to possess a valid state driver license and acceptable driving record. Employees are required every two years to complete a defensive driving course. “Smart Driver” is an in-house training program designed to reduce the risks of driving and promotes safe driving. Driver training program refreshers include summaries of changes in traffic laws, review of dangerous intersections within the City, and may highlight significant traffic control changes in high-traffic areas.

3.2.3 Traffic Control

All BES Field Operations personnel are required to complete a four-hour “Work Zone Traffic Control and Flagging Program” before working in traffic. This course addresses hazards associated with working in traffic, proper traffic control signage and traffic cone placement procedures based on road types and speed limits, and proper flagging techniques.

3.2.4 Confined Space Entry (CSE) Training

All BES Field Operations personnel are required to complete an in-house confined space entry training provided by the BES Risk Management Division. Although CSE will not be required for this project, employees are trained to recognize and identify confined spaces, properly complete confined space entry permits, operate confined space entry tools including tripods, fall protection, and atmosphere testing equipment. Emergency procedures including self-rescue and topside rescue are also included in this course.

3.2.5 Hazardous Waste Operations and Emergency Response Training

All BES Field Operations personnel are required to complete Hazardous Waste Operations and Emergency Response (HAZWOPER) Training before working on hazardous wastes sites in accordance with Occupational Health and Safety Administration (OSHA) regulations as stated in 29 CFR 1910.120. Field Operations personnel are required to complete an initial 40-hour training course and annually complete an eight-hour refresher course.

Section

4

4 Hazard Analysis

4.2 Work Zones and Site Access

The work zone is defined by the area within the traffic cone barrier surrounding the sampling manhole. In traffic control situations, the work zone is extended to the traffic cone boundaries that extend upstream and downstream of the sampling manhole. Site access will only be granted to project personnel and no unauthorized persons will be allowed in the work zone.

4.3 General Safety Equipment and Communications

First aid kits and fire extinguishers are available in the field laboratory, equipment staging area, and in each sampling vehicle. Eye wash stations and a decontamination shower are located in the field laboratory. Each employee has a cellular phone for communications and emergencies.

4.4 Personal Protective Equipment

4.4.1 Stormwater Sampling

All site personnel will wear modified Level D personal protective equipment (PPE) while conducting sampling activities. Modified Level D PPE for this project consists of steel-toed or other approved safety-toe shoes, cotton coveralls, rain gear (if applicable), latex or nitrile gloves, and Class 3 high visibility traffic vests. Modified Level D PPE, if worn properly, will reduce foot injuries, splash, skin adsorption, and traffic related risks while conducting stormwater sampling.

4.4.2 Decontamination

Decontamination procedures for stormwater sampling present the greatest potential risk for chemical exposure of any project task performed by BES employees. Reagents such as nitric acid and acetone are used to decontaminate sampling equipment. These reagents present inhalation and skin adsorption risks and must be handled with extreme caution. Employees must wear coveralls, a chemical resistant apron, chemical resistant gloves, and a face shield when handling nitric acid and/or acetone. Employees must always add reagents to water when making decontamination solutions, not water to reagents, in order to reduce splashing hazards. These reagents must also be handled under the ventilated sash fume hood located in the field laboratory, or well-ventilated area to reduce inhalation hazards.

4.5 Chemical Hazards

4.5.1 Stormwater Sampling

Based on previous stormwater sampling events, the analytical data indicate that overall, stormwater contamination is low and does not present significant exposures to employees above applicable permissible exposure limits (PELs). However, chemicals typically present in stormwater, albeit at low levels, include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), heavy metals, and pesticides. Employees must wear protective clothing and latex or nitrile gloves when conducting sampling activities to reduce exposure to these chemicals. Employees must use caution when handling stormwater to reduce splashing and skin contact. If stormwater makes contact with skin, it must be washed off immediately.

4.5.2 Decontamination Reagents

The greatest potential risk for chemical exposure to employees exists in the handling of decontamination reagents during the cleaning of sampling equipment. Nitric acid is a strong corrosive that will burn skin upon contact, causes eye and respiratory irritation, and pulmonary edema if swallowed. Acetone is a flammable liquid that causes skin and respiratory irritation upon exposure. Employees must wear proper PPE and work under a sash fume hood or well-ventilated area to minimize skin contact and inhalation risks while handling these chemicals. Eye wash stations and a decontamination shower are located in the field laboratory.

4.6 Physical Hazards

Physical hazards associated with working in urban streets with high traffic volumes are anticipated to be the most significant hazards associated with UIC stormwater sampling. At sites where sampling locations are located in or near traffic lanes, workers will wear Class 3 high visibility traffic vests and traffic control measures including signage, flashing overhead lights, traffic cones, and flaggers (if applicable) will be utilized to reduce risks.

All sampling locations associated with this project are located in manholes that should not require confined space entry since sampling will be performed with beakers attached to telescoping poles. Manhole covers will be removed however, and hazards associated with this task involve heavy lifting, crushing, tripping, and falling hazards. Manhole pulling tools must be utilized when removing and replacing manholes. Manholes should never be moved with bare hands or feet. Workers are required to wear steel-toed shoes and are to use proper lifting techniques to minimize crushing and back injury risks. Removed manhole covers should be placed out of foot traffic areas and open manholes are never to be left unattended to reduce falling hazards.

4.7 Biological Hazards

Biological hazards associated with stormwater sampling are minimal, however, some hazards do exist, such as bacteria and other waterborne pathogens present in stormwater. Latex or nitrile gloves should be worn during sampling activities to minimize exposures. Other potential biological hazards include insect bites or stings, spider bites, and rodent bites. All insect, spider, or rodent bites must be reported and if medical attention is necessary, it must be provided immediately.

4.8 Inclement Weather

Sampling in inclement weather is anticipated for UIC stormwater sampling. Samples can only be collected during times of stormwater runoff, so rainy, windy conditions are expected. Employees should take extra precaution while sampling in inclement weather in high traffic areas as driver visibility is decreased and the road surface is slippery. The potential for slips, trips and falls is also greater in wet weather. Proper clothing, such as rain gear, should be worn in inclement weather to reduce risks of cold-related illnesses such as hypothermia.

Section 5

5 Emergency Action Plan

5.2 Emergency Routes

All sampling locations lie in North, Northeast and Southeast Portland. A map of all sampling site locations and area hospitals is attached as Figure 1.1 of this HASP. **If a medical emergency occurs, first dial 911**. BES Pollution Prevention Services group also has a contract with American Medical Response (AMR) for injuries that are not life threatening but require medical evaluation and/or treatment. They can be reached at 503-230-2243. If emergency transport (ambulance) is not required and AMR is not utilized, refer to the map and choose the nearest medical facility to the sampling location to seek treatment.

5.3 Rescue and Medical Duties

If a medical emergency occurs, first dial 911. All stormwater sampling personnel are trained in First Aid and CPR, as required in section 3.1.1 of this HASP. Employees are expected, though not required, to provide immediate medical care for injuries within the scope of their training until the scene becomes unsafe, or professional medical care arrives.

5.4 Reporting Emergencies

If a medical emergency occurs, first dial 911. If a non-medical incident occurs, employees are required to complete a "BES Near Hit & Non-Medical Incident Report". If the incident requires medical attention, employees must first proceed to the emergency room, then should contact the BES Risk Management Section to complete the proper documentation.

Section 6

6 UIC Stormwater Sampling Health and Safety Plan Review

I have reviewed this HASP for UIC Stormwater Sampling and understand the hazards present for this project. I agree to follow the procedures outlined in this HASP and to inform the Monitoring Team Crew Leader, Project Manager and/or the Storm Event Coordinator should any unsafe conditions be noted. I understand that failure to follow safety requirements can result in removal from this project.

Name (print)	Date	Signature

Figure 1.1 City of Portland UIC Monitoring Locations and Hospitals

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Appendix D

Field Sampling Forms

Site Inspection Report
Field Data Sheet
Daily Field Report
Chain of Custody Form
Corrective Action Report

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CITY OF PORTLAND
ENVIRONMENTAL SERVICES
Water Pollution control Laboratory
6543 N. Burlington Ave.,
Portland, OR 97203-5452

UIC WPCF PERMIT MON – 4010.027 SITE INSPECTION REPORT

Date:	**Time:**	**Inspector:**

SECTION 1 – AREA DESCRIPTION

Site Address:	Traffic volume:

Node number: SED MH: SUMP 1: SUMP 2:

Drainage area description:

❑ Photos of site

Observed land use:

Traffic control requirements: ❑ Flagging ❑ Lane Closure # Staff Required: _____ Hours to Avoid: _____________

Describe:

Section 2 – Catch basin

Number of catch basins:	Locations:
Catch basin status:	Predominant drainage:
Depth of sediment, if no sed-MH present:	

Comments:

Section 3 – Sedimentation manhole

6.2.1.1.1.1 Location:

❑ Leaking ❑ Gooseneck present, condition:

Depth to water surface:	Is water level below gooseneck?
Depth to sediment surface:	

Comments:

Section 4 – Sump

Location in relation to Sed MH:

Inlet pipe: ❑ Flush with wall ❑ Sticking out from wall

Depth to water surface:	Depth to sediment surface:

Comments:

CITY OF PORTLAND

ENVIRONMENTAL SERVICES

Water Pollution control Laboratory
6543 N. Burlington Ave.,
Portland, OR 97203-5452

UIC WPCF PERMIT MON - 4010.027
FIELD DATA SHEET

Date:	**Time:**	**Event No:**	**Sampling Team:**

SECTION 1 – SITE CONDITIONS

Site Address:	Sample Point Code:
Observed Traffic Volume/Type:	
Weather and Flow Conditions:	Flow Rate Estimate (gpm):

Street Drainage Type:	**Catch Basin(s) Condition:**	**Sed-MH Condition:**
☐ **Curb and Gutter**	☐ **Floatable Objects:**	☐ **Floatable Objects:**
☐ **No Curb**	☐ **Oily Sheen/Staining**	☐ **Oily Sheen/Staining**
☐ **Gravel/Dirt Road**	☐ **Garbage/Debris/Organic matter**	☐ **Garbage/Debris/Organic matter**
☐ **Other:**	☐ **Other:**	☐ **Other:**

Potential Sources of Pollution in Drainage Area:

☐ **Parked vehicle(s)**	☐ **Staining on street**	☐ **Industrial Activity:**
☐ **Telephone pole(s) staining? Y / N**	☐ **Oily Sheen**	☐ **Commercial Activity:**
☐ **Garbage/Debris/Organic matter**	☐ **Pet Waste**	☐ **Other:**

Describe other conditions observed at the time of sample collection that may impact stormwater quality (*e.g.*, construction activity, car repair, street maintenance, poor housekeeping):

Photo(s) Taken? Y / N

Section 2 – Stormwater Sample collection

Sample Location:	Sample Time:
Sample Location Condition:	
Sample ID: affix FO number sticker	
Any deviations from sampling standard operating procedures? Y / N Describe:	
Duplicate sample collected here? Y / N	Duplicate Sample ID: affix FO number sticker
Field blank collected here? Y / N	Field Blank Sample ID: affix FO number sticker
Lab QC samples collected here? Y / N	Lab QC Sample ID: N/A (same as Sample ID)

City of Portland
Environmental Services

DAILY FIELD REPORT

Page ________ of ________

Project ______________________	Project No. ______________
Location ______________________	Date ______________
Subject ______________________	By ______________

Attachments

Date: ______________

Water Pollution Control Laboratory
6543 N. Burlington Ave.
Portland, Oregon 97203-5452
Sample Custodian: (503) 823-5696
General Lab: (503) 823-5681

City of Portland Chain-of-Custody

Bureau of Environmental Services

Work Order #: ______________

Collected By: ______________

Client Name: UIC

Project Name: UIC WPCF Permit

Matrix: Stormwater

Requested Analyses

Special Instructions:
1 = Metals list: As, Cd, Cr, Cu, Pb, Zn
Common Pollutants

Lab Number	Location ID	Sample Date	Sample Time	Sample Type	Total Metals[1]	PAH + Phthalates	Herbicides by 515.4 (TA)	# of Cont's	Remarks
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
				G	●	●	●		
	DUP			G	●	●	●		

Relinquished By:	Received By:	Relinquished By:	Received By:
Signature: Date:	Signature: Date:	Signature: Date:	Signature: Date:
Printed Name: Time:	Printed Name: Time:	Printed Name: Time:	Printed Name: Time:

CAR # ____________
(assigned by QA/QC chemist)

City of Portland
Water Pollution Control Laboratory

Corrective Action Report

This CAR form is to be utilized as documentation of a QA/QC non-conformance and subsequent corrective action. The CAR is initiated by the analyst and routed to the QA/QC Chemist. The CAR form should be submitted for QA approval before sample results are reported.

CAR initiated by: __________ Date: ____________ Lab area / analysis: __________________

Non-conformance:

Samples affected:

Corrective action:

Conclusion / Comments:

Comment required on sample report(s)? Yes / No Further action required? Yes / No

Corrective action executed by: _________________ Completion date: ______________

Other approval: _____________________________ Date: _________________

QA/QC Chemist Section Verification: _______ Date: ____________

Comment required on sample report(s)? Yes / No Further action required? Yes / No

QA/QC Chemist comments:

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City of Portland, Oregon

Water Pollution Control Facilities (WPCF) Permit For
Class V Stormwater Underground Injection Control Systems

Permit Number: 102830

WPCF UIC Permit
Quality Assurance Project Plan

Stormwater Underground Injection Control Monitoring

March 24, 2015

Prepared By:
City of Portland, Bureau of Environmental Services

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TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

LIST OF ACRONYMS

µg/L	microgram per liter
BES	Bureau of Environmental Services
CAR	Corrective Action Report
CCB	continuing calibration blank
CCV	continuing calibration verification
CFR	Code of Federal Regulations
COC	chain of custody
CLP	Contract Laboratory Program
CPR	cardiopulmonary resuscitation
DEQ	Oregon Department of Environmental Quality
DFR	daily field report
DQO	data quality objective
EDD	electronic data deliverables
EPA	Environmental Protection Agency
FDS	field data sheet
FO	Field Operations
HASP	Health and Safety Plan
IDL	instrument detection limit
LCS	laboratory control samples
LFB	laboratory fortified blank
LIMS	Laboratory Information and Management System
MDL	method detection limit
MLE	maximum likelihood estimation
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
O&M	Operations and Maintenance
OAR	Oregon Administrative Rule
ORELAP	Oregon Environmental Laboratory Accreditation System
PAH	polycyclic aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, completeness, comparability and sensitivity
PT	proficiency testing
QA	quality assurance

LIST OF ACRONYMS (continued)

QAPP	Quality Assurance Project Plan
QC	quality control
ROS	regression on order statistics
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SDMP	Stormwater Discharge Monitoring Plan
SOP	standard operating procedure
TA	Test America
UIC	underground injection control
UICMP	UIC Management Plan
VOA	volatile organic analyte
WPCF	water pollution control facility
WPCL	Water Pollution Control Laboratory

Section 1

1 Introduction

1.1 Introduction and Purpose

This Quality Assurance Project Plan (QAPP) outlines the quality assurance/quality control (QA/QC) procedures for the collection of stormwater samples by the City of Portland (City) Bureau of Environmental Services (BES). Stormwater data will be collected and reported annually from representative City underground injection control (UIC) structures for compliance with the Water Pollution Control Facilities (WPCF) permit (Permit Number 102830) issued to the City by the Oregon Department of Environmental Quality (DEQ) in 2015. The WPCF permit requires the City to monitor stormwater entering City-owned or operated UICs throughout the life of the permit (10 years).

This QAPP, in conjunction with the Sampling and Analysis Plan (SAP), will guide all sampling, analysis, data assessment, data management, and other monitoring-related activities and ensure that QC and consistency are maintained. The SAP (BES, 2015a) presents the methodology for selecting sampling locations and for collecting and analyzing stormwater samples. The SAP and QAPP are integrally linked and together form the Stormwater Discharge Monitoring Plan (SDMP) required by the WPCF permit.

1.2 Quality Assurance/Quality Control

The U.S. Environmental Protection Agency (EPA) defines[1] the terms "quality assurance" and "quality control" as follows:

Quality assurance (QA) is the integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected.

Quality control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the established requirements.

1.3 Objectives

As presented in Section 2 of the SAP, stormwater monitoring program objectives are to:

- Monitor the quality of stormwater discharged into UICs located in areas of shallow groundwater.
- Continue to collect and evaluate high quality data to adaptively manage the City's stormwater management program.

[1] EPA Glossary of Quality-Related Terms from EPA's Quality System website: http://www.epa.gov/quality/

- Use stormwater monitoring data to provide information necessary to identify UICs that may not meet WPCF permit requirements.
- Identify potential system improvements and guide management decisions for future system management and system monitoring activities.

One element of the monitoring program, discussed in Section 2.4 below, identifies standards and numerical data quality objectives (DQOs) for precision, accuracy and completeness of analytical data. Data quality will be evaluated by how well the final data meet the established DQOs.

1.4 QAPP Organization

This QAPP covers project management, sample collection and handling, analytical and quality control procedures, data management and evaluation, inspections, deviations, and corrective action. The QAPP is organized as follows:

- Section 1 Introduction
- Section 2 Project Management/Data Quality Objectives
- Section 3 Sample Handling and Custody
- Section 4 Analytical Procedures
- Section 5 Quality Control Procedures
- Section 6 Data Management, Validation, and Reporting
- Section 7 Data Assessment and Evaluation
- Section 8 Inspection and Audits
- Section 9 Deviations, Nonconformance, and Occurrences
- Section 10 Monitoring Program Corrections
- Section 11 References

Appendices A, B, and C provide supporting information, including field sampling and laboratory forms, laboratory method reporting limits, and data qualifiers.

1.5 Relationship to Other Plans

The SDMP describes the City's UIC stormwater discharge monitoring program to demonstrate permit compliance. In addition to the SDMP, the City has developed the following documents to comply with the permit:

- Systemwide Assessment
- UIC Management Plan (UICMP)
- Decommissioning Procedure

Monitoring data collected in accordance with the SDMP may be used to initiate corrective actions, as identified in the UICMP. Data collected in accordance with spill response, operations and maintenance (O&M), UIC closure, or groundwater monitoring in accordance with the UIC Program may be used to supplement the compliance monitoring data set as appropriate. All data collected under the UIC program will be used to:

- Ensure that infiltration of stormwater runoff from urban areas through City-owned UIC structures is performed in a manner that protects groundwater as a drinking water resource and protects watershed health.
- Meet regulatory mandates and permit requirements for all City-owned UICs.

The UICMP further describes the relationship among the various plans in the context of the City's UIC program.

1.6 QAPP Modifications

Potential modifications of the QAPP may be identified by field sampling staff, laboratory staff, or during review and evaluation of the field and/or analytical data. Modifications to the DEQ-approved QAPP will be summarized in the annual Stormwater Discharge Monitoring Report.

Modifications that do not change the basic intent of the DEQ-approved plans or modifications with low environmental and public health significance do not require DEQ to provide public notice or an opportunity for public participation. The following types of actions/modifications are considered "minor" or "Category 1" actions under Oregon WPCF rules (Oregon Administrative Rule [OAR] 340-045-0027) and will not require public notice or participation, unless determined necessary by DEQ:

- Correction of typographical errors
- Increased sampling frequency or increased analytical testing
- Incorporation of new data discovered/determined by UIC investigations/ inspections, complaint responses, system-wide assessment, etc.
- Incorporation of UICs constructed after the date of permit issuance
- Schedule changes not defined by the permit
- Changes in City data management, evaluation, or reporting methods
- Changes in field procedures or analytical methods
- Change in contract laboratory
- Collection and evaluation of source identification or corrective action data
- Collection and evaluation of groundwater data
- Selection of UIC panel locations
- Changes in City program staff

The following types of actions/modifications are considered “major”, and might be considered “Category 2” actions, and may require public notice or participation, as determined by DEQ:

- Decreased sampling frequency or decreased analytical testing
- Significant change in UIC sampling program design
- Change in Action Level concentrations

When QAPP addenda are prepared or updates to the QAPP are made, the City will distribute copies of the new version to DEQ and to internal staff members as appropriate and save the new version to the project file. A copy of each replaced document will be archived as documentation of past procedures.

