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State of Washington

Quality Assurance Project Plan

Burnt Bridge Creek
PCB and Dieldrin
Screening Study

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Publication Information

Each study conducted by the Washington State Department of Ecology (Ecology) must have an approved Quality Assurance Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completing the study, Ecology will post the final report of the study to the Internet.

This Quality Assurance Project Plan is available on Ecology's website at https://fortress.wa.gov/ecy/publications/SummaryPages/1403101.html

Data for this project will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search Study ID, RCOO0014.

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Quality Assurance Project Plan

Burnt Bridge Creek PCBs and Dieldrin Screening Study

January 2014

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Signatures are not available on the Internet version.
EAP: Environmental Assessment Program
EIM: Environmental Information Management database

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Abstract

From January through October of 2010, the Washington State Department of Ecology investigated sources of polychlorinated biphenyls (PCBs), dioxin and furans, and chlorinated pesticides to Vancouver Lake (Coots and Friese, 2011). The 2010 study identified Burnt Bridge Creek as the highest priority for follow-up sampling based on levels of PCBs and dieldrin. A source assessment was recommended to identify potential sources within the Burnt Bridge Creek drainage.

The current study will investigate the Burnt Bridge Creek drainage to identify sites or areas with elevated levels of PCBs or dieldrin. During the fall of 2013 and spring of 2014, seasonal water samples will be collected, five from the mainstem and three from major tributaries. Locations of the five mainstem sites were based on access, geomorphological changes, and best coverage for the five available samples. Cold Creek, Burton Channel, and Peterson Channel will be sampled as close to the mouth as possible.

Sampling will be conducted in two parts: a screening survey and a source identification survey. Samples will be analyzed for PCBs, dieldrin, total suspended solids, total organic carbon, and grain size for sediment or soil. The screening survey will analyze contaminants in water by a concentration method using Solid Phase Extraction techniques, and the source identification samples will use sediment or soil for analyses.

Background

The Washington State Department of Ecology (Ecology) conducted studies of Vancouver Lake and its three major surface water sources in 2006 and 2010 (Coots, 2007; and Coots and Friese, 2011). These studies reported concentrations above human health and water quality standards in fish, sediment, and water for polychlorinated biphenyls (PCBs) and dieldrin. The 2006 study measured PCBs, chlorinated pesticides, and dioxins and furans in Vancouver Lake fish tissue and sediment. In 2010, the three major surface water inputs to Vancouver Lake were analyzed for the same suite of parameters in water and evaluated as possible sources to fish and the sediment.

The 2010 study included seasonal sampling (winter, spring, and fall) of Burnt Bridge Creek, the Flushing Channel, and Lake River - the three major surface water inputs to Vancouver Lake. The highest concentrations were reported in spring and fall. Burnt Bridge Creek was found to have the highest levels for most toxic parameters and the highest priority for follow-up sampling. The National Toxics Rule (NTR) criteria for human health were exceeded all three seasons for PCBs and dieldrin during winter and spring.

The fishery (i.e., aquatic life) is the main beneficial use identified as having the highest potential for impairment by toxic substances. The NTR human health criteria for edible fish tissue have been exceeded for PCBs and dieldrin within Vancouver Lake (Coots, 2007). The assessment of surface water sources draining to Vancouver Lake found water concentrations from Burnt Bridge Creek greater than criteria for these toxics (Coots and Friese, 2011). This study will address toxic substances exceeding criteria for PCBs and dieldrin within the Burnt Bridge Creek basin. Currently there are no category 5 303(d) listings for toxics in the Burnt Bridge Creek watershed.

Study Area

Burnt Bridge Creek is a small urban stream situated within the city of Vancouver in Clark County in southwest Washington. It flows about 13 miles to the west, from rural agricultural areas east of I-205 through the highly developed City of Vancouver, and eventually discharges into the southeast corner of Vancouver Lake (Figure 1). The Burnt Bridge Creek drainage encompasses about 28 square miles. Overall, it is a very low gradient stream, with a reported 80% of the drainage less than 0.1 percent slope (Herrera, 2013).

Many of the city of Vancouver area surface waters, including the study streams, have been modified or channelized throughout development history. Upstream in the Burnt Bridge Creek drainage, channelization starts around river mile 3 to 4 near State Route 500. The creek passes through two large culverts beneath the NW Fruit Valley Road and the Burlington Northern Santa Fe Railroad line just prior to discharging into Vancouver Lake's southeast corner. Burnt Bridge Creek's downstream reach is a more natural, free-flowing, wetland structure.