Minor modifications to the QAPP will be documented in the annual monitoring report where appropriate and provided in an updated QAPP. Proposed major modifications to the DEQ-approved QAPP will be submitted to DEQ for review and approval, in accordance with the permit modification requirements (OAR 340-045-0055).

Section 2

2 Project Management / Data Quality Objectives

2.1 Project Organization

The City will be responsible for the technical components of this project and for management of task assignments. Samples will be collected by the BES Field Operations (FO) section and analyzed by the BES Water Pollution Control Laboratory (WPCL) and its contract laboratory, Test America (TA), located in Beaverton, Oregon. Responsibilities for data validation, assessment, and other related activities are outlined in Table 2.1 and discussed later in this document. Section 2.5 presents laboratory certification and accreditation information.

2.2 Project Team Roles and Responsibilities

Table 2.1 presents project roles and responsibilities.

Table 2.1 Project Team Roles and Responsibilities

Name	Organization	Title	Responsibility
Barbara Adkins Program Manager (503) 823-5737 **Joel Bowker** Hydrogeologist (503) 823-6997 **Tracy Rauscher** Env. Specialist (503) 823-7457	BES	UIC Program Staff	Responsible for coordinating and communicating UIC program needs (stormwater event sampling, source investigations, or response actions) with applicable BES WPCL personnel. Responsible for data evaluation, assessment, annual Stormwater Discharge Monitoring Report, and technical memoranda.
Aaron Wieting (503) 823-5437	BES	Monitoring Coordinator	Responsible for coordinating and communicating the sampling and analytical requirements with the field and laboratory staff. Responsible for organizing, compiling, and managing data.
Jason Law (503) 823-1038	BES	Project Statistician	Responsible for developing the sampling design and performing statistical data analyses.
Randy Belston (503) 823-5536	BES	Storm Event Coordinator	Responsible for weather tracking and overseeing sample collection, sample handling, chain-of-custody, and delivery of samples to the BES WPCL or TA.
Chuck Lytle (503) 823-5568	BES	Water Pollution Control Laboratory (WPCL)Manager	Responsible for overseeing management of BES WPCL. Final authority for data validity.

Table 2.1 Project Team Roles and Responsibilities

Name	Organization	Title	Responsibility
Jennifer Shackelford (503) 823-5614	BES	Laboratory QA Coordinator	Responsible for validating data generated by the WPCL according to the requirements of the project QAPP and WPCL Quality Manual. Ensures that laboratory protocols and QC are followed and that all corrective actions are implemented. Reviews TA laboratory data for QA/QC issues.
Jay Wilms (503) 906-9261	Test America	Contract Laboratory Project Manager	Responsible for validating data generated by the contract laboratory according to the requirements of the project QAPP and TA Quality Assurance Manual. Ensures that laboratory protocols and QC are followed and that all corrective actions for analysis of data are implemented. Submits TA laboratory reports to the WPCL.
Mike Reiner (503) 823-2431	BES	Risk Manager	Responsible for ensuring that the City's safety policies and procedures are implemented.

TA will provide analytical services that the WPCL is not capable of performing. TA has the ability to achieve low detection limits for the pollutants of interest using standard analytical methods and can meet project-specific criteria. A general overview of the organizational structure of TA and the responsibilities of key laboratory personnel are detailed in TA's current Quality Assurance Manual (Test America, 2012).

2.3 Project Task Description

In accordance with the SAP, stormwater samples will be collected from UICs located in shallow groundwater[2] between July 1 and June 30 each year. These samples will be measured annually at the laboratories for the analytes listed in Table 2.2. These data will be used to demonstrate permit compliance.

The first stormwater discharge sampling (stormwater sampling) effort of each year will be targeted to occur during the first fall storm event, meeting the storm monitoring criteria presented in Section 5.2 of the SAP. Because storms often fall short of predicted rainfall amounts and/or duration, or are of limited areal extent, there is a possibility that rainfall or runoff may cease before the successful collection of all samples. If all locations cannot be sampled during the targeted storm, the remaining locations will be

[2] As defined in the SAP, areas of shallow groundwater refer to locations where UICs have < 5 feet of vertical separation distance between the bottom of the UIC and the seasonal high groundwater level.

sampled during subsequent storms that meet storm criteria. The required "event" for this permit is defined as the successful completion of sampling at all locations. Therefore, the event will probably include sampling data from multiple individual storms. Sections 3 and 4 of the SAP provide additional information about the sampling design, timeline, and locations.

The City will report stormwater pollutant concentrations found to exceed permit Action Levels to DEQ in a Discharge Exceedance Notification within 45 days of submitting samples to the laboratory for analysis[3], and the UIC will be evaluated for appropriate corrective action. Sampling data for UICs located in areas of shallow groundwater will be evaluated each year in accordance with this QAPP and reported to DEQ on or before November 1 in the annual Stormwater Discharge Monitoring Report.

Table 2.2 Stormwater Quality Analytes [a]

Analyte	Method	Analytical Laboratory
Pentachlorophenol	EPA 515.4	TA [b]
Di(2-ethylhexyl) phthalate [c]	EPA 8270-SIM	WPCL
Benzo(a)pyrene		
Total Copper	EPA 200.8	WPCL
Total Lead		
Total Zinc		

Notes:
[a] Common pollutants are analyzed for all samples collected for permit compliance.
[b] TA = Test America.
[c] Di(2-ethylhexyl)phthalate is also known as bis(2-ethylhexyl)phthalate or DEHP.

2.4 Data Quality Objectives

DQOs are defined for environmental sampling and laboratory activities as qualitative and quantitative statements that specify the quality of the data required to support the project objectives. DQOs provide the driving force for the level of QC required for any particular sampling or analytical task. The key DQOs for the City's UIC permit compliance monitoring program are designed to provide environmental data that are of known and acceptable quality, are scientifically defensible, and demonstrate compliance with the WPCF Permit. The quality of data is known when all components associated with data generation are thoroughly documented. Data are of acceptable quality when a rigorous

[3] Typical laboratory turn-around is 21 days. However, the 30- to 45-day timeframe is identified to allow for review and validation of contract laboratory data before its addition to the WPCL database. These timelines are estimates and are subject to the City's UIC program receiving final validated laboratory data within 30 days of the sampling event.

QA/QC program is implemented and the QC indicators fall within predefined limits of acceptability. One of the primary functions of the QAPP is to detail the methods of documentation and to define the mechanisms to be used to attain data of acceptable quality.

Table 2.3 summarizes the project DQOs for analytical data. Because of the wide variation in precision and accuracy control limits of the analytical methods used in this project, the DQO targets must be broken down into analytical compound classes (e.g., pesticides, metals). Representativeness, comparability, and sensitivity cannot be distilled into numeric targets and are therefore not included in Table 2.3. However, those DQO targets are discussed in the following sections.

The quantitative goals for these analytical data DQOs and the level of effort expended to assess these DQOs will be dictated by the intended use of the data and by the nature of the analytical methods and sampling procedures. For this project, analytical data will be used primarily to demonstrate permit compliance.

Table 2.3 Overall Data Quality Objectives

Compound Class	Precision	Accuracy	Completeness
Polynuclear Aromatic Hydrocarbons (PAHs)	± 50%	Per method/per analyte	95%
Herbicides/Pesticides	± 30%	± 30%	95%
Total Metals	± 20%	± 25%	95%
Conventionals	± 20%	± 25%	95%

The QA mechanisms used to attain predefined DQOs fall within six broad categories: precision, accuracy, representativeness, completeness, comparability, and sensitivity, collectively referred to a PARCCS. The characteristics of these mechanisms for analytical data are discussed in the following sections. Given the variety and variability of other types of data collected for this project (e.g., depth to groundwater, storm event data, UIC construction data, lithologic data, drinking water well locations), PARCCS cannot be numerically defined to describe data quality. For these data types, the data quality will be qualitatively described, and associated uncertainties will be discussed in appropriate reports or technical memoranda.

2.4.1 Precision

Precision is the reproducibility of measurements under a given set of conditions. The overall precision of the measurement system is a combination of field (sampling) and laboratory (analytical) precision. Field precision may be assessed through the collection and analysis of field duplicate samples; however, this measurement incorporates both sampling and analytical precision. Laboratory precision may be assessed through the comparison of parent and matrix duplicate sample analysis and serial dilution analyses.

For two measurements (duplicate), the relative percent difference (RPD) will be used to estimate precision:

$$\text{RPD (\%)} = |X1 - X2|/[(X1 + X2)/2] \times 100$$

Where: X1 = measured sample concentration; and

X2 = measured duplicate concentration.

The precision goal ranges for analytical laboratory data are between ±20 and ±50 percent, as shown in Table 2.3. Note that collection of stormwater samples with precision is problematic because of the dynamic temporal and hydraulic conditions within the drainage system. Because of these inherent features, field duplicates outside the precision targets will not necessarily result in qualified data. However, results will be verified by the laboratory, and a thorough review of field and laboratory procedures will be performed to identify and correct problems, if any, and a case-by-case determination will be made regarding data usability.

2.4.2 Accuracy

Accuracy is the agreement between a measured value and its accepted "true" value. Accuracy is estimated from the measurements of samples of known composition. The accuracy of laboratory procedures is estimated by the analysis of calibration check standards, laboratory fortified blanks, surrogates, internal standards, and/or matrix spikes. Results outside of acceptance criteria are addressed according to policies outlined in the WPCL Quality Manual (BES, 2013). Bias in field activities (contamination) is estimated by the analysis of field blanks. Contaminant levels above the method reporting limits (MRLs) in field blanks necessitate examination of field procedures and modification of procedural steps found to cause contamination. For the analysis of standards (initial and continuing calibration verification, laboratory fortified blanks, surrogates, standard reference materials), the percent recovery is calculated as follows:

$$\text{Recovery (\%)} = (X/Y) \times 100$$

Where: X = analysis result; and

Y = "true" value.

For the analysis of spiked samples, the percent recovery is calculated as follows:

$$\text{Recovery (\%)} = [(SSR - SR)/SA] \times 100$$

Where: SSR = sample plus spike amount;

SR = sample result, and

SA = spike added.

The accuracy goals for analytical laboratory data are shown in Table 2.3 and vary by analytical laboratory method. If the laboratory recoveries are outside the analytical method accuracy goals, a thorough review of laboratory procedures will be performed to identify and correct problems, and a case-by-case determination will be made regarding data usability and the need to qualify data (i.e., flag).

2.4.3 Representativeness

Representativeness is the degree to which sample data accurately reflect conditions in the environment. The collection of representative stormwater samples is problematic because of the dynamic temporal and hydraulic conditions of stormwater within the drainage system, such as storm event size (precipitation quantity), antecedent dry period, storm duration, flow rates, etc. Given these inherent characteristics of stormwater, representativeness cannot be distilled into numeric DQOs. Representativeness is maximized by following written standard operating procedures (SOPs) in the field and in the laboratory. These SOPs include statistical methods for choosing an appropriate sampling design, how and where samples are physically taken, how subsamples are split from bulk samples, laboratory procedures for the creation of matrix spikes and matrix spike duplicates, laboratory digestion procedures, and laboratory instrumental methods.

QC checks that can be used to estimate representativeness include field blanks, field duplicates, and a variety of laboratory blanks (e.g., reagent and method blanks). The laboratory will report the analytical results for all the field, preparation, and analysis QC checks, but is able to assess and initiate corrective actions only for those procedures directly within the control of the laboratory. The examination of field QC statistics is done at the data assessment level, with corrective actions (e.g., re-sampling, changes in sampling protocols) decided at the programmatic level.

Representativeness will be qualitatively described and data uncertainties will be discussed in appropriate reports or technical memoranda.

2.4.4 Completeness

Completeness is a measure of the amount of valid data generated relative to the actual amount planned for collection. Completeness measures the effectiveness in sample collection, handling and transport, analysis, and result reporting for the entire investigation, and is calculated on a per-analyte basis by the following equation:

$$\text{Completeness (\%)} = (X/Y) \times 100$$

Where: X = number of valid results;

Y = number of possible results

The main limitations to completeness for this project are likely to be associated with incidental and unavoidable problems: accidental sample bottle breakage, instrument failure resulting in missed holding times, power outages, inability to collect samples because of the lack of adequate precipitation, etc. Failing to follow correct procedures in the field or laboratory also impacts completeness. Having detailed field and laboratory SOPs and thoroughly training all personnel involved in this project will minimize the samples lost because of avoidable procedural lapses. In the event a sample or an analytical result is lost because of such circumstances, corrective actions will be implemented. Examples of these corrective actions include additional training, adding additional personnel, extending the sampling schedule to avoid working too fast for conditions, assessing whether digestion/analytical equipment are adequate for the sample load, and re-assigning personnel who cannot perform adequately.

The completeness goals for analytical laboratory data are set at a minimum of 95 percent, as shown in Table 2.3. Completeness will be based on acceptable, verified, and usable (e.g., estimated, flagged) data, as defined in Section 6.3.

2.4.5 Comparability

Comparability is defined as the confidence with which one data set can be compared to another. Comparability is especially important in projects where sample collection and analysis occur continuously over many days, sporadically over long periods of time, under different weather conditions, or among different field collection personnel, sampling procedures, and/or laboratories.

There are no QC estimators specific to comparability. Comparability of data sets is greater if they have similar levels of precision and accuracy. Comparability must be evaluated primarily on the basis of accuracy and precision estimates generated during individual sampling events and from the various laboratory calibration and batch digestion/analysis QC checks. However, because comparability by its nature is an issue that extends beyond individual sampling events or specific laboratory QC statistics, it must be approached as a program-wide assessment task.

Comparability is maximized by following written SOPs for sample collection and other field activities, standardized analytical methods, and standardized reporting requirements (e.g., analytical laboratory data reports, units of measure, field data collection sheets).

To ensure data comparability, standardized analytical methods and QA/QC protocols will be used to the extent practicable. However, if it is determined that an analytical method is available that is more accurate or provides better precision or lower MRLs, the analytical method may be changed during the course of this project after it is adequately demonstrated that the results of the method are comparable to results derived using standard reference methods. Changes to the analytical program described in the QAPP will be made in accordance with Section 1.6. Comparability will be qualitatively described and data uncertainties will be discussed in appropriate reports or technical memoranda.

2.4.6 Sensitivity

Sensitivity is the measure of the concentration at which an analytical method can positively identify and report analytical results. The sensitivity of a given method is commonly referred to as the detection limit. Definitions for common detection limits are defined below.

1. Instrument detection limit (IDL) is the innate ability of an analytical instrument to differentiate a signal generated by the analyte from the background electronic or chemical noise.

2. Method detection limit (MDL) is a statistically determined concentration. It is the minimum concentration of an analyte that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero.
3. MRL is equal to or greater than the MDL and is regarded as the minimum level of target analyte in a sample that can be reliably achieved within specified limits of precision and accuracy. The MRL is variable and highly matrix-dependent.

The MDLs and MRLs for the analytical methods to be used for this project are presented in Section 4 for both the WPCL and TA, and also are presented in Appendix A.

Sensitivity will be qualitatively described and data uncertainties will be discussed in appropriate reports or technical memoranda.

2.5 Special Training/Certification

2.5.1 Field Operations

Fieldwork for this project will be performed under City and BES health and safety policies and procedures. The Storm Event Coordinator is responsible for ensuring that all field staff members involved in this project read and follow the requirements specified in the project Health and Safety Plan (HASP), as presented in the SAP. At least one member of each sampling team should have the following certifications:

- 40-hour Hazmat training and annual 8-hour refreshers
- Confined Space Entry and Work Practices certification
- Traffic Control and Flagging certification
- First aid and cardiopulmonary resuscitation (CPR) certification

Maintaining training records and certifications will be the responsibility of individual team members and are available upon request. The BES Training Coordinator also will maintain copies of appropriate training records for permanent FO section staff members.

2.5.2 Analytical Laboratories

The WPCL and TA follow EPA-approved analytical methods and QA/QC protocols and maintain employee-training programs. Staff members at both laboratories must demonstrate proficiency regarding laboratory equipment, analytical chemistry, analytical methods safety, math, and QC. Staff members attend training courses, workshops, and seminars on specific instrumentation, analytical techniques, and other specialized topics for continuing education.

BES WPCL. The WPCL Laboratory Manager and QA Coordinator are responsible for ensuring that all WPCL personnel follow QA/QC requirements specified in the WPCL QA manual (BES, 2013) and sound scientific practices. The WPCL is accredited through the Oregon Environmental Laboratory Accreditation Program (ORELAP) for the analytes it will measure for this project. ORELAP is recognized by the National Environmental Laboratory Accreditation Program (NELAP) to accredit environmental testing laboratories to national standards as adopted by the NELAC Institute. The WPCL maintains a training program and requires ongoing demonstrations of capability to ensure that personnel are qualified.

Currently, the WPCL also analyzes blind proficiency testing (PT) samples twice per year for most of the analyses performed by the laboratory, and every analyst participates in the program at least twice per year. These samples are purchased from a vendor certified under the National Voluntary Laboratory Accreditation Program or an equivalent accrediting program. The results of the analyses are used to evaluate the performance of individual analysts and to detect possible sources of error or bias in routine analyses. The analysis of PT samples is used for regulatory and accreditation requirements and as a learning tool with the goal of continuous improvement in data quality. Additional information is included in the WPCL QA Manual.

Test America. TA also is accredited through ORELAP for the analytes it will measure for this project. In addition, TA maintains a training and continuing education program to ensure that personnel are qualified and can demonstrate ongoing proficiency. The TA Quality Manual (TA, 2012) provides additional information regarding special training and certifications. A copy of TA's ORELAP certification is maintained in WPCL files and is available from the DEQ Laboratory or from the Oregon Public Health Laboratory or its website (http://oregon.gov/DHS/ph/orelap/about_shtml).

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Section

3

3 Sample Handling and Custody

The following sections describe sample identification; recommended sample volumes, containers, preservation, and holding times for the proposed analyses; and sample custody procedures. Appendix B of the SAP includes detailed sample collection SOPs for this project.

3.1 Sample Identification

Sample labels are necessary to prevent misidentification of samples. Each sample collected will have a unique sample point code applied in the field and a unique sample identification code applied upon receipt at the WPCL. These codes will be included on the chain of custody (COC) forms and field data sheets (FDS).

3.1.1 Field Identification

A sample point code will be assigned to each monitoring location at the beginning of each monitoring season, following site reconnaissance and location suitability evaluation. The point code will include the UIC panel number, followed by the sample site number in the order generated through the sampling design process, as follows:

SGN_X

Where: SG = denotes UICs in shallow groundwater

N = 1-5

X = 1-15

The SAP provides sample point codes and BES UIC database identification numbers. Identification numbers will remain the same unless a location is replaced.

A separate sample kit will be prepared in advance for each sampling location, with each kit in a separate cooler. Each sample kit will have a tag attached to the cooler that is labeled in indelible ink with the sample location at the time of sample collection by field personnel.

3.1.2 Laboratory Identification

The sampling team will submit samples to the WPCL under strict COC procedures. The sample custodian will log in samples to the WPCL Laboratory Information and Management System (LIMS) system under the project name and sample location ID. The LIMS generates a unique work order number for each COC (e.g., W10L041), in addition to a unique sample number for each sample (e.g., W10L041-01, -02, -03, etc.). These codes are printed on gummed labels with bar codes and are affixed to the sample containers during the sample receiving and login process. Field duplicate samples are assigned a different sample number from the parent sample to remain blind to the analysts. The work order number and sample number are entered on the COC by the sample custodian. Samples analyzed at both WPCL and any contract laboratories are labeled with these unique codes.

Each sample collected will have a unique sample point code and sample identification code. These codes will be included on the sample label, and the laboratory will use the COC forms to identify the analytical data.

3.2 Sample Volumes, Containers, Preservation, and Holding Times

3.2.1 Sample Volumes

Table 3.1 summarizes typical sample volumes required for the proposed analyses. The reported volumes are the recommended minimum field sample sizes for a single analysis, based on standard EPA-approved methodologies. If additional analyses are required (e.g., laboratory QC samples, allowance for potential repeat analyses), the sample volume collected will be increased accordingly.

Table 3.1 Recommended Sample Containers, Volumes, Preservation, and Holding Times

Compound/Compound Class	Container Type	Container Volume	Preservation Requirements	Technical Holding Time
Polynuclear Aromatic Hydrocarbons (PAHs) + Phthalates	Amber Glass	500-mL	Cool to 4°C ± 2°C	7 days (extraction); 40 days (analysis)
Total Metals	HDPE	500-mL	HNO_3 to pH<2; cool to 4°C ± 2°C	6 months (28 days for mercury)
Pesticides	Amber Glass	1-L	Cool to 4°C ± 2°C	7 days (extraction); 40 days (analysis)

3.2.2 Sample Containers

Stormwater samples will be collected into certified contaminant-free containers, according to analytical method specifications. The WPCL and TA will provide all appropriate sample containers, coolers, and additional supplies (e.g., bottle labels, custody seals) required for sample collection and transport. Table 3.1 summarizes typical sample containers for the proposed analyses.

3.2.3 Sample Preservation and Storage

Certain analytes may require chemical preservation before analysis, in order to minimize potential chemical changes or degradation that could occur in a sample before analysis. Table 3.1 summarizes typical preservation and storage conditions for the proposed analyses.

3.2.4 Sample Holding Times

Technical holding times are the recommended maximum lengths of time allowed between when a sample is collected and when the extraction and/or analysis are initiated to ensure analytical accuracy and representativeness. Stormwater samples will be submitted to the WPCL as soon as practicable, generally within 8 to 12 hours of collection. Samples assigned to TA will be delivered as soon as possible after collection or processing. Table 3.1 summarizes technical holding times for the proposed analyses.

3.3 Sample Custody

COC procedures will be strictly followed to provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. The sampling team will fill out a COC form at the time of sample collection and submit it to the laboratory along with the samples. Every sample accepted by the WPCL is recorded on a COC form. Upon receipt of the samples, the Sample Custodian or designated alternate will check and sign the COC, record the date and time received, record the sample temperature using an infrared thermometer, assign sample identification numbers, store the samples in a temperature-controlled refrigerator, and log the samples into the computerized data management system. When sample collection occurs after normal business hours, the sampling team will sign and date the COC form and place the samples in the sample-receiving refrigerator. The laboratory will accept the samples as soon as possible, following COC procedures.

Samples submitted to TA are provided with a subcontract order generated using the WPCL LIMS system. The subcontract order accompanies the samples during transport to TA by a TA courier or WPCL personnel. Subcontract orders are signed in accordance with standard COC procedures.

At a minimum, the COC form will contain the following information for each sample listed:

- Project name
- Sample date and time
- Sample matrix and type
- Name of person(s) collecting the samples
- Sample point code
- Sample identification code
- Field parameter measurements
- Analysis requested
- Sample temperature
- Printed name, signature, date, and time for each person relinquishing or receiving the samples

Appendix B of the SAP describes COC procedures for this project in detail, and Appendix D of the SAP includes an example of the WPCL COC form. Immediately following each field event, the Storm Event Coordinator or designee will verify that COC forms are completely filled out and correct. Any changes will be marked in ink and initialed.

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Section 4

4 Analytical Procedures

4.1 Field Observation Procedures

Field observations and measurements will be made during sample collection operations, as described in Section 7.9 of the SAP. Field observations will be recorded on daily field reports (DFRs) and field data sheets (FDSs). Appendix D of the SAP includes examples of these forms.

Immediately following each field event, the Storm Event Coordinator or designee will verify that DFR and FDS forms are completely filled out and correct. Changes or deletions to these forms will be made with a single line drawn through the incorrect entry and the recorder’s initials and the date added next to the revised entry. Information recorded should be detailed enough to allow the sampling event to be reconstructed without having to rely on memory and to allow the sampling team for subsequent sampling events to recognize or identify any changes in the immediate proximity of the UIC that may impact the quality of stormwater quality.

4.2 Laboratory Equipment Maintenance and Calibration Procedures

All laboratory equipment and instruments used by the WPCL and TA are maintained and calibrated according to the applicable analytical SOPs, the instrument manufacturer’s specifications, and any specific method requirements. The need for routine maintenance is based on the performance of the instrument and is carried out by the responsible chemist or analyst. Manufacturer service technicians perform preventative maintenance and major repairs. Complex instruments are under maintenance contracts with the manufacturers. All instruments have an associated bound maintenance log book in which all problems, repairs, and service visits are documented. The Laboratory QA Coordinator reviews these books regularly.

4.3 Analytical Methods, Reporting Limits, and Detection Limits

Table 4.1 identifies the recommended analytical methods and the corresponding laboratory MDLs and MRLs for the analytes of interest. This table also include the WPCF permit action levels. The proposed analytical methods for this project have been selected to achieve low-level MRLs, particularly for hydrophobic organic compounds. All analyses will be conducted according to the project SAP and QAPP, the laboratory quality manuals, and any specific analytical SOPs.

The sensitivity and precision of an analytical method are determined before the method is used. Statistical MDLs are established according to the EPA procedure at 40 Code of Federal Regulations (CFR) Part 136-Appendix B. This type of MDL study is performed for complex instrumental analysis and for bench methods where applicable.

The laboratory sets MRLs based on the established MDLs and estimates of recoverability and precision at concentrations near the MDL. In most instances, the MRL is three to five times the MDL. An MRL may be set more than five times the MDL to account for possible matrix variability. For metals analysis, IDLs are established as part of the instrument start-up protocols before establishing the MDLs.

Appendix A presents complete lists of analytes for each analytical method and their respective MDLs, MRLs, matrix spike recoveries, and blank spike recoveries.

Table 4.1 Stormwater Quality Analytes

Analyte	Analytical Laboratory[a]	Method	Method Detection Limit	Method Reporting Limit	Action Level
Pentachlorophenol	TA	EPA 515.4	0.01 µg/L	0.04 µg/L	10.0 µg/L
Di(2-ethylhexyl) phthalate	WPCL	EPA 8270SIM	0.5 µg/L	1.0 µg/L	60.0 µg/L
Benzo(a)pyrene	WPCL	EPA 8270SIM	0.01 µg/L	0.01 µg/L	2.0 µg/L
Total Copper	WPCL	EPA 200.8	0.00179 µg/L	0.2 µg/L	1300 µg/L
Total Lead	WPCL	EPA 200.8	0.00045 µg/L	0.1 µg/L	500 µg/L
Total Zinc	WPCL	EPA 200.8	0.00424 µg/L	0.5 µg/L	5000 µg/L

Notes:
[a] WPCL = BES Water Pollution Control Laboratory; TA = Test America.

Section 5

5 Quality Control Procedures

5.1 Field QA/QC

Standard field QA/QC procedures will be followed for this project. General field QA protocols include SOPs for sample collection and handling, COC and field data documentation, and training programs for personnel.

Field QC samples are used to assess sample collection procedures, environmental conditions during sample collection and shipment, and the adequacy of equipment decontamination. They also are used to estimate field precision and accuracy. Field QC samples for this project include equipment blanks, field decontamination blanks, duplicates, trip blanks, and sample temperature. If problems are identified using the field QC samples, the results may be verified by the laboratory, data may be flagged, and/or a thorough review of field and laboratory procedures may be performed to identify and correct problems, if any. A case-by-case determination will be made regarding data usability. If necessary, the SAP and/or QAPP will be modified in accordance with the procedures described in Section 1.4 of the SAP or Section 1.6 of this document. Table 5.1 summarizes minimum field QC samples.

Table 5.1 Minimum QC Samples for Field Sampling

Equipment Blank	Field Decontamination Blank	Field Duplicate	Sample Temperature
1 per compliance season	1 per event	1 in 10	1 per cooler

5.1.1 Equipment Blanks

Equipment blanks (i.e., rinsate blanks) are designed to check whether sampling equipment is properly decontaminated. This is particularly important for water samples because contaminants often are present in the parts per billion range, and improper decontamination can result in erroneous detections. For this project, equipment blanks are prepared under controlled conditions in the laboratory before sampling by pouring analyte-free water into the sample collection equipment being used in the project-specific sampling event (i.e., a decontaminated stainless steel beaker), then filling the sample containers for analysis of all target analytes. One equipment blank will be collected for each compliance-monitoring season. However, if the decontamination procedure changes or different sampling equipment is used, additional equipment blanks will be collected. The equipment decontamination procedure is considered acceptable if the concentrations of target analytes in the equipment blank are reported as less than the MRL.

If any target analyte is detected in the equipment blank, samples will be flagged if the sample concentration is less than 5 or 10 times (depending on the analyte) the blank concentration. The equipment decontamination procedure and materials will be evaluated and corrected as appropriate. Another equipment blank then will be collected to assess the effectiveness of the changes or revisions made. Any changes or revisions made will be documented for the project file.

5.1.2 Field Decontamination Blanks

Field decontamination blanks (i.e., transfer blanks) are used to evaluate the decontamination procedure and test for any contamination introduced by atmospheric conditions or field sampling activities. Field decontamination blanks are prepared in the field by passing analyte-free water through the sample collection equipment (i.e., a decontaminated stainless-steel beaker). One field decontamination blank will be collected during each storm event. Field decontamination blanks are considered acceptable if the concentrations of target analytes are reported as less than the MRL. If any target analyte is detected in the field decontamination blank, samples will be flagged if the sample concentration is less than 5 or 10 times (depending on the analyte) the blank concentration. The sample decontamination, collection, and handling procedures will be evaluated and corrected as appropriate. Any changes or revisions made will be documented for the project file.

5.1.3 Field Duplicates

Field duplicate samples are collected as a check on sample collection, handling, shipment, storage, and analysis. They also are used to assess the combination of field and laboratory precision and reproducibility. In addition, duplicate samples provide an indication of the variability within a sample. Field duplicates are collected by simultaneously filling two sample containers for each analyte with a sample. They will be collected at a 10 percent frequency. Field duplicate samples are given unique sample identification numbers and are submitted blind to the laboratory. An RPD calculation will be performed on the duplicate results to estimate precision. The acceptance criteria vary depending on the analysis and are included in Table 2.4. If the RPD exceeds these criteria, data may be flagged and a thorough review of field and laboratory procedures will be performed to identify problems, and the appropriate corrective actions implemented. Any changes or revisions made will be documented for the project file.

5.1.4 Sample Temperature

The temperature will be read and recorded on the COC form by the Sample Custodian or designated alternate at the beginning of the sample login process. Temperature is measured directly on a sample bottle using a Van Water & Rogers (VWR) infrared thermometer. For this project, it is likely that samples will be collected and hand-delivered to the laboratory within a relatively short period of time. Consequently, samples may not have time to sufficiently cool before they arrive at the laboratory. It is assumed that samples are acceptable for analysis, since these samples will have been placed on ice immediately after collection and stored in a chilled cooler until delivery to the laboratory.

5.2 Laboratory QC

Standard laboratory QA/QC procedures will be followed for this project. General laboratory QA protocols include good laboratory practices; SOPs for sample handling, analysis, and data management; training programs for personnel; and analytical QC.

Laboratory QC is used to assess analytical performance, including the precision and accuracy of the analytical methods used, and includes system and matrix samples. System QC samples serve to verify that the analytical system is functional, clean, and calibrated. Matrix QC samples are used to evaluate potential effects from the sample matrix. Specific procedures and frequencies for analytical quality control samples are detailed in the WPCL and TA Quality Manuals (BES, 2013; TA, 2012) and specific analytical SOPs. Table 5.2 summarizes guidelines for the minimum laboratory QC analyses.

Table 5.2 Guidelines for Minimum QC Samples for Laboratory Analysis

System QC			Matrix QC		
Method Blank	**LCS[b] or LFB[c]**	**CCV[b, c] and CCB[c]**	**Duplicate[c]**	**MS[c] and MSD[d]**	**Surrogate[b]**
1 per batch[a]	1 per batch	Method-specific	1 per batch	1 per batch	Each sample

Notes:

[a] Laboratory batches are 10 or 20 samples, depending on the method

[b] Organics

[c] Inorganics

[d] For organics, duplicate precision is calculated on the MS and MSD pair

LCS – Laboratory Control Sample

LFB – Laboratory Fortified Blank

CCB – Continuing Calibration Blank

CCV – Continuing Calibration Verification

MS/MSD – Matrix Spike/ Matrix Spike Duplicate

5.2.1 System QC

5.2.1.1 Method Blank

Method blanks, consisting of laboratory pure water, are taken through all procedural steps, reagents, and glassware used during sample preparation and analysis. A minimum of one laboratory blank per analytical batch will be prepared and analyzed to evaluate potential laboratory contamination. If a target analyte is detected at or above the MRL and any sample in the batch contains less than 10 times the amount detected in the method blank, the sample will be reprepared and reanalyzed. If no additional sample is available for reanalysis, the result will be reported with a data qualifier "B." Table 5.3 presents typical categories of laboratory assigned data qualifiers. Blank subtraction by the laboratory is not performed. If a target analyte is detected at or above the MRL, but the samples all contain at least 10 times more of the analyte than the method blank, the contamination is considered negligible for that batch and the sample results will be reported. If unexplained contamination is found in a consecutive measurement, laboratory corrective action will be taken to identify the source.

Table 5.3 General Data Qualifiers Used by Labs

Qualifiers	Meaning for Qualification
D	Value is the result of an analysis at a secondary dilution factor.
B	The analyte is present in the associated method blank and in the sample.
J	The numerical concentration is an estimated quantity because it is below the MRL.
M	Matrix spike recovery outside control limits.
SU	Surrogate recovery outside control limits

5.2.1.2 Laboratory Control Samples (LCS)/ Laboratory Fortified Blank (LFB)

LCS and LFB are samples containing a known contaminant concentration that falls within the analytical calibration range, but is prepared from a source different than that used to establish the calibration curve. LCS and LFB samples are often referred to as "blank spikes" and consist of a clean matrix (e.g., deionized water) that has been spiked with known levels of the analytes of interest and taken through all procedural steps, reagents, and glassware used during sample preparation and analysis. Successful recovery verifies that the analytical system, including the analyst's performance, is in control. Recovery outside the acceptance range indicates a system nonconformance; the cause must be determined and the samples reextracted or redigested. A minimum of one LCS or LFB per analytical batch will be prepared and analyzed to evaluate analytical accuracy. The frequency of LCS and LFB samples required is defined in each analytical SOP (WPCL Quality Manual; BES, 2013). For metals and other inorganics, all analytes are used in the LCS. For organic analyses, representative target analytes are use used in the LCS.

5.2.1.3 Continuing Calibration Verification (CCV)/ Continuing Calibration Blank (CCB)

Complex instrumental analyses often require method-specific QC standards and samples. CCVs are standards used to verify that instrument response remains relatively constant over the course of an analytical batch. For inorganic analyses, CCVs are run after every 10 samples and at the end of the run. If a result falls outside the acceptance limits, the instrument must be recalibrated, and the samples run since the last successful CCV must be reanalyzed. In metals analysis, each CCV is followed by a CCB to monitor for system contamination or carry over. For organic analyses, calibration is verified as the method requires, including, at a minimum, verifications at the beginning and end of each analytical batch.

5.2.2 Matrix QC

5.2.2.1 Laboratory Duplicate

Laboratory duplicates are separate analytical samples prepared from the same parent sample and are treated the same throughout all steps of preparation and the analytical method. They are used to evaluate the precision of the analytical method, including sample preparation and the homogeneity of the sample matrix, by evaluating the RPD between the two results. If an RPD is above acceptance limits, the data are examined to determine whether that is due to analytical or matrix problems. Samples are either reanalyzed or the data are flagged. A minimum of one duplicate sample per analytical batch will be analyzed if adequate sample volume is available, or LCS/LCS duplicate(s) will provide data for precision measurement. A batch consists of 10 or 20 samples, depending on the analysis, and is defined in the analytical SOP (WPCL Quality Manual; BES, 2013).

5.2.2.2 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

An MS is an actual sample spiked with known amounts of target analytes before any sample preparation steps. A minimum of one MS per analytical batch will be analyzed to evaluate sample preparation efficiency, provide an indication of bias due to interference from components of the sample matrix, and evaluate the accuracy of the analytical method. For metals and other inorganics, all analytes are used in the matrix spike. For organic analyses, representative target analytes are used in the matrix spike. Recovery within acceptance limits indicates that the matrix is not significantly affecting the analysis. If MS recovery is outside acceptance limits, the data are examined to determine whether that is due to analytical or matrix problems. Samples are reanalyzed whenever possible. If reanalysis is not possible or the reanalysis confirms matrix interference, the data are flagged. MSD samples may also be prepared at the same frequency as MS samples (i.e., one MS/MSD pair per analytical batch) in order to evaluate analytical accuracy and precision.

5.2.2.3 Surrogate Compounds (Organics only)

For organic analyses, all samples are routinely spiked with a series of surrogate compounds (i.e., analogues of the target analytes) before any sample preparation steps. Recoveries of these compounds are used to assess the behavior of actual analytes in individual samples during the preparation and analysis steps. Recoveries outside the acceptance limits require that the sample results be flagged as estimates due to matrix interference.

Table 5.4 presents analyte-specific QC limits. The control limits in this table are generally taken from the EPA reference method. The WPCL provided some laboratory-derived control limits for the PAH and semivolatile organic compound analyses.

Table 5.4 Quality Control Limits[1]

Analyte	Duplicate	Matrix Spike		Blank Spike		Surrogate Spike
	RPD[2] (%)	%R	RPD	%R	RPD (%)	%R
Polynuclear Aromatic Hydrocarbons (PAHs) by EPA 8270-SIM						
Benzo(a)pyrene	N/a[3]	42-135	50	42-135	35	N/a
Bis(2-ethylhexyl)phthalate	50	29-185	50	29-185	50	N/a
Surr: 2-Methylnaphthalene-d10	N/a	N/a	N/a	N/a	N/a	56.2-122
Surr: Fluoranthene-d10	N/a	N/a	N/a	N/a	N/a	66.5-142
Total Metals by EPA 200.8	20	70-130	N/a	85-115	N/a	N/a
Herbicides by EPA 515.4[4]						
Pentachlorophenol	30	70-130	20	70-130	20	N/a
Surr: 2,4-Dichlorophenylacetic acid	N/a	N/a	N/a	N/a	N/a	70-130

Notes:

[1] This table includes quality control limits targets used for first year of the 2015 permit. Quality control limits are expected to change during the 10-year permit life. The range of the control limits used for each year's data will be included in the raw laboratory data presented in the annual Stormwater Discharge Monitoring Report. Limits will be modified by WPCL or TA based on control charts, as appropriate. It is anticipated that control limits will be updated annually.
[2] RPD = relative percent difference
[3] N/a = not applicable
[4] TA limits are based on referenced EPA Method.

Section 6

6 Data Management, Validation, and Reporting

6.1 Data Management and Storage

Technical data that will be generated by the UIC monitoring program include, but are not limited to:

- Field data
- Analytical laboratory data
- Storm event data (e.g., precipitation data)
- UIC operations and maintenance data
- Sedimentation manhole depth to sediment measurements
- Calculated or manipulated data

Discrepancies in existing and historical data discovered during implementation of the UIC monitoring program will be documented and revised or updated as appropriate. Records will be retained for a minimum of ten years, and no records will be destroyed without prior permission of the City's UIC Program Manager and notification of the DEQ UIC Permit Manager, since this project is a long-term monitoring program that has regulatory commitments and implications.