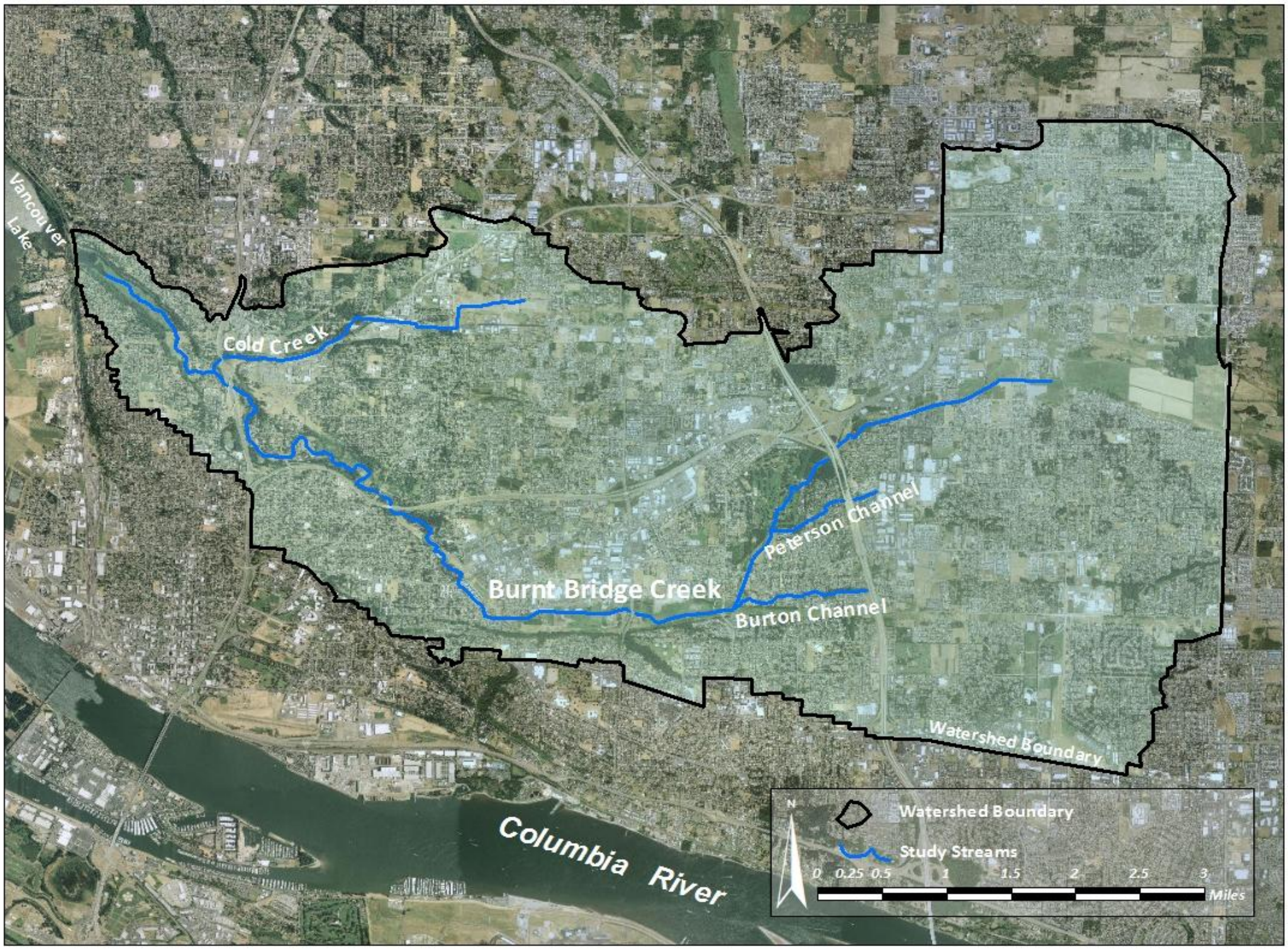

Figure 1. Burnt Bridge Creek watershed study area.

Water Resource Inventory Area (WRIA) and 8-digit Hydrologic Unit Code (HUC) numbers for the study area

WRIA

- 28

HUC Number

- 17090012

Historical Data

From January through October 2010, Ecology investigated Burnt Bridge Creek as a source of PCBs, dioxins, and chlorinated pesticides being discharged to Vancouver Lake from its three major surface water sources (Coots and Friese, 2011). The highest concentrations of PCBs and dieldrin were reported discharging from Burnt Bridge Creek exceeding NTR human health standards. The highest total PCB concentrations were measured during wash-off of spring and fall averaging about three times the NTR human health criteria of 170 pg/L (parts per quadrillion). Dieldrin exceeded the 140 pg/L NTR human health standard in winter and spring, measuring 397 and 141 pg/L dissolved, respectively.

In 2009, an Environmental Protection Agency (EPA) contractor analyzed sediments from Vancouver Lake, the Flushing Channel, Burnt Bridge Creek, Lake River, and the Columbia River (Ecology and Environment, 2010). In Burnt Bridge Creek total PCBs were present in sediment at two sites. Levels were fairly low, ranging from 8.2 to 35 ug/Kg dry weight (parts per billion). These levels were well below any freshwater cleanup screening levels of 2500 ug/Kg or cleanup objectives of 110 ug/Kg, per WAC 173-204-563.

Historical PCB or dieldrin data collected within the Burnt Bridge Creek basin is very sparse. No other studies could be located that have been conducted within the last 10 to 15 years.

Project Description

Description

Ecology's Water Quality Program, Vancouver Field Office, has requested Ecology's Environmental Assessment Program to conduct a source assessment in the Burnt Bridge Creek drainage for PCBs and dieldrin.

Previous studies measuring PCBs and dieldrin in the Burnt Bridge Creek basin have reported concentrations above water quality criteria. Watershed sources have not been systematically evaluated but are likely related to run-off from land surfaces during precipitation events, wet and dry deposition, and past and present handling practices.

The study will include an initial screening survey to identify or eliminate areas for further study. Based on results from the initial survey, a more intense sampling will focus on sites and source areas. The initial survey will collect water samples from five mainstem and the three major tributary sites during fall 2013 and the following spring. Water samples will be analyzed by solid phase extraction (SPE) for PCB congeners and dieldrin. Following return of these results, sample concentrations will be ranked and prioritized using aquatic life and surface water quality criteria as the screen for the follow-up survey source identification.

Adaptive management will be used to identify suspected sites or source areas for the second sample survey. Once the initial results identify reaches in need of further study a sample scheme will be developed for the more focused sampling. Sediments or soil will be collected for the source identification survey. Sediment or soil samples will be analyzed for PCB Aroclors, dieldrin, total organic carbon, and grain size.

The upstream areas of sites in need of follow-up will be evaluated for possible sources. This may be accomplished by a review of aerial photography, land-use maps that include historical and current industrial sites, stream walks, or anecdotal information from water quality managers or local residents. Upstream-downstream sampling will be used to isolate suspected sources, to the extent possible. As many as 25 additional samples will be used for the source identification sampling.

Goal and Objectives

The goal of this study is to identify possible sources of PCBs and dieldrin within the Burnt Bridge Creek drainage. This goal will be accomplished by successfully completing the following objectives:

- Conduct a screening survey for PCBs and dieldrin in the water column by sampling reaches and tributaries within the Burnt Bridge Creek watershed.
- Prioritize study reaches based on screening results for focused source identification.
- Conduct focused, upstream-downstream sediment sampling of problem areas for the purpose of follow-up and implementation of corrective action.

Organization and Schedule

Table 1 lists the people involved in this project. All are employees of the Washington State Department of Ecology. Table 2 presents the proposed schedule for this project.

Table 1. Organization of project staff and responsibilities.

Staff (all are EAP except client)	Title	Responsibilities
Brett Raunig TMDL Program Lead, WQP Vancouver Field Office Phone: (360) 690-4660	EAP Client	Clarifies scopes of the project. Provides internal review of the QAPP and approves the final QAPP.
Randy Coots Toxics Studies Unit SCS Phone: (360) 407-6690	Project Manager/ Principal Investigator	Writes the QAPP. Oversees field sampling and transportation of samples to the laboratory. Conducts QA review of data, analyzes, and interprets data. Writes the draft report and final report.
Dale Norton Toxics Studies Unit SCS Phone: (360) 4407-6765	Unit Supervisor for the Project Manager	Provides internal review of the QAPP, approves the budget, and approves the final QAPP.
Will Kendra SCS Phone: (360) 407-6698	Section Manager for the Project Manager	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Robert F. Cusimano Western Operations Section Phone: (360) 407-6596	Section Manager for the Study Area	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Michael Friese Toxics Studies Unit SCS Phone: (360) 407-6737	Field Lead/ EIM Lead	Develops and conducts all field sampling and transportation of samples to the laboratory. Manages and oversees all input of study data into EIM, oversees the QA review, and final access by the public.
Joel Bird Manchester Environmental Laboratory Phone: (360) 871-8801	Director	Approves the final QAPP.
William R. Kammin Phone: (360) 407-6964	Ecology Quality Assurance Officer	Reviews and approves the draft QAPP and the final QAPP.

TMDL: Total Maximum Daily Load
WQP: Water Quality Program
EAP: Environmental Assessment Program
QAPP: Quality Assurance Project Plan
SCS: Statewide Coordination Section
EIM: Environmental Information Management database

Table 2. Proposed schedule for completing field and laboratory work, data entry into EIM, and reports.

Field and laboratory work	Due date	Lead staff
Field work completed	May 2014	Michael Friese
Laboratory analyses completed	August 2014	
Environmental Information System (EIM) database		
EIM user study ID	RCOO0014	
Product	Due date	Lead staff
EIM data loaded	October 2014	Michael Friese
EIM quality assurance	November 2014	Randy Coots
EIM complete	December 2014	Michael Friese
Final report		
Author lead / Support staff	Randy Coots / Michael Friese	
Schedule		
Draft due to supervisor	October 2014	
Draft due to client/peer reviewer	November 2014	
Final (all reviews done) due to publications coordinator	December 2014	
Final report due on web	January 2015	

Quality Objectives

Quality Objectives for this study are to:

- Analyze samples for PCBs and dieldrin from Burnt Bridge Creek and its tributaries, which are representative of typical fall and spring conditions.
- Obtain analytical results that minimize uncertainty and establish baseline conditions comparable to future results.

Objectives will be achieved through careful planning and execution of analysis, and through quality control (QC) procedures presented in this plan. The plan was developed with direction found in *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Lombard and Kirchmer, 2004).

The laboratory contracted by Ecology's Manchester Environmental Laboratory (MEL) is expected to meet QC requirements selected for the project. QC procedures used during laboratory analyses will provide data for determining the accuracy of the monitoring results.

Table 3 shows measurement quality objectives (MQOs) for the methods selected for sample analysis. Analytical precision and bias will be evaluated and controlled by use of laboratory blanks, check standards, duplicates, and labeled compounds analyzed along with study samples (MEL, 2008).

Precision is a measure of the ability to consistently reproduce results. Precision will be evaluated by analysis of check standards, duplicates, and labeled compounds. Results of laboratory duplicate (split) analyses will be used to estimate laboratory precision.

Bias is the systematic error due to contamination, sample preparation, calibration, or the analytical process. Most sources of bias are minimized by adherence to established protocols for the collection, preservation, transportation, storage, and analysis of samples. Check standards (also known as laboratory control standards, LCS) contain a known amount of an analyte and indicate bias due to sample preparation or calibration.

Blanks are particularly important quality control samples for low-level analyses. Laboratory method blanks will be analyzed along with all samples to measure any response in the analytical system for target analytes. Method blanks have an expected theoretical concentration of zero. Field blanks will also be analyzed at a rate of one per screening study event.