6.1.1 Field Data

UIC sampling locations are field verified to confirm that they are representative of the intended sampling scenario and are suitable for sampling (see Section 4.4 of the SAP). Documentation and record-keeping procedures are most important during UIC characterization and sampling because these steps produce the basic data used in subsequent decisions. Field documentation and data management are an integral part of the QA/QC in order to:

- Verify adherence to SAP protocols;
- Track nonconforming events, corrective actions, and inherent data uncertainties;
- Demonstrate that field procedures do not impact samples through collection of appropriate QC samples;
- Ensure that field records cannot be tampered with or accidentally lost or damaged;
- Maintain project schedules and analytical holding times; and
- Document safe work practices (i.e., adherence to the HASP).

Field data will be recorded on project-specific paperwork, as described in Section 7.12 of the SAP. Data should be recorded directly and legibly in indelible ink onto the appropriate forms, with all entries initialed and dated. When entries must be changed, the original entry will be crossed out with a single line so that the original entry is still legible. The change will be initialed by the person making the revised entry. At a minimum, the field records maintained will include (but are not be limited to):

- DFRs, FDSs, and COC forms
- HASP

- Field meter calibration and maintenance records (as applicable)
- Sample collection SOPs
- Weather forecasts from ERF

Field records will be maintained in both hard copy and electronic (.pdf file) formats.

6.1.2 Laboratory Data

Sample information and analytical results from the WPCL are transferred automatically into BES's LIMS from most of the laboratory instruments. Analyses that do not support automatic data transfer (i.e, bacteria) are manually entered into the LIMS.

The LIMS functions as the primary BES database for data storage, sample tracking, and reporting. The LIMS in use at the WPCL is Element by Promium and is backed up daily. In addition, the WPCL maintains project files containing any records necessary to reconstruct the analytical events associated with this project. All procedures for storage of hardcopy and electronic data will comply with the WPCL Quality Manual (BES, 2013). At a minimum, records maintained include (but are not limited to):

- COC forms
- Instrument calibration and tuning records (as applicable)
- Analytical standards preparation logs
- Method SOPs
- Analytical QC results (including method blanks, internal standards, surrogates, replicates, and spike and spike duplicate results, as applicable)
- Raw data, specifically instrument printouts
- Bench work sheets and/or quantification reports
- Corrective action reports (if any)
- Details of the QA/QC program in place at the time that the project analyses were conducted

Once data are validated and all analyses are complete, results are spooled from Element each night and transferred automatically to the Water Quality Database (WQDB). The WQDB is an Access database and is the primary database for data end-users. Contract laboratory data are also received as electronic data deliverables (EDDs) and uploaded to the WQDB. If data do not transfer properly due to missing or incorrect information in project or sample location fields, data for those samples are not transferred, and an error report is generated. Errors are addressed the following business day, and data are resubmitted overnight for data transfer.

Precautions will be taken in the analysis and storage of data to prevent the introduction of errors or loss or misinterpretation of data. Original laboratory data sheets (i.e., hard copy) will be maintained in a secure location where they will not be lost or tampered with. Copies of original data should be used for compiling the data to prevent loss or damage.

Laboratory data will be manually tabulated in an electronic format by UIC location and analytical constituent. Tables will be carefully checked against copies of the original final data sheets before data analyses. Data should be tabulated as it is shown on the original data sheets.

Sampling and analysis documents and records associated with this project will be stored and maintained in hard copy and/or electronic versions at the WPCL. Hardcopy information will be kept on file. Electronic information will be maintained on current industry-standard hardware and software. The BES computer network is backed up on tape nightly by information technology personnel. The Monitoring Coordinator will be responsible for ensuring that the project field and laboratory activities are properly documented and that those records are stored and maintained.

6.2 Data Validation

6.2.1 Field Data

The Storm Event Coordinator or designated alternate will conduct a thorough review of all field data to ensure that data collection was conducted according to procedures specified in the SAP and QAPP. The Storm Event Coordinator or designated alternate will also review the DFRs, FDSs, and COC forms for completeness. Incomplete field notes or forms or abnormal or irregular values will be identified and resolved as soon as possible. If an error is made on a document, the sampler will be asked to make corrections by drawing a line through the error and entering the correct information. Any subsequent error discovered on a document will be corrected either by the sampler, the project manager, or editing hydrogeologist, chemist, or engineer. All corrections will be initialed and dated.

A narrative in the form of a technical memorandum to the City's UIC Program Manager will document all procedural deviations, data qualifications, or other significant problems identified based on this review. The technical memorandum will be included in the annual Stormwater Discharge Monitoring Report submitted to DEQ.

6.2.2 Laboratory Data

6.2.2.1 Laboratory Validation of Data

Data generated by both the WPCL and TA will be reviewed and validated following guidelines described in their respective quality manuals (BES, 2013; TA, 2012). The Laboratory QA Coordinator will review analytical reports submitted by TA to verify acceptable QC results. The Laboratory QA Coordinator or any qualified member of the laboratory staff may perform data validation. Validation occurs throughout the analytical process. Initial validation is performed during sample receipt and log-in and includes examining the integrity of sample containers and labels, including suitability of containers for requested analyses; examining the COC form for the presence of all required information and signatures; and verifying sample container identification numbers against those listed on the COC form.

Data validation also occurs during sample analysis and is carried out at the instrument by the analyst. This phase of validation involves performing and maintaining instrument calibration and assessing precision and accuracy of the data via the analysis of the appropriate QC checks. The analyst ensures that the QC statistics are within control limits and takes appropriate corrective actions during analysis if control limits are exceeded.

Final data validation involves checking the data reduction and transcription/data entry operations used to calculate final results. An analyst or chemist other than the one who conducted the analysis, but who is fully knowledgeable about the analysis, performs this validation. All results are verified against the raw data, including checking calculations, use of correct units and/or conversion factors, and use of correct sample preparation conditions. The technical reviewer also checks to make sure that all relevant previous validation checks were correctly applied and that QC statistics are within control limits. Each analyst enters their own data, whether by direct data entry or through instrument uploads. The LIMS data entry is checked for errors against the raw data, and results are validated/QA reviewed on an analysis-by-analysis basis. When each analysis has been thoroughly reviewed, the status is changed by the reviewer to indicate that the analysis is complete and has been checked for errors. The Laboratory QA Coordinator or designee perform the final review step.

Results that do not meet quality criteria will be flagged (e.g., see Section 6.3 or Appendix B). Data are most often flagged for reasons relating to sample integrity, sample matrix, analytical error, or sample uncertainty. Some examples include:

- Holding time exceedance
- Incorrect sample bottle or preservation
- Results reported to the MDL
- Matrix problems causing QC failures
- Loss of sample due to broken sample bottle or laboratory glassware

The WPCL and TA use customized flags to qualify results and provide explanations for the flags in the “comments” section of the laboratory analysis reports. Definitions for these data qualifiers are included in the data reports.

Data will not be released for use until the data review and validation process is complete. The permit requires the City to notify DEQ when an action level concentration is exceeded at a UIC. The City will notify DEQ of the exceedance within 7 days after receipt and review of the final validated data package, but not later than 30 days after receipt of the final laboratory data package.

6.2.2.2 Independent Data Validation of Contractor Laboratory Data

City staff will review data provided by the contractor laboratory (i.e., TA) during data entry, analysis, compilation, and validation. The City will independently check the contractor laboratory data reports to ensure that data meet the project DQOs. The extent of the review will be determined on a case-by-case basis, depending on the purpose and ultimate use of the data package. Independent validation may include, but is not limited to, review of the following:

- Timeliness: Verify that analyses were performed within the recommended analytical holding times. Samples not extracted or tested within the specified period will be noted or flagged.
- Detection Limits: Verify that the analytic detection limits for each analysis meet the project-specific limits. For stormwater discharge, sample detection limits should meet MRLs that are less than the action levels specified in the permit, to the extent practicable. The detection limits achieved by the laboratory indicate the quality of the sample matrix and the precision of the analyses. In some cases, results may need to be reported to the MDL to meet the action level concentrations.
- Chain of Custody: Verify that COC procedures were followed by the laboratory.
- Reagent Blanks/Trip Blanks: Verify that blanks do not contain any analytes. Analytes detected in the reagent blank indicate laboratory-introduced contamination that can be identified and flagged or separated from the sample results.
- Matrix Spikes and Matrix Spike Duplicates: Verify that the percent recoveries between the spike quantity recovered and the known spike value are acceptable. The RPD is calculated using the duplicate analyses results. The lower the RPD, the more closely the analyses results match.
- Surrogate Spike Analyses: Verify that the percent recoveries are within the acceptable range for the analytical laboratories database.
- Blind Duplicates: Verify that the RPD between the original sample and the blind duplicate is acceptable.
- Equipment Blanks/Field Decontamination Blanks: Verify that blanks do not contain any analytes. Analytes detected in the blank indicate introduced contamination from field or decontamination processes. Blank detections are evaluated on a case-by-case basis.

If data QA/QC issues are identified during the City's review of the data, the contract laboratory will be contacted and the source of the error traced and corrected if possible. Corrected laboratory data sheets will then be provided to the City. If the error cannot be corrected, the City or laboratory may assign appropriate data qualifier codes to those data to indicate that QA parameters do not meet the acceptance criteria presented in Section 2.4. Data quality issues and data usability will be evaluated in general accordance with EPA guidance (EPA, 2002), using the data validation criteria listed above. Results of the data validation will be documented in the Event Summary Reports, annual Stormwater Discharge Monitoring Reports, or technical memoranda, as appropriate, and maintained in the City files in accordance with Section 6.1. Data usability will be determined on a case-by-case basis, based on consideration of the nature of the issue, analytical method, analytical result, results of reanalyzed samples, and nature and evaluation of the QA/QC results. DEQ will be consulted on data usability issues, as needed.

A full EPA contract laboratory procedure (CLP) validation will not be performed; calibration curves, response factors, and independent confirmation of mass spectral identifications will not be verified or calculated. The contract laboratory will not submit full CLP deliverable packages.

6.3 Data Usability

The data are deemed acceptable and usable if no field or laboratory issues are identified that compromise the anticipated use of the data and if DQOs (described in Table 2.4) are met. If data are considered potentially unacceptable (e.g., flagged data or sample analysis/ sample collection problems), the appropriate UIC or WPCL staff (e.g., Laboratory QA Coordinator, Storm Event Coordinator, Monitoring Coordinator, Hydrogeologist, Statistician) will review the specific issue(s) and recommend whether or not the data are usable on a case-by-case basis, as dictated by the data. UIC staff recommendations will be discussed with appropriate members of the City's UIC team (including TA and WPCL staff) to determine whether data are usable. DEQ may be consulted on specific data usability issues. If data are subsequently determined to be acceptable, they will be used for data evaluation. If, however, data are determined not to be acceptable, they will be flagged and reported, but they will not be used for data evaluation. To the extent practicable, data or samples determined to be unusable will be recollected and analyzed to maintain the intent and integrity of the data set. If additional data cannot be collected in a timely manner, the UIC Program Manager or designee will determine if data evaluation can proceed with the existing, acceptable data set, if alternative evaluation methods are needed, or if additional data are needed. If additional data are needed, more samples will be collected if a storm meeting the sampling criteria occurs before June 30, the end of the monitoring period. If additional samples cannot be collected, DEQ will be notified.

All data usability issues and their resolution will be documented in the annual Stormwater Discharge Monitoring Report.

6.4 Reporting

The following sections summarize laboratory data reporting, deliverables, and data management procedures for both the WPCL and TA. Final reports will be included as attachments or appendices to the annual Stormwater Discharge Monitoring Report, or provided to DEQ upon request.

6.4.1 WPCL

The WPCL Laboratory Analysis Report will be created by the Laboratory QA Coordinator after all data have been reviewed, flagged as needed, entered into LIMS, and checked for data entry accuracy following data validation procedures outlined in the WPCL Quality Manual (BES, 2013). Standard laboratory analysis reports created in

LIMS will be available in hard copy and electronic (.pdf file) formats. In addition, data will available in spreadsheet format (e.g., Microsoft Excel) for use in data interpretation and analyses. The laboratory analysis reports will include the following information:

- Sample date and time
- Sample ID
- Project name
- Sample point code
- Laboratory and field comments
- Sample type and matrix
- Test analytes
- Results
- Units
- Data flags
- MRLs
- Analytical methods

Electronic data can be customized to include additional sample information entered into LIMS, but these data will not be included in the standard laboratory analysis reports. The official hardcopy laboratory analysis report will be initialed on every page by the Laboratory QA Coordinator. The electronic versions will state that the QC signature is on file.

6.4.2 Contract Laboratories

Contract laboratories (i.e., TA) will prepare and submit analytical reports in accordance with the terms of their contract and in accordance with this QAPP. The analytical report will be created by the Project Manager or designee, after all data have been reviewed and flagged as needed. The analytical reports will include, at a minimum, the project name, sample date and time, sample identification number, sample point code, test analyte, analytical method, MRL, result, data flags, and any appropriate comments.

Analytical reports and EDDS will be sent to the WPCL QA Coordinator and checked following procedures outlined in the WPCL Quality Manual (BES, 2013). A copy of the contract laboratory report will be attached to the final WPCL report that is provided to the UIC Program Manager for reporting. EDDs will be uploaded electronically to the WQDB.

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Section 7

7 Data Assessment and Evaluation

7.1 Data Assessment

Before data assessment, the data will be validated (described in Section 6.2) to verify that they are of acceptable quality and meet project DQOs. Data assessment and validation will be performed by various members of the City's UIC program team (e.g., Monitoring Coordinator, Storm Event Coordinator, Laboratory QA Coordinator, Hydrogeologist, Statistician) as appropriate for the data use. Assessment will include (but is not limited to) the following:

- Review of any information collected regarding UICs for consistency, reasonableness, and accuracy to the extent practicable, before use;
- Identification of potential errors or inconsistencies in data obtained from available resources that may require further evaluation, before use of the data;
- Review of applicable field and laboratory documentation to ensure that the applicable SOPs were followed;
- Review of field and laboratory QC reports to understand quality and usability of data including:
  - Results of QC samples that were collected and analyzed;
  - Overall DQO performance for analytical laboratory data by reviewing precision, accuracy, and completeness, and evaluating representativeness, comparability, and sensitivity; and
  - Data qualifier flags assigned to analytical laboratory data to assess sample collection, handling, or laboratory QC issues.
- Calculation of basic quantitative characteristics of the data using common statistical parameters (e.g., range, mean, medium, frequency of detection);
- Graphing the data using appropriate methods to identify patterns or trends in the data. These patterns or trends may be used to describe the data, identify potential correlations or problems with the data set, and to convey information to others.

Data assessment activities will be performed in general accordance with EPA Guidance (EPA, 2006a).

7.2 Data Evaluation

Data evaluation for this project addresses permit compliance and the City's watershed health goals. Section 2 of the SAP describes the overall objectives of the monitoring program. Data analysis to achieve those objectives will include:

- Comparison of individual storm event results to permit action levels;
- Evaluation of analyte concentrations relative to factors that may have influenced stormwater quality; and
- Evaluation of analyte concentrations related to actions taken to improve stormwater quality to evaluate the effectiveness of the actions as appropriate.

This analysis may be used to develop recommendations for changes to UIC management and necessary adjustments to the SAP or QAPP.

7.2.1 Data Analysis Issues

Environmental data sets often contain non-detects, estimated values, missing data, and outliers. This section describes how these issues may be addressed during data evaluation. Statistical methods, which may be used for data evaluation, are briefly discussed in the following sections. While these methods may be appropriate, the City reserves the right to modify the method or select other methods more appropriate for the actual data. The data analyses method used and the results of data analysis will be described in the annual Stormwater Discharge Monitoring Report.

7.2.1.1 Non-Detects

An analytical result that is designated as a "non-detect" indicates that the specific analyte was analyzed, but not detected at a concentration equal to or greater than the MRL for that analyte. There are several methods for handling non-detects. A commonly used method for environmental data is to substitute one-half the analyte's MRL. However, this method produces biased results by assuming that the values for the non-detects are known, when they really are not. The value substituted is not a function of anything known about the stormwater sampled or the laboratory methods used to evaluate analyte concentrations. Furthermore, substitution with one-half the MRL can generate different results for statistical tests by overestimating or underestimating concentrations.

Non-detect data also occur in the medical sciences, social sciences, economics, and industry. The suggested methods below for evaluating non-detects have been widely used in these fields for quite some time and are equally appropriate for handling non-detect environmental data.

Unlike substitution methods, the following methods take into account the nature of the data: whether it follows a normal distribution or lognormal distribution, how many data points are available, and how many non-detected values exist. As a result, these methods likely provide a more accurate representation of the water quality being discharged to UICs than the substitution method of one-half the MRL.

The methods listed below may be applied to obtain descriptive statistics, such as means, as well as perform statistical tests to compare two or more groups (such as different traffic categories). These methods can also handle data with multiple detection limits. Depending on the number of data points and the percentage of those data points that are non-detects, the most appropriate method will be selected and used to develop estimates for analytes that have been reported by the laboratory as non-detect.The potential methods that may be selected for analyses of "non-detect" data are summarized below and in Table 7.1:

- The Kaplan-Meier method is a nonparametric method used widely in biomedical statistics. It is appropriate if less than 50 percent of the data are non-detect.

- Regression on order statistics (ROS) (Helsel, 2005) is a method that assumes the non-detected values follow a specific distribution, such as the lognormal distribution. Actual numerical values are estimated for the non-detected data points, using the lognormal distribution. These estimated values are then combined with the detected data points to compute descriptive statistics and perform statistical tests. This method is appropriate if 50-80 percent of the data are non-detect.
- Maximum likelihood estimation (MLE) is a parametric method and is appropriate if there are more than 50 data points in the analysis and 50-80 percent of those data points are non-detect. Cohen's method, which is recommended by the EPA's Practical Method for Data Analysis, is an example of MLE. However, Cohen's method can only be applied to data with only one detection limit. Fortunately, other MLE methods can handle multiple detection limits. If more than 80 percent of the data are non-detect, reporting the percentage of data points above the action level or reporting the 90th or 95th percentiles is most appropriate.

Table 7.1 Statistical Methods for Datasets Containing Non-detects

Percentage of Non-detects	**Amount of Available Data**	
	< 50 observations	**≥ 50 observations**
< 50%	Kaplan-Meier	Kaplan-Meier
50% - 80%	ROS	MLE
>80%	Report % above the action level	Report high sample percentiles (90th or 95th)

If estimated data are available and determined to be usable, the estimated value would be used for purposes of compliance determination rather than an estimated value derived from one of the statistical methods described above. In these cases, the estimated value is expected to be somewhere between the MDL and the MRL for an individual analyte.

7.2.1.2 Missing Data

If there are missing data due to field or laboratory error (e.g., bottle breakage, equipment failure), the locations with missing data will be resampled, if possible. If it is beyond the reasonable control of the City to provide all required data for each sampling location in one year, data analysis will proceed with the amount of data available. Missing data will be included in evaluation of the 95 percent completeness DQO.

7.2.1.3 Estimated Data

Final and validated data that are of known and acceptable quality are generally considered appropriate for data evaluation and will be used without modification. Examples of situations where estimated data are considered appropriate for use include:

- Data from samples with known matrix effects; and

- Data with associated known analytical QC issues, such as matrix spike recoveries, surrogate recoveries, exceedance of holding times, etc. These data will be appropriately flagged to track the issue.

Data usability will be determined on a case-by-case basis, based on consideration of the nature of the issue, analytical method, analytical result, results of reanalyzed samples, and nature and evaluation of the QA/QC results. DEQ will be consulted on data usability issues, as needed.

7.2.1.4 Outliers

Outliers will be retained to the extent practical. However, data resulting from known equipment malfunction or sample collection errors may be rejected. Statistical methods that are robust to outliers will be preferred in order to incorporate outliers into the data analysis rather than discarding them, when possible. Any outliers and discussion about how outliers are included in the data analyses will be discussed in the annual Stormwater Discharge Monitoring Report.