Labeled PCB congeners will be added to congener samples prior to extraction. They have similar characteristics but do not interfere with resolution of target compounds. The percent recovery of labeled compounds is used to estimate the recovery of target compounds in samples.

The lowest concentrations of interest in Table 3 are from reporting limits MEL and their contractors have reported for analyses from similar studies.

Data outside MQOs will be evaluated for appropriate corrective action by the contract laboratory and MEL. The project manager will be contacted by laboratory quality assurance (QA) personnel to discuss how to handle the data. The final decision to accept, to accept with qualification, or to re-analyze the samples in question will be the responsibility of the project manager.

Table 3. Measurement quality objectives (MQOs).

Analyte	Lab Control Standards (% Recovery)	Laboratory Duplicates (RPD)[1]	Recoveries (% Recovery)	Lowest Concentration of Interest
Water				
PCB Congeners	25-150%	≤50%	25-150%[2]	10 pg/L[3]
Dieldrin	50-150%	≤50%	25-150%	0.14 ng/L
TSS	80-120%	≤20%	NA[4]	1 mg/L
TOC	80-120%	≤20%	NA	0.10%
Sediment or Soil				
PCB Aroclors	25-150%	≤40%	25-150%	1.25 ug/Kg, dw
Dieldrin	50-150%	≤50%	50-150%	0.125 ug/Kg, dw
TOC	75-125%	≤20%	NA	0.1 ug/Kg
Grain Size	NA	≤20%[5]	NA	NA

[1] Relative percent difference. [2] Labeled compounds. [3] Congener specific. [4] Not applicable.
[5] Relative standard deviation (RSD) for grain size, because it uses triplicate analyses.
TSS: Total suspended solids
TOC: Total organic carbon

Comparability

Comparability of study results will be ensured by using standard operating procedures and adhering to established data quality criteria consistent with other studies analyzing PCBs or dieldrin. Detection limits will be equal to or better than other investigations of PCBs or dieldrin conducted in the basin.

Representativeness

The sampling design was developed to obtain representative data on PCBs and dieldrin in Burnt Bridge Creek and its tributaries. Representativeness will be ensured by using appropriate sampling and sample handling procedures and a sampling network that defines areas for needed follow-up. Water samples will be collected by Continuous Low-Level Aquatic Monitoring (CLAM) passive sampling technology over a 24- to 36-hour period. Concentrations of target parameter are reported as a mean over the deployment period. Sediment samples will be collected as composites of multiple grabs.

Completeness

Completeness can be defined as the need to collect enough valid data to allow decisions to be made for which the study was designed. The goal of completeness is to collect and analyze 100% of the samples described in the sampling plan.

Sampling Design

This study will generate baseline data for PCBs and dieldrin within the Burnt Bridge Creek watershed including the following tributaries: Cold Creek, Burton Channel, and Peterson Channel. Collection methods and sample matrix will be specific to the initial and source identification surveys. Initial screening samples will be collected for target parameters in water, while source identification sampling will use sediment or soils. Data are needed and will be used to (1) provide representative concentrations of target chemicals in Burnt Bridge Creek and three major tributaries, (2) prioritize areas in need of follow-up sediment sampling, and (3) direct follow-up sampling to determine sources or areas in need of corrective actions.