Section 8

8 Inspections and Audits

Inspections or audits are performed to evaluate the adequacy of and compliance with established procedures, instructions, drawings, and other applicable documents; determine the effectiveness of implementation; and ensure that project expectations are being met. The objectives of an audit are to:

- Assess activities that have an significant impact on the project or the project's performance;
- Ensure that the data being collected fulfill the DQOs established for this project; and
- Identify any areas requiring field or laboratory corrective action.

Inspection activities should assess technical competence and proficiency, compliance with approved procedures, verification of data and statistical computations, and effectiveness of internal QC procedures. The City will be responsible for internal audits and inspections. DEQ will be responsible for external audits and inspections, if deemed necessary.

8.1 Field Inspections and Audits

The project Storm Event Coordinator will be responsible for ensuring that all fieldwork performed meets the objectives established for this project. The Storm Event Coordinator and field team leaders meet before conducting any work. If actual field conditions or sample locations require modifications to the predetermined sampling procedures, the Storm Event Coordinator must approve the modifications and document them as necessary. Field staff are required to read, understand, and follow all procedures documented in the SAP. At a minimum, field sampling personnel will be responsible for:

- Inspecting field sampling equipment before use to ensure it is in proper working order and calibrated;
- Ensuring that all field sampling collection forms (e.g., COC forms, FDSs) are properly and completely filled out; and
- Ensuring that samples are collected, stored, and delivered to the laboratory in accordance with the project SAP.

An audit of field sampling activities will be conducted and documented annually by either the Storm Event Coordinator or City personnel not directly involved in the activity being addressed. Additional field audits will be performed as needed or if an apparent sampling inconsistency or deficiency is discovered by reviewing project documentation, analytical data, or QA/QC results. The type of field audit required will be based on the inconsistency or deficiency in question. For example, detections in field blank samples will warrant a complete review of written decontamination procedures and visual observation of all steps in the decontamination and blank generation process. If field duplicate sample data are outside the RPD acceptance range, observation of sample collection and duplicate sample collection may be performed. Observations and corrective actions will be documented in writing for all audits performed. The results of any field audits will be included in the annual Stormwater Discharge Monitoring Report.

8.2 Laboratory Inspections and Audits

The WPCL and TA conduct internal audits of laboratory activities as part of their respective QA programs. A multi-day audit of the WPCL is conducted every other year by representatives of the NELAC Institute, in accordance with WPCL's current ORELAP accreditation.

The City reserves the right to conduct an inspection or audit of TA, if determined to be necessary. If this occurs, qualified WPCL personnel will be responsible for ensuring that all work performed meets the objectives established for this project and all corresponding internal SOPs and quality manuals. An audit consists of a site visit to interview TA personnel; examine sampling handling, preparation, and analysis procedures; observe personnel engaged in laboratory work; and review all QA/QC, data reporting, and safety procedures and laboratory guidance documents. If concerns are raised, WPCL personnel will meet with TA personnel to discuss corrective actions. Follow-up inspections may be performed to ensure corrective actions have been fully implemented.

The City may at its discretion submit a duplicate sample(s) (i.e., split sample) to another analytical laboratory to verify the performance of the WPCL or TA (or other contract laboratory).

The City will document laboratory inspections and audits and any corrective actions implemented as a result. The results of any audits or inspections will be included in the annual Stormwater Discharge Monitoring Report.

Section 9

9 Deviations, Nonconformance, and Occurrences

9.1 Deviations

A deviation is a planned or unplanned departure from a procedure, deemed reportable and tracked by the City's UIC Program Manager. DEQ must preapprove planned deviations (i.e., those made with foreknowledge), as discussed in Section 1.6. Unplanned deviations to the SAP or QAPP encountered during field activities will be documented on field sheets or COC forms. The laboratory will document deviations from analytical methods. Deviations will be reported to the City's UIC Program Manager. The UIC Program Manager or designee will determine if the deviation will or may significantly impact data quality and if a corrective action is needed (e.g., data qualification flags, uncertainty discussion). The UIC Program Manager may consult with the DEQ permit manager to discuss significant deviations and agree on an appropriate corrective action. Significant deviations and related corrective actions, if needed, will be described in the annual Stormwater Discharge Monitoring Report or UICMP Annual Report.

9.2 Nonconformance

Nonconformance is a deficiency in characteristics, documentation, or procedures that renders the quality of an item or activity unacceptable or indeterminate. Nonconformance may be those items or activities not conforming to specified requirements that are identified before their use, acceptance, or intended purpose. A nonconforming item or activity has the potential to affect other programs. Depending on the nature of the nonconformance, field and laboratory corrective action protocols may be initiated. The UIC Program Manager will be notified of any nonconformance that affects data quality. The UIC Program Manager or designee will determine the cause and significance of the nonconformance and whether a corrective action is needed. Corrective actions may include redoing the item or activity determined to be unacceptable or indeterminate (e.g., reinspect, resample, reanalyze). The UIC Program Manager may consult with the DEQ permit manager to discuss nonconformance and agree on an appropriate corrective action. Nonconformance incidents and related corrective actions, if needed, will be described in the annual Stormwater Discharge Monitoring Report or UICMP Annual Report.

9.3 Occurrences

An occurrence is any condition or event that could affect the health and safety of the public, have an adverse effect on the environment, endanger the health and safety of workers, affect the operations and intended purpose of a facility, or result in loss or damage of property. Occurrences may be a specific type of deviation or nonconformance. Routine or preventive maintenance, personnel issues, or similar issues covered by existing administrative programs are typically not included. Occurrences will be documented and reported to the City's UIC Program Manager. Any occurrence that could affect health and safety will also be immediately reported to the City's Risk Manager. The UIC Program Manager or designee will determine the significance of the occurrence and if a corrective action is needed (e.g., modifications to the SAP, QAPP, or HASP; UIC system cleaning; alternative water supply; groundwater investigation; public notification). If an occurrence related to the UIC system indicates that an underground source of drinking water may be endangered (i.e., imminent threat or risk), the UIC Program Manager will immediately report the occurrence to DEQ. Otherwise, the UIC Program Manager may consult with the DEQ permit manager to discuss the occurrence and agree on an appropriate corrective action. Occurrences and related corrective actions, if needed, will be described in the annual Stormwater Discharge Monitoring Report.

Section 10

10 Monitoring Program Corrections

An integral part of quality improvement includes corrective action planning based on cause analysis to ensure that identified problems are analyzed and corrected in a manner likely to prevent recurrence. For purposes of this QAPP, corrective action is defined as a measure taken to rectify and/or to prevent recurrence of a field or analytical laboratory quality failure. Not all problems are of equal severity or significance; therefore, the effort to solve problems should be "graded" in proportion to their significance. Project personnel should take a proactive approach to identify activities requiring improvement, modification, and/or additional training. Actions should be initiated to control the event or condition that resulted in an occurrence, deviation, or nonconformance. Events, external inspections or audits, and/or data evaluation may require changes to the SAP, QAPP, or HASP to ensure high-quality data and the safety of field and laboratory personnel.

Deviations, nonconformance, and occurrences are identified during field inspections or by sampling personnel. They should be evaluated in terms of potential risks to worker health and/or the environment and to data integrity. They also should be evaluated to determine the likelihood of occurrence of a condition or event. The UIC Program Manager or designee will determine the significance of the deviations, nonconformance, and/or occurrences and if a corrective action is needed (e.g., modifications to SAP, QAPP, HASP; resampling; UIC system cleaning; groundwater investigation).

These actions may include, but are not limited to:

- Implement a quick fix (i.e., correct the error or problem during or immediately following the assessment);
- Resample the location(s) where either field or laboratory procedures may have invalidated the data;
- Discuss the negative observations and the requirements or procedures concerning the deviation with the person(s) responsible and discuss how the work can/will be corrected following appropriate procedures;
- Conduct a follow-up inspection to ensure that the problem or deficiency has been corrected; and
- Conduct retraining and reevaluation of technical proficiency.

Corrective actions that occur as a result of independent, external assessments will be documented and reported to the City's UIC Program Manager or designee for resolution. Responses to deficiencies identified in an independent audit should identify:

- The cause of the problem
- Actions taken to resolve the problem
- Actions that will be taken to prevent recurrence
- Actions to be taken for improvement

Corrective actions will be discussed in the annual Stormwater Discharge Monitoring Report.

10.1 Field Corrective Actions

Field sampling personnel are responsible for documenting and reporting any field activity that results in a deviation, nonconformance, or occurrence. These will be documented in the DFRs and/or FDSs and reported to the City's UIC Program Manager. If problems associated with field measurements or field sampling equipment are observed, sampling personnel will take appropriate actions to correct the problem. Actions may include repeating measurements taken, retraining personnel, or repairing or correcting field measurement instruments and sampling equipment. If necessary, work should be stopped until the problem can be corrected. Problems and associated corrective actions will be documented on a corrective action report (CAR). Appendix C includes an example of the FO CAR.

If the problem requires a significant change to the activities described in the project SAP, both the City's UIC Program Manager and the DEQ UIC Permit Manager will be notified, and the appropriate plan will be modified following the procedures specified in Section 1.6. The UIC Program Manager may consult with the DEQ permit manager to discuss the issues and concerns and agree on an appropriate corrective action, if necessary. Corrective actions will be described in the annual Stormwater Discharge Monitoring Report or UICMP Annual Report, as appropriate.

10.2 Laboratory Corrective Actions

The WPCL and TA are responsible for maintaining internal quality control and for taking corrective actions when quality control criteria are not met, in accordance with internal SOPs and quality manuals. The QA Coordinator will be responsible for issuing, tracking, and documenting any corrective actions and should address all problems or deficiencies found. Problems and associated corrective actions will be documented on a CAR. Each completed CAR becomes part of the laboratory QA record as evidence that nonconformances have been investigated and corrected. A CAR also serves as information to help solve a problem if it happens again.

Project-related deviations and corresponding corrective actions should be reported immediately to the City's UIC Program Manager. The UIC Program Manager may consult with the DEQ permit manager to discuss the issues and concerns and agree on an appropriate corrective action, if necessary. Corrective actions will be described in the annual Stormwater Discharge Monitoring Report or UICMP Annual Report, as appropriate.

Section 11

11 References

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Appendices

Appendix A

Analytical Laboratory
Method Detection Limits

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City of Portland Water Pollution Control Lab

1/13/2015

Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Cu ICPMS T in Water (EPA 200.8)								
Preservation: HNO3, cool <6								
Container: P clean 500ml HNO3		**Amount Required:** 500 mL			**Hold Time:** 180 days			
Copper	0.200	0.200 ug/L		20	70 - 130	20	85 - 115	20

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City of Portland Water Pollution Control Lab

Analytical Method Information

PAH/phthal LL 8270 SIM in Water (EPA 8270-SIM)

Preservation: Cool <6

Container: G amber 500ml — **Amount Required:** 1000 mL — **Hold Time:** 7 days

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Acenaphthene	0.020	0.020 ug/L		50	39 - 136	50	39 - 136	20
Acenaphthylene	0.020	0.020 ug/L		50	48 - 134	50	48 - 134	20
Anthracene	0.020	0.020 ug/L		50	55 - 133	50	55 - 133	20
Benzo(a)anthracene	0.010	0.010 ug/L		50	53 - 140	50	53 - 140	20
Benzo(a)pyrene	0.010	0.010 ug/L		50	42 - 135	50	42 - 135	20
Benzo(b)fluoranthene	0.010	0.010 ug/L		50	46 - 137	50	46 - 137	20
Benzo(g,h,i)perylene	0.010	0.010 ug/L		50	32 - 142	50	32 - 142	20
Benzo(k)fluoranthene	0.010	0.010 ug/L		50	46 - 128	50	46 - 128	20
Chrysene	0.010	0.010 ug/L		50	32 - 142	50	64 - 142	20
Dibenzo(a,h)anthracene	0.010	0.010 ug/L		50	32 - 144	50	32 - 144	20
Fluoranthene	0.010	0.010 ug/L		50	57 - 142	50	57 - 142	20
Fluorene	0.020	0.020 ug/L		50	50 - 135	50	50 - 135	20
Indeno(1,2,3-cd)pyrene	0.010	0.010 ug/L		50	33 - 143	50	33 - 143	20
1-Methylnaphthalene	0.040	0.040 ug/L		50	50 - 150	50	50 - 150	20
2-Methylnaphthalene	0.040	0.040 ug/L		50	50 - 150	50	50 - 150	20
Naphthalene	0.040	0.040 ug/L		50	46 - 157	50	46 - 157	20
Pentachlorophenol	1.0	1.0 ug/L		50	50 - 150	50	50 - 150	20
Phenanthrene	0.020	0.020 ug/L		50	57 - 137	50	57 - 137	20
Pyrene	0.010	0.010 ug/L		50	59 - 136	50	59 - 136	20
Butyl benzyl phthalate	0.50	1.0 ug/L		50	66 - 152	50	66 - 152	20
Di-n-butyl phthalate	0.50	1.0 ug/L		50	73 - 157	50	73 - 157	20
Diethyl phthalate	0.50	1.0 ug/L		50	62 - 166	50	62 - 166	20
Dimethyl phthalate	0.50	1.0 ug/L		50	60 - 157	50	60 - 157	20
Di-n-octyl phthalate	0.50	1.0 ug/L		50	27 - 173	50	27 - 173	20
Bis(2-ethylhexyl) phthalate	0.50	1.0 ug/L		50	29 - 185	50	29 - 185	20
surr: 2-Methylnaphthalene-d10			56.2 - 122					
surr: Fluoranthene-d10			66.5 - 142					

City of Portland Water Pollution Control Lab

Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Pb ICPMS T in Water (EPA 200.8)								
Preservation: HNO3, cool <6								
Container: P clean 500ml HNO3			**Amount Required:** 500 mL			**Hold Time:** 180 days		
Lead	0.100	0.100 ug/L		20	70 - 130	20	85 - 115	20

City of Portland Water Pollution Control Lab

Analytical Method Information

Analyte	MDL	Reporting Limit	Surrogate %R	Duplicate RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike / LCS %R	Blank Spike / LCS RPD
Zn ICPMS T in Water (EPA 200.8)								
Preservation: HNO3, cool <6								
Container: P clean 500ml HNO3		**Amount Required:** 500 mL			**Hold Time:** 180 days			
Zinc	0.500	0.500 ug/L		20	70 - 130	20	85 - 115	20

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Appendix B

Laboratory Data Qualifiers

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Appendix B: City of Portland Water Pollution Control Lab Data Qualifiers

Qualifiers	Definition
A2	Result is the average of duplicate analysis.
A3	Result is the average of triplicate analysis.
A4	Result is the average of 4 analyses.
ALK	Because the pH of the sample is less than 8.3, the total alkalinity result is equal to the bicarbonate alkalinity.
AR0	[Custom Value]
AR1	PCB quantified as Aroclor 1260 may be a mixture of 1260 and 1254.
AR10	Quantification may be affected by overlapping Aroclor pattern.
AR11	Identified Aroclor pattern differs somewhat from the reference standard, affecting quantification.
AR2	PCB quantified as Aroclor 1254 may be a mixture of 1254 and 1260.
AR3	PCB quantified as Aroclor 1254 may be a mixture of 1254 and 1248.
AR4	PCB quantified as Aroclor 1248 may be a mixture of 1248 and 1254.
AR5	PCB quantified as Aroclor 1260 may be a mixture of 1260 and 1262.
AR6	PCB quantified as Aroclor1248 may be a mixture of 1248 and 1016/1242.
B1	Analyte was detected in the Method Blank at a concentration greater than one tenth the amount in the sample. Sample result may be a high estimate.
B2	Analyte was detected in the Method Blank, but at a concentration less than one tenth the amount in the sample(s).
B3	This analyte was detected in the Method Blank but not in the samples; results are not affected.
BL	This blank was carried through the leaching process.
C1	Sample was submitted in a container that does not comply with analytical method requirements.
C2	The sample was not preserved according to analytical method requirements.
C3	VOA vial had headspace; target analytes may have volatilized prior to analysis.
C4	VOA vial was not sufficiently acidified for preservation for 14-day holding time. The 7-day non-preserved holding time was exceeded.
C5	The sample container had visible headspace.
D1	The sample required dilution due to non-target matrix interferences, resulting in raised reporting limits.
D2	The sample required dilution due to high levels of target analytes.
D3	Reporting limits are raised for this sample due to the low % solids.
D4	Reporting limit is raised for this analyte due to non-target matrix interference.
D5	Reporting limits are raised for this sample due to non-target matrix interference.
E	Sample result exceeded the calibration range for the analyte.
F0	[Custom Value]
F1	Result for diesel-range hydrocarbons is primarily due to overlap from the heavy oil range.
F10	Identified product appears to be weathered gasoline.
F11	Sample aliquot was sub-sampled from a soil jar. The sub-sampled aliquot was preserved with methanol within 48 hours of sampling.

Qualifiers	Definition
F12	Sample aliquot was sub-sampled from a soil jar. The sub-sampled aliquot was not preserved with methanol within 48 hours of sampling. Sample results may be biased low.
F2	Result for heavy oil is primarily due to overlap from diesel-range hydrocarbons.
F3	Result for diesel-range hydrocarbons is primarily due to overlap from gasoline range.
F4	Result for gasoline is primarily overlap from diesel-range hydrocarbons.
F5	Detected components do not resemble a fuel pattern but the quantity exceeds the reporting threshold.
F6	Surrogate recovery could not be determined due to the high concentration of hydrocarbons in the sample.
F7	This sample underwent silica gel clean-up.
F8	Hydrocarbons quantified as Diesel and Lube Oil appear to be a single petroleum product that is heavier than Diesel #2 and lighter than the reference Lube Oil.
F9	Hydrocarbons were detected in one replicate but not in its duplicate. By method protocol, the sample result is DETECTED.
FO1	The result for this field parameter is an estimate because post-measurement check of the field instrument was outside the acceptance range.
FO2	Dissolved oxygen is not reportable because it exceeds 200% of saturation concentration.
FO3	The result for this field parameter is not reportable due to instrument malfunction.
H1	Holding time was exceeded for this analysis due to laboratory error.
H2	Holding time was exceeded for required re-analysis.
H3	Holding time was exceeded due to delayed sample delivery.
H4	Compliance with holding time requirement could not be verified because sample collection time was not available.
H5	Holding time was exceeded due to delayed request for analysis.
H6	Holding time verification is based on collection time of the earliest field sample.
H7	Holding time was exceeded for required dilution.
H8	Holding time exceedance for Total Solids does not adversely affect its use for calculating other results on a dry weight basis.
I1	One or more internal standard responses were outside the acceptance range due to matrix effect. Re-analysis confirmed the effect. Results should be considered estimates.
I2	One or more internal standard responses were outside the acceptance range due to matrix effect. No sample remained for re-analysis. Results should be considered estimates.
J	Analyte was detected but at a concentration below the reporting limit; the result is an estimate.
K1	BOD result is a minimum because the seed value could not be calculated.
K2	BOD result is a maximum because the seed value could not be calculated.
K3	BOD result should be considered an estimate due to failed check standard results.
K4	BOD result is an estimate based on failed duplicate precision (non-homogeneous matrix).
K5	BOD is not reportable for regulatory purposes due to failed QC results (high blanks).