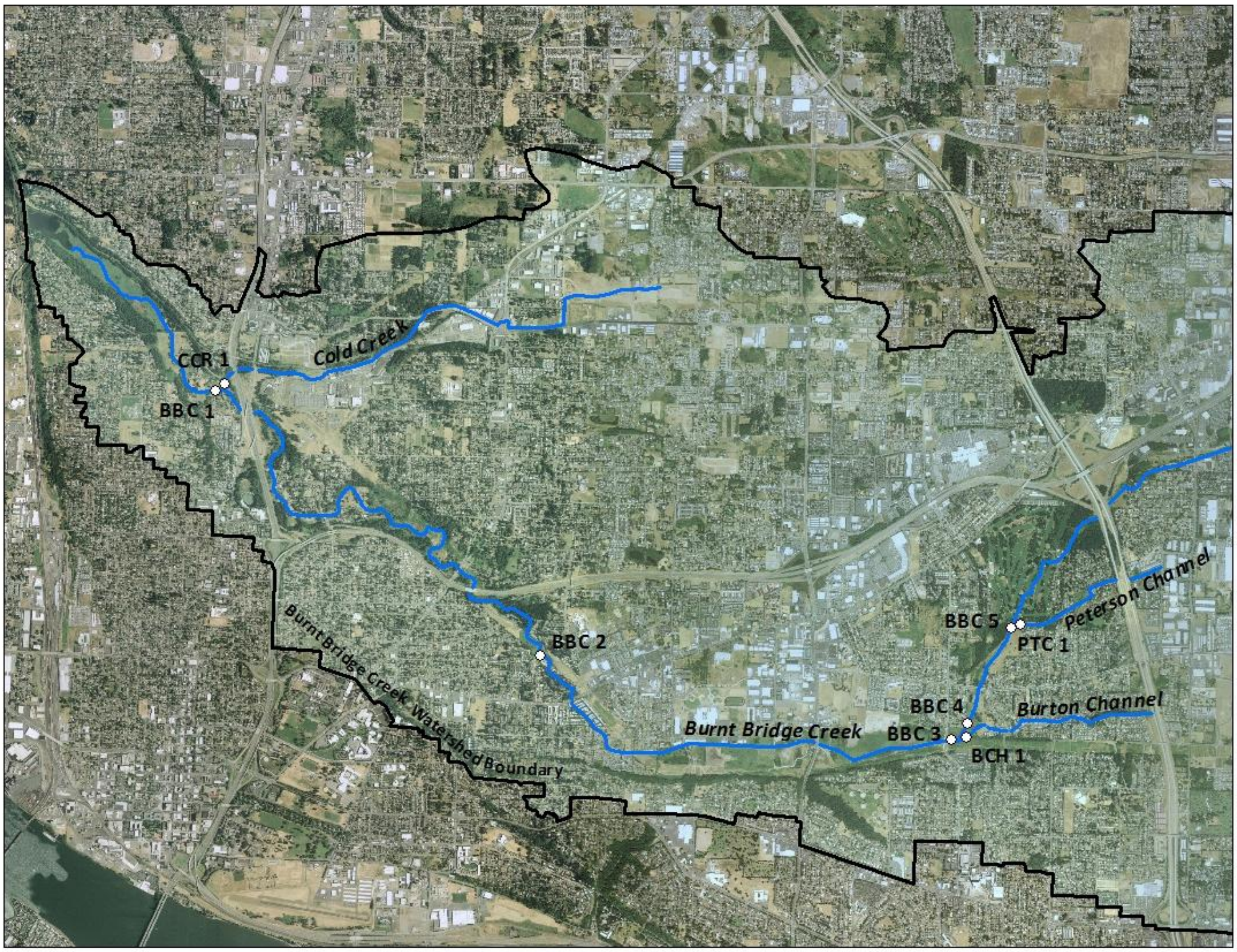

Figure 2. Study area and initial sampling sites.

Concentrations of target chemicals are anticipated to be below detection levels in whole water. As a result, for the initial water sampling portion of the study, a method that concentrates the contaminant will be used to assure detection and quantification. Also, a low-level analysis for PCB congeners will be used for initial screening to help with lower detection levels.

Initial survey samples will be collected by a relatively new sampling method called Continuous Low-Level Aquatic Monitoring (CLAM). The CLAM is a water sampling device that concentrates contaminants prior to analysis, sampling 60 or more liters of water during deployment. Solid Phase Extraction (SPE) techniques are used with this flow-through system. CLAM can also collect a large volume sample, allowing for substantially lower detection levels. SPE technology has been used for a number of years as a laboratory bench method. This newer monitoring method is generally a field application of the laboratory technique.

Following review of initial survey results, focused sampling of sediment or possibly soil samples will be conducted. The initial survey will identify reaches that exceed water quality criteria. They will be the focus of follow-up sediment or soil sampling to isolate sites or areas using an upstream/downstream sampling technique after review of the near-stream areas, land-use maps, aerial photography, and local contact knowledge.

Follow-up sediment or soil site locations intended for sampling will have fine-grained silts and clays available for collection. Areas with larger-grained materials should be avoided in efforts to locate fines.

Table 4 presents the water quality criteria to be used as screening levels for follow-up sampling and source identification work. The total PCBs and dieldrin sediment criteria for the follow-up sampling will also be applied to any soil sample results. Freshwater sediment criteria are likely conservative for soils concentrations, but for screening purposes they will serve as the best available.

Table 4. Water and sediment quality criteria as screening levels.

	Water Aquatic Life[1] (ug/L, chronic)	Sediment SMS Freshwater[2] (ug/Kg, dw)
Total PCBs	0.014	110
Dieldrin	0.056	4.9

[1] http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm
[2] Sediment Management Standards, Sediment Cleanup Objectives, WAC 173-204-563 (TCP, 2013).

Monitoring Sites

During fall 2013 and the following spring, eight sites will be sampled for PCBs and dieldrin, five along Burnt Bridge Creek and three sites at tributary mouths. The latitude and longitude of all sample locations will be located by a global positioning system (GPS) and recorded in field logs. Station position relative to significant land structure will also be recorded. Other information also recorded in field logs include site and sampler names, date, time, weather conditions, sample identification, and any other pertinent comments about the sample or site.

Figure 2 shows sample locations. A more detailed view of each site area is in the Appendix, Figure A1 through A4. Table 5 shows proposed site coordinates (i.e., latitude and longitude).

Table 5. Sample sites, coordinates, and location.

Waterbody	Latitude	Longitude	Location
Burnt Bridge Creek (BBC 1)	45.66161	-122.66928	Off 2nd Avenue
Cold Creek (CCR 1)	45.66220	-122.66822	Along NE Hazel Dell Avenue
Burnt Bridge Creek (BBC 2)	45.64124	-122.63165	End of Rossiter Lane
Burnt Bridge Creek (BBC 3)	45.63540	-122.58494	Below NE 86th Ave Bridge
Burton Channel (BCH 1)	45.63566	-122.58324	Access from NE 19th Circle
Burnt Bridge Creek (BBC 4)	45.63677	-122.58311	Access from NE 20th Street
Burnt Bridge Creek (BBC 5)	45.64445	-122.57852	Access from end of NE 93rd Avenue
Peterson Channel (PCH 1)	45.64473	-122.57745	Off end of NE 93rd Avenue

Datum: NAD 83HARN

Sampling Timing

The initial screening samples will be collected once in the fall of 2013 and once in the spring of 2014 at each of the eight sites shown in Figure 2. Collection periods were selected to coincide with previous sample events that identified the critical period for target analyte input to surface water.

High levels of suspended sediments in the water column can plug the SPE filters in CLAM samplers, reducing filter capacity and total sample volume. Higher flows from precipitation can increase water column sediments by wash-off from land surfaces and re-suspension of bed-load. To avoid potential plugging and sample volume reduction, CLAM samplers will not be deployed during rain events.

CLAM samplers will be deployed for 24 to 36 hours, when discharge at study sites is stable following the fall groundwater recharge period. Recharge of groundwater in the fall can be verified by monitoring stage height within the basin. Following the onset of fall rain events when a small amount of rainfall increases stage height at a gage, groundwater is recharged. CLAM samplers will be deployed between storm events, and deployment will be avoided within 24 hours following a storm.

After results from the initial sample survey are analyzed and reviewed, a second round of sampling, based on results from the first round, will be conducted. The second round will focus on sites or areas that may be contributing levels of PCBs or dieldrin, alone or in combination, where the surface water body exceeds water quality criteria. These samples will likely be collected sometime in April following receipt and review of results from the fall initial sampling, stream walks, and review of aerial land-use photography and historical locations of industrial sources.

Invasive Species Procedures

The Burnt Bridge Creek drainage is located in an area of the state that is considered an "Area of Extreme Concern" for the spread of invasive species. This designation requires field staff to use special decontamination procedures when engaged in any field activities within the area.

Ecology's Environmental Assessment Program has developed a standard operating procedure (SOP), *Standard Operating Procedure to Minimize the Spread of Invasive Species* (Parsons et al., 2012). This SOP must be followed if field work is conducted within a designated area of extreme concern for the spread of invasive species. It covers all field operations and also applies to contractors or organizations working jointly with Ecology.

Washington State law prohibits the transportation of all aquatic plants, animals, and many noxious weeds. The SOP was developed to meet the law's requirement and to minimize risk of spreading any organisms, especially aquatic invasive species (AIS), within or between water bodies or sites. All field operations, sample equipment, supplies, and gear are covered in the SOP.

Personnel involved in sampling require specific training for the procedures included in SOP EAP070. Staff working in the field to collect samples for the study will be familiar with and will adhere to SOP EAP070 for minimizing the spread of invasive species.

Sampling Procedures

Initial screening survey samples will be collected by CLAM samplers. All persons involved in deployment and retrieval of CLAMs will be familiar with the methods, use, and application of the sampler. Source identification sampling will analyze sediment or soil to isolate sites or areas in need of follow-up.

Field staff who process samples will be familiar with SOPs for surface water sampling of the conventional parameters as outlined in Ecology SOP EAP015 *Standard Operating Procedure for Manually Obtaining Surface Water Samples* (Joy, 2006); for collection of freshwater sediments SOP EAP040 *Standard Operating Procedure for Obtaining Freshwater Sediment Samples* (Blakley, 2008); and SOP EAP013 *Standard Operating Procedure for Determining Coordinates Via Hand-held GPS Receivers* (Janisch, 2006).

Screening Survey

The CLAM sampling system will be used for the initial sampling survey to identify areas in need of a more detailed follow-up. CLAMs will be deployed and retrieved at each of eight sites during fall of 2013 and spring of 2014. Locations of deployments will target reaches of the mainstem Burnt Bridge Creek and the mouths of the three major tributaries. Each deployment period will last 24 to 36 hours. Deployments will proceed from downstream sites to upstream sites. Rain events will be avoided because the CLAMs could be overwhelmed with sediments. Urban streams are known to be flashy and quick to wash-off surface debris, particularly during first flush events or long periods without rainfall.

Ecology field staff will deploy and retrieve the CLAMs. On site, prior to deployment and at retrieval, field staff will determine a sample volume by calibrating the CLAM pumping system. Calibration determines the amount of water pumped through the CLAM during deployment.

Prior to deployment, a tube will be attached to the outlet of the CLAM. The pumping volume will be determined over a specified period. This procedure will be repeated until three measurements are in agreement. This will also be done at retrieval. This allows for a good estimate of total volume of water sampled. Field studies have shown a linear relationship between starting pump rates and ending pump rates. A video on YouTube explains the deployment and retrieval process: http://youtu.be/TKybXgT0DoI.

The CLAM utilizes a solid phase extraction (SPE) disc as a sampler. Prior to deployment SPE discs intended for field use will be sent to the analytical laboratory for conditioning. The conditioning process prepares the discs for field use by running clean solvents through them and spiking them with surrogates for the target analytes. The developer of the system, C.I. Agent Storm Water Solutions, has an SOP for the conditioning process to be used by the analytical laboratory doing the analysis.

A number of different types of SPE discs can be used with the choice based on the analytes of interest. Typically for non-polar organics like PCBs and dieldrin, a high capacity C18 SPE disc is used. More information on SPE discs and the CLAM system is at the manufacturer's website: www.ciagent-stormwater.com/.

Biofouling is often problematic with deployments of water quality instruments. CLAMs will probably not have this problem due to the relatively short maximum deployment period of 36 hours. High amounts of sediment could slow down or even clog the filter and would likely present the greatest risk to the sample from event- based loads coming in during rain or terrestrial activity. Shorter deployment times can compensate for higher sediment levels if needed. Rain events will be avoided for the initial sample surveys.