Qualifiers	Definition
K6	Requested BOD analysis is not reportable due to QC failure; a re-sample has been requested.
K7	Results for multiple BOD dilutions indicate sample toxicity; reported result may be a low estimate.
K8	One or more blanks in the batch are acceptable; sample results are reportable.
K9	The average of the blanks in the batch is acceptable; sample results may be reported.
L1	Recovery for this analyte in the laboratory control sample was outside the acceptance range (low). Sample results may be low estimates.
L2	Recovery for this analyte in the laboratory control sample was outside the acceptance range (high). Sample results may be high estimates.
L3	LCS recovery for this analyte was high; the analyte was not detected in the samples and results are not affected.
L4	Recovery was low for this analyte in the laboratory control sample but acceptable in the matrix spike(s).
L5	High recovery in the Standard Reference Material is due to use of an alternate sample preparation procedure.
M0	[Custom Value]
M1	Matrix duplicate precision measurement indicates non-homogeneous sample matrix. Sample result should be considered an estimate.
M10	RPD exceeds the advisory limit. Duplicate microbiology results may vary due to matrix factors and the nature of biological analysis.
M11	Matrix spike recovery for this analyte was high; the analyte was not detected in the sample and results are not affected.
M12	High matrix spike recovery is due to low spike amount and a trace level of target analyte not accounted for in the % recovery calculation.
M13	Dissolved metal result greater than total metal result was verified as probable bottle contamination.
M14	Dissolved metal result greater than total metal result was verified as probable laboratory contamination.
M15	The result is an estimate due to chromatographic interference that affected quantitation.
M16	MS/MSD RPD is high for this analyte; recoveries are acceptable.
M17	Matrix spike recovery could not be determined due to high concentration of analyte in the sample.
M18	Matrix spike recovery(ies) could not be determined due to required sample dilution.
M19	Matrix spike recovery is outside the acceptance limits due to low spiking level and matrix interference.
M2	Matrix duplicate precision measurement indicates non-homogeneous sample matrix.
M20	The TCLP leachate was prepared using less than the method-specified 100 gram aliquot, due to the limited quantity of sample received. Proportionately less leaching solution was used.

Qualifiers	Definition
M21	Volatile organic compound Acrolein was not recoverable from this sample due to required de-chlorination using sodium thiosulfate.
M22	Volatile organic compound 2-chloroethylvinyl ether was not recoverable from this sample due to acid preservation.
M3	Inconsistent results for matrix QC (duplicates and/or matrix spikes) indicate non-homogeneous sample matrix. Sample results should be considered estimates.
M4	Based on low matrix spike recovery, the sample result may be a low estimate due to matrix interference.
M5	Based on high matrix spike recovery, the sample result should be considered an estimate due to matrix effect and/or non-homogeneous matrix.
M6	Based on low matrix spike recovery, sample results may be low estimates due to matrix interference.
M7	Based on high matrix spike recovery, sample results should be considered estimates due to matrix effect and/or non-homogeneous matrix.
M8	The matrix duplicate control limit is not applicable at concentrations less than 5 times the reporting limit.
M9	Matrix spike recovery control limits are not applicable because the sample concentration is greater than 4 times the spike amount.
N	Refer to case narrative.
NR	NR
OG0	[Custom Value]
OG1	Based on Total Oil & Grease result <5 mg/L, Non-polar Oil & Grease is also <5 mg/L.
OG2	Based on Total Oil & Grease result <10 mg/L, Non-polar Oil & Grease is also <10 mg/L.
Q0	[Custom Value]
Q1	Analyte in blank but samples >10x amount in blank.
Q10	Hg 201 is reported due to Tungsten interference on Hg 202.
Q11	This data is not reportable but should not be deleted.
Q12	This Aroclor was quantitated using less than 5 peaks due to interference or overlap.
Q13	Overlying water was removed from the sample prior to mixing for prep.
Q2	RPD out but results are <5x MRL.
Q3	MS recovery out but sample concentration is >4x the spike amount.
Q4	All analytical criteria were met for this analysis.
Q5	Analyte detected in blank >1/2 MRL but samples are < MRL.
Q6	Analyte detected in blank >1/2 MRL but analysis of the results do not indicate contamination in the sample.
Q7	Dup or MS out; re-analysis of QC sample passed.
Q8a	Extract cleaned up with H2SO4.
Q8b	Extract cleaned up with H2SO4 and copper.
Q8c	Extract cleaned up with Florisil.
Q9	Holding time not applicable. Sample is a PT or other QC sample.
R	Revised result(s).
RE1	Result is reported from re-analysis; all QA/QC criteria were met.
RE2	Results are reported from re-analysis; all QA/QC criteria were met.
RE3	Required re-analysis was done outside the holding time; both results are reported.
RE4	The result was confirmed by re-analysis.

Qualifiers	Definition
SU1	Recovery for one or more surrogate compounds was outside the acceptance range (low). Sample results may be low estimates.
SU2	Recovery for one or more surrogate compounds was outside the acceptance range (high). Sample results may be high estimates.
SU3	Recovery for one or more acidic surrogates was outside the acceptance range (low). Results for acidic compounds may be low estimates.
SU4	Recovery for one or more acidic surrogates was outside the acceptance range (high). Results for acidic compounds may be high estimates.
SU5	Surrogate recovery could not be determined due to required dilution of the sample extract.
SU6	Recovery for surrogate compound was high. No associated target analytes were detected and results are not affected.
SU7	High surrogate recovery is due to co-eluting matrix interferent.
SU8	Low surrogate recovery is due to matrix interference.
SU9	Low surrogate recovery is likely due to the high level of suspended solids in the sample.
T1	The result for Total Suspended Solids should be considered an estimate because the high concentration affects the precision of the analysis.
T2	The result for Total Dissolved Solids should be considered an estimate because the high concentration of suspended solids affects the precision of the analysis.
TIC	Refer to case narrative for information on tentatively identified compounds.
V1	Continuing calibration verification was high; sample results for this analyte may be high estimates.
V2	Continuing calibration verification was high for this analyte; the analyte was not detected in the sample and results are not affected.
V3	Continuing calibration verification was low; sample results for this analyte may be low estimates.
V4	Recovery for this analyte in the initial calibration verification was outside the acceptance limits (low). Sample results may be low estimates.
V5	Recovery for this analyte in the initial calibration verification was outside the acceptance limits (high). Sample results may be high estimates.
Z0	[Custom Value]

Appendix B: Test America Data Qualifiers

Flag	Flag Suite	Definition
4	STL Standard	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.
4	STL Standard - SP	MS, MSD: La concentración del compuesto/analito originalmente en la muestra era 4 veces mas alto que la concentración del dopaje de la muestra Matriz Dopada y por lo tanto los Limites de Control no Aplican
!	FL 62-160 Table 1	Data deviates from historically established concentration ranges.
#	STL Standard	?
*	AFCEE	LCS/LCSD RPD exceeds MS/MSD RPD limits; Note the AFCEE QAPP does not specify limits for LCS/LCSD RPD
*	TAL Standard	Recovery or RPD exceeds control limits
*	OLM04.2	Duplicate RPD exceeds control limits
*	STL Standard	RPD of the LCS and LCSD exceeds the control limits
*	FL 62-160 Table 1	Not reported due to interference.
*	STL Standard	LCS or LCSD exceeds the control limits
*	STL Standard	Isotope Dilution analyte exceeds control limits
*	OLM04.2	MS or MSD exceeds the control limits
*	STL Standard	Tracer exceeds control limit
*	STL Standard	Carrier exceeds control limits
*	Hanford_Organic	MS/MSD RPD exceeded the control limit
*	ILM05.3	Duplicate analysis not within control limits.
*	Hanford_Metals	Duplicate analysis not within control limits
*	STL Standard	LCS, LCSD, MS, MSD, SD or Surrogate exceeds the control limits
*	OLM04.2	Surrogate exceeds the control limit
*	Maine DEP	QC Results not within control limits
*	STL Standard	SD: Serial dilution exceeds the control limits.
*	STL Standard	ICPMS Relative Intensity is outside the method limits.
*	STL STD RAD	The Sample MDC is greater than the requested RL.
*	STL Standard - SP	La señal o Tiempo de Retención del Estándar Interno (ISTD) excede el limite de control superior
*	STL Standard - SP	RPD de la LCS y LCSD excede los límites de control.
*	OLM04.2	ISTD response or retention time outside acceptable limits
*	TAL Standard	Interference Check standard exceeded control limits.
*	STL Standard - SP	La Intensidad Relativa del instrumento ICPMS esta fuera de los limites del método
*	STL Standard - SP	LCS o LCSD excede los límites de control
**	Edison Level 1	Not included in the initial calibration.
?	FL 62-160 Table 1	Data are rejected and should not be used. Some or all of the quality control data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data.
^	STL Standard - SP	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK o MRL estándar: Control de Calidad del instrumento excede los límites de control.
^	STL Standard	ICV,CCV,ICB,CCB, ISA, ISB, CRI, CRA, DLCK or MRL standard: Instrument related QC exceeds the control limits.
^	STL Standard - SP	La recuperación del ICVH excede el limite de control inferior.
^	STL Standard - SP	QC relacionado con el instrumento excede los límites de control.
^	STL Standard - SP	La recuperación del ICVH excede el límite de control superior.
^	STL Standard	ICVH recovery was below method acceptance limits
^	TAL Standard	Instrument related QC exceeds the control limits
^	STL Standard	ICVH recovery was above method acceptance limits
^1	STL Standard	Analyte detected in calibration blank
^2	STL Standard	Calibration check high
^3	STL Standard	Calibration check low
_	Edison Level 1	Tentatively Identified Compound (TIC) for library search of organic compounds
+	STL Standard - SP	El Coeficiente de Correlación del MSA es menos de 0.995
+	STL Standard	MSA correlation coefficient is less than 0.995.
<	STL Standard - SP	No Detectado a, o mas allá del Limite de Reporte
<	STL Standard	Not detected at or above the reporting limit
<	TRRP	The result is reported as less than the value of the SQL
>	STL Standard - SP	El analito/compuesto excede la concentración indicada
>	Hanford_Wet Chem	Result greater than quantifiable range or greater than upper limit of the analysis range.
>	Edison Level 1	The analyte exceeded the indicated concentration
A	FL 62-160 Table 1	Value reported is the arithmetic mean (average) of two or more determinations.
A	OLM04.2	The tentatively identified compound is a suspected aldol-condensation product.
a	Hanford_Organic GCMS	Spike and/or spike duplicate recovery is outside control limits.
A	STL Standard - SP	La compuesto tentativamente identificado (TIC) es un posiblemente un producto de la condensación Aldol.
A	DOD_QSM	Concentration exceeds the instrument calibration range or below the reporting limit.
A1	Arizona ELAC Rev 2.0	Too numerous to count.
A2	Arizona ELAC Rev 2.0	Sample incubation period exceeded method requirement.
A3	Arizona ELAC Rev 2.0	Sample incubation period was shorter than method requirement.
A4	Arizona ELAC Rev 2.0	Target organism detected in associated method blank.
A5	Arizona ELAC Rev 2.0	Incubator/water bath temperature was outside method requirements.
A6	Arizona ELAC Rev 2.0	Target organism not detected in associated positive control.
A7	Arizona ELAC Rev 2.0	Micro sample received without adequate headspace.
A8	AZ Rev. 3	Plate count was outside the method's reporting range. Report value as estimated
Absent	Edison Level 1	Indicates the absence of the particular bacterial genus
AJ	BP Shell	Heavier hydrocarbon than diesel
AK	BP Shell	Lighter hydrocarbon than diesel
AX	BP Shell	Surrogate(s) diluted out

Flag	Flag Suite	Definition
AY	BP Shell	Matrix Interference suspected
AZ	BP Shell	Surrogate recover outside of acceptance limits due to matrix interference
B	Edison Level 1	The reported value is less than the Practical Quantitation Limit but greater than or equal to the Instrument Detection Limit
B	STL Standard - SP	Compuesto fue detectado en el blanco y la muestra.
B	Stoller	Value less than contract required detection limit but greater than or equal to the Method Detection Limit
B	OLM04.2	Analyte was found in the associated method blank as well as in the sample.
B	Edison Level 1	The analyte was found in the laboratory blank as well as the sample. This indicates possible laboratory contamination of the environmental sample.
B	Hanford_WetChem	Estimated result. Result is less than the RL, but greater than MDL
B	ILM05.3	Sample result is greater than the IDL but below the CRDL
B	STL Standard	Compound was found in the blank and sample.
B	Tierra_Inorganic	The reported value was obtained from an instrument reading that was less then than PQL.
B	FL 62-160 Table 1	Results based upon colony counts outside the acceptable range. This code applies to microbiological tests and specifically to membrane filter colony counts.
B	DOD_QSM	Blank contamination: The analyte was detected above one-half the reporting limit in an associated blank.
B	STL Std RAD	Analyte was found in the associated method blank.
b	STL Standard	Result Detected in the USB
b	TRRP	The compound was found in the blank and sample
b	STL Standard - SP	El resultado detectado en el USB.
B	Arizona ELAC Rev 2.0	Target analyte detected in method blank at one or above the method reporting limit.
B	AFCEE	The analyte was found in an associated blank, as well as in the sample.
B1	AZ Rev. 3	Target analyte detected in method blank at or above the method reporting limit (AZ Rev 3).
B2	Arizona ELAC Rev 2.0	Non-target analyte detected in method blank and sample, producing interference.
B3	Arizona ELAC Rev 2.0	Target analyte detected in calibration blank at or above the method reporting limit.
B4	Arizona ELAC Rev 2.0	Target analyte detected in method blank at or above the method reporting limit, but below trigger level or MCL.
B4	AZ Rev. 3	Target analyte detected in blank at or above method acceptance criteria.
B5	Arizona ELAC Rev 2.0	Target analyte detected in method blank at or above the method reporting limit, but below trigger level or MCL.
B5	AZ DEQ DW	Target analyte detected in method blank at or above the method reporting limit, but below trigger level or Target analyte detected in method blank at or above the method reporting limit, but below trigger level or Target analyte detected in method blank at or above the method reporting limit, but below trigger level or MCL.
B6	Arizona ELAC Rev 2.0	Target analyte detected in calibration blank at or above the method reporting limit.
B6	AZ DEQ DW	Target analyte detected in calibration blank at or above the method reporting limit, but below trigger level or MCL.
B7	STL Standard - SP	Analitos/compuestos de interés también se encontraron en el Blanco del Método en concentraciones mas alta que el valor del Limite de Reporte. La concentración del mismo analito en la muestra era de mas de 10 veces mayor que la concentración que se encontró en el Blanco.
B7	Arizona ELAC Rev 2.0	Target analyte detected in method blank at or above method reporting limit. Concentration found in the sample was 10 times above the concentration found in the blank.
BA	EDF	Relative percent difference out of control
BB	BP Shell	Sample > 4X spike concentration
BF	EDF	Reporting limits raised due to high hydrocarbon background
BH	BP Shell	RL raised due to high level of non target analyte
BL	Maine DEP	Compound is found in the associated method blank as well as inorganic sample.
BPJ	Maine DEP	Best Professional Judgement
BR	STL Standard - SP	Analito Excede el Límite de Acción.
BR	STL Standard	Analyte breached action limit
BS	EDF	Insufficient sample available to follow standard QC procedures
BU	BP Shell	Analyzed out of holding time
BU	BP Shell	Sample received out of HT
BV	EDF	Sample received after holding time expired
BV	EDF	Sample received after holding time expired
BZ	BP Shell	Sample preserved improperly
C	Hanford_WetChem	The analyte was detected in both the sample and the assoicated QC blank, and the sample concentration was </= 5X the blank concentration.
C	STL Standard - SP	Ver la Narrativa
C	STL Standard - SP	La identificación del Pesticida fue confirmada usando GC/MS
C	FL 62-160 Table 1	See Case Narrative
C	STL Standard	Pesticide identification was confirmed by GC/MS.
c	STL Standard - SP	El compuesto o analito excedió los limites de control de rutina pero se encuentra dentro del criterio de calibración del cliente o proyecto
C	Co-elution	The compound co-eluted with other compounds
C	OLM04.2	Identification has been confirmed by GC/MS.
c	STL Standard	Compound exceeds routine control limits, but is within acceptable client specific calibration criteria
C1	Arizona ELAC Rev 2.0	Confirmatory analysis not performed as required by the method.
C107	Co-elution	The compound co-eluted with PCB-107
C110	Co-elution	The compound co-eluted with PCB-110
C12	Co-elution	The compound co-eluted with PCB-12
C128	Co-elution	The compound co-eluted with PCB-128
C129	Co-elution	The compound co-eluted with PCB-129
C134	Co-elution	The compound co-eluted with PCB-134
C135	Co-elution	The compound co-eluted with PCB-135
C139	Co-elution	The compound co-eluted with PCB-139
C147	Co-elution	The compound co-eluted with PCB-147

Flag	Flag Suite	Definition
C153	Co-elution	The compound co-eluted with PCB-153
C156	Co-elution	The compound co-eluted with PCB-156
C171	Co-elution	The compound co-eluted with PCB-171
C18	Co-elution	The compound co-eluted with PCB-18
C180	Co-elution	The compound co-eluted with PCB-180
C198	Co-elution	The compound co-eluted with PCB-198
C20	Co-elution	The compound co-eluted with PCB-20
C21	Co-elution	The compound co-eluted with PCB-21
C26	Co-elution	The compound co-eluted with PCB-26
C3	Arizona ELAC Rev 2.0	Qualitative confirmation performed.
C4	Arizona ELAC Rev 2.0	Confirmatory analysis was past holding time.
C40	Co-elution	The compound co-eluted with PCB-40
C44	Co-elution	The compound co-eluted with PCB-44
C49	Co-elution	The compound co-eluted with PCB-49
C5	Arizona ELAC Rev 2.0	Confirmatory analysis was past holding time. Original result not confirmed.
C50	Co-elution	The compound co-eluted with PCB-50
C59	Co-elution	The compound co-eluted with PCB-59
C6	Arizona ELAC Rev 2.0	Sample RPD between primary and confirmatory analysis exceeded 40%. Per EPA Method 8000B, the higher value was reported as there was no obvious chromatographic interference.
C61	Co-elution	The compound co-eluted with PCB-61
C7	Arizona ELAC Rev 2.0	Sample RPD between primary and confirmatory analysis exceeded 40%. Per EPA Method 8000B, the lower value was reported due to apparent chromatographic interference.
C8	AZ Rev. 3	Sample RPD betweeen the promary and confirmatory analysis exceeded 40% Per EPA Method 8000C, the lower value was reported as there was no evidence of chromatographic problems.
C85	Co-elution	The compound co-eluted with PCB-85
C86	Co-elution	The compound co-eluted with PCB-86
C88	Co-elution	The compound co-eluted with PCB-88
C90	Co-elution	The compound co-eluted with PCB-90
C93	Co-elution	The compound co-eluted with PCB-93
C98	Co-elution	The compound co-eluted with PCB-98
CE1	STL Standard - SP	1,4-DM-2,6-DNB & 1,4-DM-2,5-DNB Co-eluyen
CE1	STL Standard	1,4-DM-2,6-DNB & 1,4-DM-2,5-DNB Co-elute
CI	EDF	See narrative
CL	BP Shell	Initial Analysis within HT, but needed a dilution
cn	STL Standard - SP	Ver la Narrativa
CN	BP Shell	Hydrocarbon response in diesel range but does not resemble diesel
cn	TAL Standard	Refer to Case Narrative for further detail
CO	BP Shell	Hydrocarbon response in gasoline but does not resemble gas
Confluent	Edison Level 1	Indicates the presence of high densities of non-coliform colonies with total coliform colonies also present.
CQ	BP Shell	Analyte concentration greater than 10 times the blank concentration
CR	EDF	QC criteria not met, sample re-analyzed with similar results
D	FL 62-160 Table 1	Measurement was made in the field (i.e. in situ).
D	STL Standard - SP	Los resultados analíticos se obtuvieron de una dilución. Los resultados de Recuperación de los Surrogados, y de las muestras dopadas fueron igualmente calculados de los mismos resultados diluidos.
D	STL Standard	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis; also compounds analyzed at a dilution may be flagged with a D.
D	ILM05.3	The reported value is from a dilution.
D	OLM04.2	Sample was analyzed at a higher dilution factor.
D	DLM	The coumpound was identified in an analysis at a secondary dilution factor.
D	AFCEE	Due to a dilution of 4X or greater, the reported % recovery may be outside control limits.
D	STL Standard - SP	La Recuperación de los Surrogados o de las Matrices Dopadas No pudo ser calculada por que el análisis se llevo a cabo en un extracto de muestra diluida. Los Analitos/compuestos de interés analizados en un extracto diluido también serán reportados con una bandera "D".
D	FL 62-160 Table 1	Measurement was made in the field.
D	STL Standard	Sample results are obtained from a dilution; the surrogate or matrix spike recoveries reported are calculated from diluted samples.
D1	AZ DEQ DW	Sample required dilution due to matrix interference. See case narrative.
D1	Arizona ELAC Rev 2.0	Sample required dilution due to matrix.
D1	FL 62-160 Table 1	Surrogate or matrix spike recoveries were not obtained because the extract was diluted for analysis
D2	Arizona ELAC Rev 2.0	Sample required dilution due to high concentration of analyte.
D2	AZ DEQ DW	Sample required dilution due to high concentration of target analyte.
D3	Arizona ELAC Rev 2.0	Sample dilution required due to insufficient sample.
D3	AZ DEQ DW	Sample dilution required due to insufficient sample.
D4	Arizona ELAC Rev 2.0	Minimum Reporting Level (MRL) adjusted to reflect sample amount received and analyzed.
D4	AZ DEQ DW	Minimum Reporting Level (MRL) adjusted to reflect sample amount received and analyzed.
D5	AZ Rev. 3	Minimum Reporting Limit (MRL) adjusted due to sample dilution; analyte was non-detect in the sample.
D6	AZ Rev. 3	Minimum Reporting Limit (MRL) adjusted due to an automatic 10X dilution performed on this sample for the purpose of reporting traditional drinking water analytes for wastewater requirements
DF	BP Shell	RL raised due to matrix interference
DH	BP Shell	RL raised due to reduced sample size
DIL	Hanford_Organic	Concentration is estimated or not reported due to dilution or interferences
DL	BP Shell	Quantified using 30-wieght motor oil standard

Flag	Flag Suite	Definition
DNQ	STL Standard	Result is less than the RL but greater than or equal to the MDL and the concentration is estimated.
DU	BP Shell	Insufficient sample quantity for matrix spike/dup matrix spike
DW	STL Standard	Result has been dry weight corrected
DW	STL Standard - SP	El resultado ha sido ajustado como si fuese obtenido como "Peso Seco"
DX	BP Shell	Value < lowest standard (MQL), but >than MDL
E	Stoller Gen Chem	Estimated Quantitation
E	Hanford_WetChem	Reported value is estimated due to matrix interference.
E	Stoller	Serial Dilution exceeds the control limits
E	STL Standard	Result exceeded calibration range.
E	FL 62-160 Table 1	Indicates that extra samples were taken at composite stations.
E	ILM05.3	The reported value is estimated because of the presence of interference based on serial dilution analysis.
E	TRRP	Result is greater then the UQL and the concentration is an estimated value.
e	TRRP	The reported value is est. because of the presence of interference based on serial dilution analysis.
E	Edison Level 1	Estimated concentration for the compound
E	OLM04.2	Compound concentration exceeds the upper level of the calibration range of the instrument for that specific analysis.
E	STL Standard - SP	La concentración reportada excede la calibración de instrumento.
E1	Arizona ELAC Rev 2.0	Concentration estimated. Analyte exceeded calibration range. Reanalysis not possible due to insufficient sample.
E2	Arizona ELAC Rev 2.0	Concentration estimated. Analyte exceeded calibration range. Reanalysis not performed due to sample matrix.
E2	Historical Data Tracker	2 Sigma Exceeded
E3	Hisorical Data Tracker	3 Sigma Exceeded
E3	Arizona ELAC Rev 2.0	Concentration estimated. Analyte exceeded calibration range. Reanalysis not performed due to holding time requirements.
E4	Arizona ELAC Rev 2.0	Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL).
E5	Arizona ELAC Rev 2.0	Concentration estimated. Analyte was detected below laboratory minimum reporting level (MRL), but not confirmed by alternate analysis.
E6	Arizona ELAC Rev 2.0	Concentration estimated. Internal standard recoveries did not meet method acceptance criteria.
E7	Arizona ELAC Rev 2.0	Concentration estimated. Internal standard recoveries did not meet laboratory acceptance criteria.
E8	Arizona ELAC Rev 2.0	Analyte reported to MDL per project specification. Target analyte was not detected in the sample.
EC	Hisotrical Data Tracker	Client Limit Exceeded
EDR	BP Shell	Hydrocarbon reported is in early diesel range but does not match the Diesel Standard
EMPC	Maine DEP	Peak Detected, but did not meet quantification criteria, result reported represents estimated maximum possible concentration.
ET	BP Shell	Extracted Out of HT
EX	BP Shell	Matrix spike diluted to not detectable during analysis
EY	BP Shell	Estimated value. The concentration exceeds the calibration of analysis
EY	EDF	Result exceeds normal dynamic range; reported as a min. est.
F	BP Biomarker	The analyte was positively identified but the associated numerical value is below the MDL.
F	TAL Standard	MS/MSD Recovery or RPD exceeds the control limits
F	STL Standard	MS or MSD exceeds the control limits
F	STL Standard - SP	RPD duplicado excede los límites de control.
F	FL 62-160 Table 1	Indicates the female sex.
F	STL Standard - SP	RPD de la MS y MSD excede los límites de control.
F	STL Standard - SP	MS o MSD excede los límites de control
F	AFCEE	The analyte was positively identified but the associated numerical value is below the RL.
F	STL Standard	Duplicate RPD exceeds the control limit
F	STL Standard	RPD of the MS and MSD exceeds the control limits
F	STL Standard - SP	Después de una revisión analítica se escogió un pico/analito diferente
FT	Hanford_WetChem	The assoicated analysis is recommended to be performed in the field.
FT	STL Standard - SP	Este análisis lo condujo la persona que tomó la muestra y cuyo nombre aparece en la Cadena de Custodia
FT	STL Standard	This analysis was performed in the field by the sampler whose name appears on the attached Chain of Custody form.
FX	BP Shell	PB Result Detected
G	STL Standard	The reported quantitation limit has been raised due to an exhibited elevated noise or matrix interference
g	BP Shell	Hydrocarbon reported in the gasoline range does not match our gasoline standard
g	STL Standard - SP	El resultado excede los Estándares para Agua Potable
g	STL Standard	Result fails applicable drinking water standards
G	Tierra_Organic	Data indicated the presence of a compound that meets the ID criteria: the result is below the PQL but above the MDL.
G	Maine DEP	Greater than specified amount
GR	BP Shell	Internal Standard out of Range
GS	BP Shell	RL raised due to high level of target analyte present
GY	EDF	Analyte assoc. with sample processing and analysis in lab. environ.
h	STL Standard - SP	Después de una revisión analítica se escogió un pico/analito diferente
H	DLM	Analyte was analyzed using peak heights rather than peak areas for both the analyte and its internal standard.
H	STL Standard - SP	La muestra fue preparada o analizada en exceso del Tiempo Máximo indicado por el método.
H	STL Standard	Sample was prepped or analyzed beyond the specified holding time
H	FL 62-160 Table 1	Value based on field kit determination; results may not be accurate.
h	STL Standard	Alternate peak selection upon analytical review.
H1	Arizona ELAC Rev 2.0	Sample analysis performed past holding time.
H2	Arizona ELAC Rev 2.0	Initial analysis within holding time. Reanalysis for the required dilution was past holding time.
H3	Arizona ELAC Rev 2.0	Sample was received and analyzed past holding time.
H4	Arizona ELAC Rev 2.0	Sample was extracted past required extraction holding time, but analyzed within analysis HT.
H5	AZ Rev. 3	This test is specified to be performed in the field within 15 minutes of sampling; sample was received and analyzed past the regulatory holding time.
HF	STL Standard - SP	Este es un ensayo de campo con un Limite de Tiempo Analítico Máximo de 15 minutos

Flag	Flag Suite	Definition
HF	STL Standard	Field parameter with a holding time of 15 minutes
I	STL Standard	Indicates the presence of an interference, recovery is not calculated.
I	DLM	Ion Ratio outside of limits, value is EMPC.
I	Hanford_WetChem	Result is greater than the upper limit of the analytical range.
I	Tierra_Organic	Presence of an interference during the sample analysis.
I	FL 62-160 Table 1	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
I	STL Standard - SP	Indica la presencia de una interferencia, la Recuperación no puede ser calculada
IA	BP Shell	Results are valid even though CCV recovery outside of limits
IB	BP Shell	CCV recovery above limit; analyte not detected
ID	EDF	Analyte identified by RT & presence of single mass ion
IG	EDF	See Corrective Action Report
IH	EDF	Calibration Verif. recovery below method CL for this analyte
IT	EDF	Temperature during TCLP extraction exceeded SW 1311 range
J	TRRP	Result is less than the MQL but greater than or equal to the SDL and the concentration is an estimated value.
J	Edison Level 1	Mass Spectral Organic Analysis indicates the presence of a compound that meets the identification criteria. The result is less than the specified reporting limit but greater than the method detection limit. The concentration given is an approximate value.
J	Stoller	Indicates an estimated value; analyzed outside of the specified holiding time.
J	STL Standard	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
J	STL Standard - SP	Indica que el Valor/Cantidad se considera una "Estimación"
J	Wisconsin	Reported value was between the limit of detection and the limit of quantitation.
J	ILM05.3	Sample result is greater than the MDL but below the CRDL
J	STL Standard	Indicates an Estimated Value for TICs
J	DOD_QSM_41	Estimated: The quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.
J	AFCEE	Value is above the high standard/linear range
J	Hanford_WetChem	Method blank contamination. The assoicated method blank contains the target analyte at a reportable level.
J	AFCEE	The analyte was positively identified, the quantitation is an estimation.
J	ILM05.3	Reported value was obtained from a reading that was less than the CRQL but greater than or equal to the MDL.
J	Stoller	Estimated Quantitation
J	AFCEE 4	Sample was prepped or analyzed beyond the specified holding time.
J	DOD_QSM	Estimated: The analyte was positively identified; the quantitation is an estimation
J	AECOM	Result exceeded calibration range.
J	OLM04.2	Indicates an estimated value.
J	STL Standard - SP	Indica que el analyte es un valor estimado entre el RL y el MDL.
J	URS_Ellsworth	MS, MSD: The analyte present in the original sample is 4 times greater than the matrix spike concentration; therefore, control limits are not applicable.
J	URS	One or more Quality Control criteria failed
J	FL 62-160 Table 1	Estimated value; value may not be accurate.
J	STL Standard - SP	Indica que el Valor/Cantidad se considera una "Estimación" para estos TICs
J,DX	EDF BP	Estimated value; value < lowest standard (MQL), but >than MDL
J1	FL 62-160 Table 1	Estimated value; value may not be accurate. Surrogate recovery outside of criteria.
J2	FL 62-160 Table 1	Estimated value; value may not be accurate.
J3	NCDWQ	Estimated Value; Sample matrix interfered with the ability to make any accurate determination.
J3	FL 62-160 Table 1	Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria.
J4	NCDWQ	Estimated Value; Data is questionable because of improper laboratory or field protocols.
J4	FL 62-160 Table 1	Estimated value; value may not be accurate. Not reported due to interference
J5	NCDWQ	Estimated Value; Temperature limits exceeded during transport.
J5	FL 62-160 Table 1	Estimated value; value may not be accurate. Improper procedure used.
J6	NCDWQ	Estimated Value; Laboratory analysis was from an unpreserved or improperly chemically preserved sample.
J7	NCDWQ	Estimated Value; Blank contamination evident, value may not be accurate.
K	STL Standard - SP	Los compuestos Benzo (b&k) fluoranteno no fueron separados analíticamente y son entonces reportados como Benzo (b) fluoranteno
K	Hanford_Organic	Benzo (b&k) fluoranthene are unresolved due to matrix, result is reported as Benzo(b)fluoranthene.
k	STL Standard	Benzo (b&k) fluoranthene are unresolved due to matrix, result is reported as Benzo(k)fluoranthene.
K	Maine DEP	Trace level below stated reporting limit (HETL)
K	FL 62-160 Table 1	Off-scale low. Actual value is known to be less than the value given.
K1	Arizona ELAC Rev 2.0	The sample dilutions set-up for the BOD analysis did not meet the oxygen depletion criteria of at least 2 mg/L. Any reported result is an estimated value.
K2	Arizona ELAC Rev 2.0	The sample dilutions set-up for the BOD analysis did not meet the criteria of a residual dissolved oxygen of at least 1 mg/L. Any reported result is an estimated value.
K4	Arizona ELAC Rev 2.0	The seed depletion was outside the method acceptance limits. The reported result is an estimated value.
K5	Arizona ELAC Rev 2.0	The dilution water D.O. depletion was > 2.0 mg/L.
K6	Arizona ELAC Rev 2.0	Glucose/glutamic acid BOD was below method acceptance criteria.
K7	Arizona ELAC Rev 2.0	A discrepancy between the BOD and COD results has been verified by reanalysis of the sample for COD.
K8	Arizona ELAC Rev 2.0	Glucose/glutamic acid BOD was above method acceptance criteria.
L	Hanford_WetChem	Serial dilution in the analytical batch indicates that physical and chemical interferences are present.
L	STL Standard	A negative instrument reading had an absolute value greater than the reporting limit
L	FL 62-160 Table 1	Off-scale high. Actual value is known to be greater than the value given.
L	STL Standard - SP	El instrumento analítico registro un valor absoluto superior al Limite de Reporte.
L1	Arizona ELAC Rev 2.0	The associated blank spike recovery was above laboratory acceptance limits.
L1	AZ DEQ DW	The associated blank spike recovery was above laboratory acceptance limits. See case narrative.
L2	AZ DEQ DW	The associated blank spike recovery was below laboratory acceptance limits. See case narrative.

Flag	Flag Suite	Definition
L2	Arizona ELAC Rev 2.0	The associated blank spike recovery was below laboratory acceptance limits.
L3	Arizona ELAC Rev 2.0	The associated blank spike recovery was above method acceptance limits.
L4	Arizona ELAC Rev 2.0	The associated blank spike recovery was below method acceptance limits.
LC	EDF	Original analysis a positve result. Reanalysis did not confirm.
LDR	BP Shell	Hydrocarbon reported is in late diesel range but does not match the Diesel Standard
LG	BP Shell	LG=Surrogate recovery below the acceptance limits
LH	BP Shell	Surrogate Recoveries were higher than QC limits
LM	BP Shell	MS/MSD Spike Recoveries were above acceptance limits
LM	EDF	MS and/or MSD above acceptance limits. See Blank Spike (LCS)
LN	EDF	MS and/or MSD below acceptance limits. See Blank Spike (LCS)
LN	BP Shell	MS/MSD Spike REcoveries were below acceptance limits
LO	BP Shell	MS and/or MSD result unavailable. Batch acceptance based on LCS recovery
LP	BP Shell	LCS recovery high, sample ND
LQ	BP Shell	LCS/LCSD recovery above method control limits
LR	BP Shell	LCS/LCSD recovery below method control limits
LT	EDF	RPD calc. does not provide useful info due to sample wt variation
LT	Maine DEP	Less than specified amount (Non -Lab data only)
LW	BP Shell	Quantitated against gasoline
LX	BP Shell	Quantit of unknown hydrocarbon(s) in sample based on diesel
LZ	EDF	Sample (stored at >0C,<4C) receipt >8hr HT. Analysis within method HT
M	Hanford_WetChem	Sample duplicate precision not met.
M	FL 62-160 Table 1	Presence of material is verified but not quantified; the acutal value is less than the value given.
M	STL Standard	Manual integrated compound.
m	AFCEE	A matrix effect was present.
M1	AZ DEQ DW	Matrix spike recovery was high, the method control sample recovery was acceptable.
M1	Arizona ELAC Rev 2.0	Matrix spike recovery was high, the method control sample was acceptable.
M1	AZ Rev. 3	Matrix spike recovery was high; the associated blank spike recovery was acceptable.
M2	AZ DEQ DW	Matrix spike recovery was low, the method control sample recovery was acceptable.
M2	AZ Rev. 3	Matrix spike recovery was low; the associated blank spike recovery was acceptable.
M2	Arizona ELAC Rev 2.0	Matrix spike recovery was low, the method control sample was acceptable.
M3	AZ DEQ DW	The accuracy of the spike recovery value is reduced since the analyte concentration in the sample is disproportionate to spike level. The method control sample recovery level was acceptable.
M3	AZ Rev. 3	The spike recovery value is unusable since the analyte concentration in the sample is disproportionate to the spike level. The associated blank spike was acceptable.
M3	Arizona ELAC Rev 2.0	The accuracy of the spike recovery value is reduced since the analyte concentration in the sample is disproportionate to spike level. The method control sample recovery level was acceptable.
M4	AZ DEQ DW	The analysis of the spiked sample required a dilution such that the spike concentration was diluted below the reporting limit. The method control sample recovery was acceptable.
M4	AZ Rev. 3	The analysis of the spiked sample required a dilution such that the spike recovery calculation does not proved useful information. The associated blank spike recovery was acceptable.
M4	Arizona ELAC Rev 2.0	The analysis of the spike sample required a dilution such that the spike concentration was diluted below the reporting limit. The method control sample recovery was acceptable.
M5	AZ DEQ DW	Analyte concentration was determined by method of standard addition (MSA).
M5	Arizona ELAC Rev 2.0	Analyte concentration was determined by method of standard addition (MSA).
M6	Arizona ELAC Rev 2.0	Matrix spike recovery was high. Data reported per ADEQ policy 0154.000.
M6	AZ DEQ DW	Matrix spike recovery was high. Data reported per ADEQ policy 0154.000.
M7	Arizona ELAC Rev 2.0	Matrix spike recovery was low. Data reported per ADEQ policy 0154.000.
M7	AZ DEQ DW	Matrix spike recovery was low. Data reported per ADEQ policy 0154.000.
MB	EDF	Analyte present in the method blank
MC	EDF	Sample received unpreserved but analyzed wihtin 7 days
MD	Maine DEP	Model L&W
MDO	Maine DEP	Model-Old L&W
MI	Maine DEP	Matrix Interference
MSB	Hanford_Metals	The Sample amount was greater than four times the spike amount.
N	FL 62-160 Table 1	Presumptive evidence of material.
N	STL Standard - SP	Pruebas presuntas de un compuesto. Esta bandera es sólo usada para compuestos tentativamente identificados (TICs), donde la identificación está basada en una búsqueda de biblioteca espectral de masas. Es aplicado a todos los resultados de TIC.
N	TRRP	MS/MSD RPD exceeded the control limit
N	Hanford_Metals	Recovery exceeds upper or lower control limits
N	STL Standard	MS, MSD: Spike recovery exceeds upper or lower control limits.
N	OLM04.2	This flag indicates the presumptive evidence of a compound.
N	Hanford_Organic	LCS, LCSD: Recovery exceeds upper or lower control limits.
N	TRRP	RPD of the MS and MSD exceeds the control limits
N	ILM05.3	PDS exceeds control limits
N	DOD_QSM	Nontarget analyte: The analyte is a tentatively identified compound (using mass spectroscopy).
N	ILM05.3	Spiked sample recovery is not within control limits.
N1	Arizona ELAC Rev 2.0	See case narrative.
N2	Arizona ELAC Rev 2.0	See corrective action report.
N3	Arizona ELAC Rev 2.0	The analysis meets all method requirements. See case narrative.
N4	AZ Rev. 3	The Minimum Reporting Level (MRL) verification check did not meet the laboratory acceptance limits.