CLAM samples will be analyzed for PCB congeners and dieldrin. Results will be reported as total concentrations in units of pg/L (picograms per liter or parts per quadrillion). No pre-filtering of samples will be conducted. When SPE discs are retrieved, they will be placed in their special plastic bags and shipped directly to MEL and their contractor.

Ancillary samples for total organic carbon (TOC) and total suspended solids (TSS) will be collected along with the CLAM samples on site following deployment and retrieval of the CLAM samplers. These samples will be collected from each site when CLAMs are deployed and when they are retrieved, from 24 to 36 hours after deployment. TOC and TSS samples will be collected mid-stream or within the stream thalweg if not located stream center. Standing in undisturbed substrate, facing upstream, field staff will collect the samples at wrist-depth.

Laboratory staff add preservative to the new TOC bottles before field samplers receive them. The TOC can be collected by drawing the sample with the cap covering most of the opening. This allows for a slower filling, to monitor for prevention of overfill and loss of preservative.

Discharge will not be measured during the study, so loads will not be calculated. Screening for source identification will be based on target analyte concentrations compared to criteria. No other ancillary parameters beyond TOC and TSS will be measured.

Table 6 lists requirements for containers, preservation, and holding times. Chain-of-custody procedures will be maintained throughout the sampling and analysis process.

Table 6. Containers, preservation, and holding times for screening survey samples.

Parameter	Container[1]	Preservation	Holding Time
PCB Congeners	C-18 SPE discs are placed in manufacturer-provided amber plastic bags	Cool to 4°C	14 days
Dieldrin			
TOC	2-60 mL poly bottles	1:1 HCl to pH<2; Cool to 4°C	28 days
TSS	1 L poly bottle	Cool to 4°C	7 days

[1] Certified sample containers provided by Manchester Environmental Laboratory or their contract laboratory.
TOC: Total organic carbon.
TSS: Total suspended solids

Source Identification Sampling

Once the initial screening results are reviewed to identify or eliminate reaches in need of further study, the source identification survey will be conducted. Adaptive management will be used to locate and identify sites or source areas through paired or upstream downstream sampling to focus attention to as small a localized area as possible.

Based on levels of PCBs and dieldrin from screening survey samples, reaches that have water concentrations greater than water quality criteria will undergo focused source sampling to isolate sites or areas needing correction. A ranking system to prioritize sites exceeding screening survey criteria will be used, based on reported concentrations. This may also include calculating a hazard index to prioritize the magnitude of the exceedance above criteria. The decisions for placement of sample locations will be based on sample results, review of the near-stream areas, land-use maps, aerial photography, and local contact knowledge. Toxic parameters for the source identification study will be total PCBs as Aroclors and dieldrin measured from sediment or soil.

The top 2 centimeters of surface sediment will be collected by use of a stainless steel 0.05 m^2 Ponar grab or stainless steel spoons, depending on depth of the overlying water. Following collection of each sediment grab, an evaluation of acceptability will be made. Information about each grab will be recorded in field logs. A Ponar grab will be considered acceptable if it is not overfilled, overlying water is present but not overly turbid, and the sediment surface appears intact.

Any overlying water will be siphoned off prior to sub-sampling. Equal volumes of sediment will be removed from three separate grabs per site when available. Dedicated stainless steel bowls and spoons will be used for sub-sampling and homogenizing sediment or soil from each station to a uniform color and consistency. Debris on the sediment surface or materials contacting the sides of the Ponar grab will be discarded.

Soil samples will be collected, using dedicated stainless steel bowls and spoons, after loose debris on the soil surface is removed. The top 2 centimeters of soil will be collected and retained for analysis.

Homogenized sediment or soil from each station will be placed in 8-oz. glass jars with Teflon-lined lids for analysis of total PCBs as Aroclors and dieldrin. Sample containers will be cleaned to EPA (1992) quality assurance/quality control (QA/QC) specifications and certified for trace organic analyses. Additionally, 2-oz. glass jars will be filled with homogenate for total organic carbon analysis, while 8-oz. plastic jars will be filled to determine grain size.

All equipment used to collect sediment or soil samples will be washed thoroughly with tap water and Liquinox detergent, followed by sequential rinses of hot tap water, de-ionized water, and pesticide-grade acetone. Sampling equipment will be air-dried between each cleaning step under a fume hood. Following the last rinse, the air-dried equipment will be wrapped in aluminum foil, dull side contacting equipment, until used in the field. The same cleaning procedure will be used on the grab sampler prior to going into the field. To avoid cross-contamination between sample stations, the grab sampler will be thoroughly brushed down with on-site water at each of the next sample locations.

Immediately after their collection, samples will be placed in coolers on ice at 4°C and transported to MEL within 48 hours. MEL will repack and ship the samples frozen in coolers to the contract laboratory.

Table 7 lists requirements for containers, preservation, and holding times. Chain-of-custody procedures will be maintained throughout the sampling and analysis process.

Table 7. Study parameters, sample and container size, preservation, and holding times for sediment or soil samples.

Parameter	Sample Size (Grams)	Container[1]	Preservation	Holding Time
PCB Aroclors Dieldrin	250	8-oz Glass	Cool to 4°C or Freeze -18°C	1 year to extraction, 1 year to analysis
TOC	25	Certified 2-oz Glass w/ Teflon Lid Liner	Cool to 4°C	14 days; 6 months frozen
Grain Size	150	8-oz Glass or Poly	Cool to 4°C	6 months

[1] Certified sample containers provided by Manchester Environmental Laboratory (MEL) or their contract laboratory.
TOC: Total organic carbon.