Flag	Flag Suite	Definition
N5	AZ Rev. 3	The Minimum Reporting Level (MRL) verification check did not meet the laboratory acceptance limitsThe Minimum Reporting Level (MRL) verification check did not meet the method acceptance limits.
N6	AZ Rev. 3	Data suspect due to quality control failure, report per data user's request
NAN	Maine DEP	Not Analyzed
NC	Hanford_Organic	The Recovery and/or RPD were not calculated.
NC	Maine DEP	Not Confirmed
ND	STL Standard - SP	Compuesto no detectado.
ND	STL Standard	Compound not detected.
ndp	BP Shell	Hydrocarbon reported does not match the pattern of our Diesel standard
NDP	BP Shell	Hydrocarbon does not match Diesel Standard
NQ	Maine DEP	Not Quantitated
NULL	NULL	NULL
NULL	NULL	NULL
O	FL 62-160 Table 1	Sampled, but analysis lost or not performed.
O	CHPRC	LCS, LCSD: Recovery exceeds upper or lower control limits.
O	CHPRC	Recovery exceeds upper or lower control limits.
OT	EDF	Sample spiked had pH <2, 2-Chloroethylvinylether degrades in acid
P	NCDWQ	Elevated PQL due to matirx interference and/or sample dilution.
P	STL Standard	The %RPD between the primary and confirmation column/detector is >40%. The higher value has been reported
p	STL Standard	The %RPD between the primary and confirmation column/detector is >40%. The lower value has been reported.
P	OLM04.2	The % Difference between columns is greater than 25%.
P	CBC	PCB-156 and PCB-157 Co-eluted more than 2 seconds apart.
P	OLM04.2	This flag is used for a pesticide/Aroclor target analyte where there is greater than 25% difference for detected concentrations between the two GC columns
p	STL Standard - SP	El RPD entre las dos columnas GC es mayor que el 40 % y existen anomalías. El Resultado más bajo de los dos ha sido reportado.
P	Hanford_Organic	This flag is used for an aroclor target analyte where there is greater than 25% difference for detected concentrations between the two GC columns
P	STL Standard - SP	El RPD entre las dos columnas GC es mayor que el 40 % y ningunas anomalías están presentes. El resultado más alto de los dos ha sido reportado.
PC	EDF	Sample taken from VOA vial with air bubble > 6 mm diameter
PI	EDF	Primary and confirm results varied by > than 40% RPD
PK	Maine DEP	Slightly Positive (oil screen test)
PO	Maine DEP	Positive (Coliform Bacteria tests)
PP	EDF	Dilutions for BOD failed criteria of 2 mg/L diss. O depletion
Present	Edison Level 1	Indicates the presence of the particular bacterial genus
PV	EDF	Hydrocarbon result partly due to individual peak(s) in quant. range
Q	STL Standard - SP	El resultado fue cualitativamente confirmado pero no fue cuantificado
Q	FL 62-160 Table 1	Sample held beyond the accepted holding time.
Q	NCDWQ	Holding time exceeded
Q	STL Standard	Result was qualitatively confirmed, but not quantitated.
q	STL Standard	The isomer is qualified as positively identified, but at an estimated quantity because the quantitation is based on the theoretical ratio for these samples.
Q	DOD_QSM	One or more quality control criteria failed.
Q1	Arizona ELAC Rev 2.0	Sample integrity was not maintained. See case narrative.
Q1	NCDWQ	Holding time exceeded prior to receipt by lab.
Q1	BP Shell	Concentration reported represent individual or discrete peaks not matching a typical fuel pattern but quantitated as Gasoline
Q10	Arizona ELAC Rev 2.0	Sample received in inappropriate container.
Q11	Arizona ELAC Rev 2.0	Sample is heterogeneous. Sample homogeneity could not be readily achieved using routine laboratory practices.
Q12	AZ DEQ DW	Insufficient sample received to meet method QC requirements. See case narrative.
Q2	Arizona ELAC Rev 2.0	Sample received with headspace.
Q2	NCDWQ	Holding time exceeded following receipt by lab.
Q3	STL Standard - SP	La muestra fue recibida con insuficiente o deficiente Preservación Química
Q3	Arizona ELAC Rev 2.0	Sample received with improper chemical preservation.
Q4	Arizona ELAC Rev 2.0	Sample received and analyzed with improper chemical preservation.
Q5	Arizona ELAC Rev 2.0	Sample received with inadequate chemical preservation, but preserved by the laboratory.
Q6	BP Shell	The concentration reported reflect(s) individual or discrete unidentified peaks not matching a typical fuel pattern
Q6	Arizona ELAC Rev 2.0	Sample was received above recommended temperature.
Q6	BP Shell	Concentration reported represent individual or discrete peaks not matching a typical fuel pattern
Q7	Arizona ELAC Rev 2.0	Sample inadequately dechlorinated.
Q8	Arizona ELAC Rev 2.0	Insufficient sample received to meet method QC requirements. Batch QC requirements satisfy ADEQ policies 0154 and 0155.
Q9	Arizona ELAC Rev 2.0	Insufficent sample received to meet method QC requirements.
Q9	STL Standard	Hydrocarbon pattern most closely resembles weathered diesel.
QP	EDF	Holding time Immediate. Analyzed as close to receipt as possible
QU	EDF	Per EPA, benzidine subject to oxidative loss during solvent conc.
QW	EDF	Matrix is reductive; possible low bias in matrix/post spike.
QX	EDF	This test was performed in the field, not in the laboratory.
R	ILM05.3	The percent relative abundance for the ICPMS internal standard is outside the specified acceptance ranges
R	AFCEE 4	Data was rejected.

Flag	Flag Suite	Definition
R	STL Standard	The instrument was not calibrated for this compound. A non-detect indicates that the characteristic ions were not present and the compound was not qualitatively identified. No controls were present to determine either sample preparation efficiency or the instrument sensitivity for the compound. As a result, the limit of detection is not known and the reported concentrations are estimates.
R	FL 62-160 Table 1	Significant rain in the past 48 hours.
R	AFCEE	The data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.
R	Maine DEP	Results are rejected during Data Validation due to serious analytical or sampling deficiencies.
R	DLM	% Recovery is outside of Limits
R	STL Standard - SP	El instrumento no fue calibrado para este compuesto/analito. Un resultado de No-Detectado indica que los iones característicos del analito no estaban presentes y por lo tanto no fue cualitativamente identificado. Por igual no hay controles establecidos para la eficiencia de extracción o de la sensibilidad para este compuesto en el instrumento. Por lo tanto se desconoce el Limite de Detección y cualquier concentración reportada debe ser tomada como una aproximación.
R1	Arizona ELAC Rev 2.0	RPD exceeded the method control limit. See case narrative.
R1	AZ Rev. 3	RPD/RSD exceeded the method acceptance limit.
R10	Arizona ELAC Rev 2.0	Sample RPD between the primary and confirmatory analysis exceed 40%. Per EPA Method 8000B, the lower value was reported due to apparent chromatographic problems.
R11	Arizona ELAC Rev 2.0	The RPD calculation for MS/MSD does not provide useful information due to varying sample weights when Encore samplers/methanol field preserved samples are used.
R2	Arizona ELAC Rev 2.0	RPD exceeded laboratory control limit. See case narrative.
R2	AZ DEQ DW	RPD exceeded the laboratory control limit. See case narrative.
R2	AZ Rev. 3	RPD/RSD exceeded the laboratory acceptance limit.
R4	Arizona ELAC Rev 2.0	MS/MSD RPD exceeded the method control limit. Recovery met acceptance criteria.
R5	AZ DEQ DW	MS/MSD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.
R5	Arizona ELAC Rev 2.0	MS/MSD RPD exceeded laboratory control limit. Recovery met acceptance criteria.
R6	Arizona ELAC Rev 2.0	LFB/LFBD RPD exceeded method control limit. Recovery met acceptance criteria.
R6	AZ Rev. 3	LFB/LFBD RPD exceeded the method acceptance limit. Recovery met acceptance criteria
R7	AZ DEQ DW	LFB/LFBD RPD exceeded the laboratory control limit. Recovery met acceptance criteria.
R7	AZ Rev. 3	LFB/LFVD RPD exceeded the laboratory acceptance limit. Recovery met acceptance criteria.
R7	Arizona ELAC Rev 2.0	LFB/LFBD RPD exceeded laboratory control limit. Recovery met acceptance criteria.
R8	Arizona ELAC Rev 2.0	Sample RPD exceeded the method control limit.
R8	AZ Rev. 3	Sample RPD exceeded the method acceptance criteria
R9	AZ DEQ DW	Sample RPD exceeded the laboratory control limit.
R9	AZ Rev. 3	Sample RPD exceeded the laboratory acceptance limit.
R9	Arizona ELAC Rev 2.0	Sample RPD exceeded laboratory control limit.
RA	BP Shell	RPD exceeds limits due to matrix interference. % recoveries were within limits
RB	BP Shell	RPD exceeded method control limit; % recovery within limits
RJ	EDF	Contract limits originate from BP LaMP Technical Requirements
S	STL Standard	Result was determined by the Method of Standard Additions
s	STL Standard - SP	SCB Alto de Recuperación
S	STL Standard - SP	El resultado fue determinado usando el proceso de Método de Adición de Estándares
s	STL Standard	SCB Recovery Low
s	STL Standard - SP	SCB Bajo de Recuperación
S	AFCEE	To be applied to all field screening data
s	STL Standard	SCB Recovery High
s	TAL Standard	SCB Recovery exceeds limits.
S	SOM01.2	Aroclor only: Value estimated, 5 point ICAL not performed prior to detection in sample.
S1	AZ DEQ DW	Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits.
S1	Arizona ELAC Rev 2.0	Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits.
S10	Arizona ELAC Rev 2.0	Surrogate recovery was above laboratory and method acceptance limits. See case narrative.
S11	Arizona ELAC Rev 2.0	Surrogate recovery was high. Data reported per ADEQ policy 0154.000.
S11	AZ DEQ DW	Surrogate recovery was high. Data reported per ADEQ policy 0154.000.
S12	Arizona ELAC Rev 2.0	Surrogate recovery was low. Data reported per ADEQ policy 0154.000.
S12	AZ DEQ DW	Surrogate recovery was low. Data reported per ADEQ policy 0154.000.
S3	Arizona ELAC Rev 2.0	Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits. No target analytes were detected
S3	Arizona ELAC Rev 2.0	Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits. No target analytes were detected in the sample.
S3	AZ DEQ DW	Surrogate recovery was above laboratory acceptance limits, but within method acceptance limits. No target analytes were detected in the sample.
S4	Arizona ELAC Rev 2.0	Surrogate recovery was above laboratory acceptance limits and method acceptance limits. No target analytes were detected in the sample.
S5	AZ DEQ DW	Surrogate recovery was below laboratory acceptance limits, but within method acceptance limits.
S5	Arizona ELAC Rev 2.0	Surrogate recovery was below laboratory acceptance limits, but within method acceptance limits.
S6	AZ DEQ DW	Surrogate recovery was below laboratory acceptance limits and method acceptance limits. Reextraction and/or reanalysis confirms low recovery caused by matrix effect.
S6	Arizona ELAC Rev 2.0	Surrogate recovery was below laboratory acceptance limits and method acceptance limits. Reextraction and/or reanalysis confirms low recovery caused by matrix effect.
S7	Arizona ELAC Rev 2.0	Surrogate recovery was below laboratory acceptance limits and method acceptance limits. Unable to confirm matrix effect.
S7	STL Standard	Sample breakthrough to second section is >10%. Results maybe biased low.
S8	AZ DEQ DW	The analysis of the sample required a dilution such that the surrogate concentration was diluted below the method acceptance criteria. The method control sample recovery was acceptable.

Flag	Flag Suite	Definition
S8	AZ Rev. 3	The analysis of the sample required a dilution such that the surrogate recoviery calculation does not provide useful information. The associated blank spike recovery was acceptable.
S8	Arizona ELAC Rev 2.0	The analysis of the sample required a dilution such that the surrogate recovery calculation does not provide any useful information. The method control sample recovery was acceptable.
S9	AZ DEQ DW	The analysis of the sample required a dilution such that the surrogate concentration was diluted below the laboratory acceptance criteria. The method control sample recovery was acceptable.
SC	Extra_DODQSME	Surrogate results reported from confirmation analysis and is not used for control purposes. Raw data is attached.
T	STL Standard	Result is a tentatively identified compound (TIC) and an estimated value.
T	Maine DEP	Analyte recalcualted against alternate labeled compound(s) or internal standard.
T	STL Standard - SP	El resultado es un compuesto tentativamente identificado (TIC) y es un valor estimado.
T	AFCEE	Tentatively identified compound (using GC/MS)
T	Hanford_Organic GCMS	LCS, LCSD: Recovery exceeds upper or lower control limits.
T	FL 62-160 Table 1	Value reported is less than the laboratory method detection limit. The value is reported for informational purposes and shall not be used in statistical analysis.
T	Hanford_Organic GCMS	MS, MSD: Recovery exceeds upper or lower control limits.
T1	Arizona ELAC Rev 2.0	Method approved by EPA, but not yet licensed by ADHS.
T2	Arizona ELAC Rev 2.0	Cited ADHS licensed method does not contain this analyte as part of the method compound list.
T3	Arizona ELAC Rev 2.0	Method not promulgated either by EPA or ADHS.
T4	Arizona ELAC Rev 2.0	Tentatively identified compound. Concentration is estimated and based on the closest internal standard.
T5	EDF	<100g available for TCLP extractn-vol of extract adjusted per procedure
T5	AZ Rev. 3	Laboratory not licensed for this parameter
T6	AZ Rev. 3	The reported result cannot be used for compliance purposes.
T7	AZ Rev. 3	Incubator/Oven temperatures were not monitored as required during all days of use.
TN	Maine DEP	Bacterial results reported too numerous to count
TOC	Hanford_WetChem	Soil samples are not analyzed in quadruplicate.
U	AFCEE	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL
U	STL Standard - SP	Indica que el compuesto fue analizado pero no detectado
U	TRRP	Analyte was not detected at or above the SDL.
U	ILM05.3	Indicates analyzed for but not detected.
U	DOD_QSM	Undetected at the Limit of Detection.
U	OLM04.2	Analyzed for but not detected.
U	STL Standard	Indicates the analyte was analyzed for but not detected.
U	FL 62-160 Table 1	Indicates that the compound was analyzed for but not detected.
U	Maine DEP	Not Detected above the associated Quantitaion Limit
UH	Maine DEP	Historical data identified as non-detect but without a reporting limit provided.
UJH	Maine DEP	Historical data without a reporting limit provided- not detected above elevated quantitaion limit.
V	FL 62-160 Table 1	Indicates the analyte was detected in both the sample and the associated method blank.
V	STL Standard - SP	La dilución consecutiva excede límites de control.
V	STL Standard	Serial Dilution exceeds the control limits
V1	Arizona ELAC Rev 2.0	CCV recovery was above method acceptance limits. The analyte was not detected in the sample.
V2	Arizona ELAC Rev 2.0	CCV recovery was above method acceptance limits. The analyte was detected in the sample. The sample could not be reanalyzed due to insufficient sample.
V3	Arizona ELAC Rev 2.0	CCV recovery was above method acceptance limits. The analyte was detected in the sample. The sample was not reanalyzed. See case narrative.
V4	Arizona ELAC Rev 2.0	CCV recovery was below method acceptance limits. The sample could not be reanalyzed due to insufficient sample.
V5	Arizona ELAC Rev 2.0	CCV recovery after a group of samples was above acceptance limits. The analyte was not detected in the sample. Acceptable per EPA method 8000B.
V6	Arizona ELAC Rev 2.0	Data from one-point calibration criteria per ADEQ policy 0155.000.
V6	AZ DEQ DW	Data reported from one-point calibration criteria per ADEQ policy 0155.000.
V7	Arizona ELAC Rev 2.0	Calibration verification recovery was above method control limits for this analyte, however the average % difference or % drift for all the analytes met method criteria.
V8	Arizona ELAC Rev 2.0	Calibration verification recovery was below method control limits for this analyte, however the average % difference or % drift for all the analytes met method criteria.
V9	AZ Rev. 3	CCV Recovery was below method acceptance limits
W	STL Standard	PS: Post-digestion spike was outside control limits
W	STL Standard - SP	La recuperación de pos-digestión muestra dopada no esta dentro de límites de control.
W1	Arizona ELAC Rev 2.0	The % RSD for this compound was above 20%. The average % RSD for all compounds in the calibration met the 20% criteria as specified in method 8000B.
W2	Arizona ELAC Rev 2.0	The % RSD for this compound was above 15%. The average % RSD for all compounds in the calibration met the 15% criteria as specified in EPA method 8260B/8270C.
X	OLM04.2	See case narrative notes for explanation of the 'X' flag
X	STL Standard	Surrogate is outside control limits
X	Hanford_Metals	Serial dilution in the analytical batch indicates that physical and chemical interferences are present.
X	AZ DEQ DW	Laboratory recommends resampling.
X	OLM04.2	Other
X	NCDWQ	Not Analyzed
X	STL Standard - SP	Surragados exceden los límites de control.
X	Hanford_Organic	More than 40% difference between columns, lower result reported.
X	AZ DEQ DW	Laboratory recommends resampling.
X1	NCDWQ	Not analyzedSample not screened for this constituent.
X2	NCDWQ	Not analyzed; Sample, but analysis lost or not performed - field error.
X3	NCDWQ	Not analyzed; Sampled but analysis lost or not performed - lab error.

Flag	Flag Suite	Definition
Y	NCDWQ	Elevated PQL due to insufficient sample size.
Y	STL Standard - SP	La señal o traza cromatografía es similar a la señal típica de un combustible
Y	OLM04.2	See case narrative notes for explanation of the 'Y' flag
Y	FL 62-160 Table 1	The laboratory analysis was from an improperly preserved sample. The data may not be accurate.
Y	STL Standard	The chromatographic response resembles a typical fuel pattern.
Y	Hanford_Organic	More than 40% difference between columns, higher result reported.
Z	FL 62-160 Table 1	Too many colonies were present (TNTC); the numeric value represents the filtration volume.
Z	NCDWQ	Rejected; Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria.
Z	STL Standard - SP	La señal o traza cromatografía no es similar a la señal típica de un combustible
Z	Maine DEP	Surrogate or Spike diluted out of sample
Z	OLM04.2	See case narrative notes for explanation of the 'Z' flag
Z	STL Standard	The chromatographic response does not resemble a typical fuel pattern.

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Appendix C

Laboratory Forms

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WPCL Cooler Receipt Form

Work Order Number:__________________________ Cooler Receipt Form Filled Out By:________

Project: ____

Sample transport: Samples received on ice____ Courier______

Directly from field__________

Temperature (°C)__________

	Yes	No	NA
Is the COC present and signed?			
Are sample bottles intact?			
Do the COC and sample labels match?			
Are the appropriate containers used?			
Are samples appropriately preserved?			
Do VOA vials have Headspace?			
Are samples received within holding times?			

Pres. #	Preservative	LIMS ID	Standard Preservation Amounts
1	**HNO_3 (1:1) to pH <2**		0.5mL/250mL; 1.0mL/500mL; 4-5 drops/50mL centrifuge tube
2	**H_2SO_4 (18N) to pH <2**		0.4mL/250mL; 0.8mL/500mL ; 1.6mL/1000mL
3	**HCl (1:1) to pH <2**		1.0mL/500mL; 2.0mL/1000mL
4	**HCl (1:1) to pH 2-3**		For TOC: 2-5 drops/250mL
5	**NaOH (pellets) to pH >12**		4-10 pellets/500mL; 8-20 pellets/1000mL

Date	Time	Analyst	Sample LIMS ID	Bottle ID	Pres. #	Comments

Comments:____

CAR #

City of Portland
Water Pollution Control Laboratory

Corrective Action Report

This CAR form serves as documentation of a QA/QC non-conformance and subsequent corrective action. It may also serve as a Preventative Action Report, to document procedures initiated to prevent QC failures.

CAR initiated by**:** Date**:** Lab area / analysis**:**

Non-conformance:

Work order/samples affected:

Root cause analysis:

Possible corrective actions:

Corrective action(s) taken:

Corrective action executed by(date/init):

Comment required on sample report(s)?

Corrective action follow-up review (date/init/comments):

Included in internal audit (date/init):

Corrective action closed (date/init):

QA Coordinator Section

Non-conformance reviewed:
Work order/samples reviewed/corrected/reported as needed:
Root cause reviewed:
Corrective actions taken reviewed:
Follow-up review:
Internal audit review:
Management review:

QA comments:

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