Measurement Procedures

Laboratory

The analytical parameters, sample numbers, expected range of results, reporting limits, and analytical methods to be used on study samples are presented below in Table 8. Study objectives and the goal of reporting limits equal to or better than the lowest concentration of interest determine which method is selected.

Sample containers will be obtained from MEL or the contract laboratories conducting the analysis and cleaned to analyte-specific standards. Chain-of-custody procedures will be followed throughout the sampling and analysis process.

All project samples will be analyzed at MEL or by a MEL-selected contractor. Laboratories may use other appropriate methods, after consulting with the project lead.

Laboratories contracted by MEL must be on the Ecology list of accredited laboratories (www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html). Additionally, when available, laboratories conducting analysis for Ecology studies must be on the General Administration master contract.

Table 8. Laboratory parameters, number of samples, expected range of results, reporting limits, and analytical methods for the Burnt Bridge Creek Study.

Parameter	Sample Number[1]	Expected Range of Results	Reporting Limits	Sample Cleanup and Extraction Methods	Analytical Method
Water					
PCB Congeners	20	10 – 1,000 pg/L	10 pg/L[2]	EPA 3535	EPA 1668C
Dieldrin	20	0.001 – 10 ng/L	2 -10 ng/L	EPA 3535M	EPA 8081M
TOC	18	1 – 2 mg/L	1 mg/L	SM 5310B	
TSS	18	1 – 4 mg/L	1 mg/L	SM 2540D	
Sediment or Soil					
PCB Aroclors	30	5-500 ug/Kg	10 ug/Kg	EPA 3620C, 3660B, 3665A/ EPA 3535 and 3541	SW-846 EPA 8082 GC/ECD
Dieldrin	30	<1 – 10 ug/Kg	1 – 5 ug/Kg	EPA 3620C, 3660B/EPA 3535 and 3541	EPA 8081/8270
TOC	27	1 – 6%	0.1%	PSEP – TOC, Combustion NDIR	
Grain Size	27	NA	0.1%	PSEP 1986, Sieve and pipet	

[1] Sample number includes QC samples.
[2] PCBs reporting limits are congener specific.
TOC: Total organic carbon. TSS: Total suspended solids.

Budget

The estimated laboratory costs for this project total $37,667. Table 9 presents the breakdown for these estimates.

Table 9. Burnt Bridge Creek Study estimated laboratory analysis budget.

Parameter	Number of Samples	Number of QA Samples	Total Number of Samples	Cost Per Sample	MEL Subtotal	Contract Fee[1]
Screening Samples						
PCB Congeners	16	4	20	815	16,300	4075
Dieldrin	16	4	20	173	3,460	
TOC	32	4	36	36	1,296	
TSS	32	4	36	12	432	
Source Identification Samples						
PCB Aroclors	25	4	29	255[2]	7,395	
Dieldrin	25	4	29			
TOC	25	2	27	46	1,334	
Grain Size	25	2	27	100	2,700	675
				Screening Survey Subtotal	21,488	
				Source ID Subtotal	11,429	
				Contracting Subtotal		4750
				Lab Grand Total	$37,667	

[1] Contract Fee includes a 25% additional charge.
[2] PCB Aroclors and dieldrin in sediment are completed as one analysis.
Costs include 50% discount for Manchester Laboratory.

Additional costs to the project are:

- Rental of CLAM sampler systems for eight sites and two QA samples over two seasons.
- Purchase of 20 SPE discs for the CLAM systems.

Table 10 shows estimated additional cost for rental of CLAM equipment and SPE discs.

Table 10. Burnt Bridge Creek Study estimated cost of CLAM equipment rental and SPE discs.

Equipment	Events	Sites	QA	Total	Cost Each	Total Cost
CLAMS	2	8	2	20	$180	3600[1]
SPE C-18 Discs	2	8	2	20	$89	1780[2]
					Equipment Total:	$5,380

[1] CLAMs rent for $180 each.
[2] SPE disc are $89 each.

Quality Control Procedures

Field

Table 11 lists the field QC samples used for the project. Field QC samples will provide an estimate of the total variability of results (field plus laboratory) and will consist of collection and analysis of replicate samples and field blanks.

Estimates of variability will be assessed from replicate samples consisting of two samples collected as close to the same time and location as possible and sent to the laboratory as two independent samples.

Field blanks will be handled, transported, and analyzed as any other study sample. Transfer field blanks will use two pre-cleaned containers: one filled with laboratory-grade reagent water, the other empty. The filled container serves as the source for the transfer. The empty container receives the source water in the field during collection of other samples.

Transfer blank water should be from the same source as method blank water and consist of Deionized Reagent Water (Type II ASTM and organic free). The reagent water should be provided by the laboratory conducting analysis of study samples.

One transfer field blank will be analyzed for each of the two water sample events and analyzed for PCB congeners and dieldrin. Transfer field blanks detect any bias due to contamination from sample equipment, containers, or handling.

All efforts will be made to avoid cross-contamination of samples. Field staff will wear non-talc nitrile gloves throughout the sample collection process. Immediately after collecting samples, staff will store and ship on ice to MEL. MEL will receive study samples, process, and send to their respective analyst or ship to contract labs.

To help minimize field variability from sample collection, field staff processing samples will be familiar with these 2 SOPs:

- for surface water sampling - EAP015 *Standard Operating Procedure for Manually Obtaining Surface Water Samples* (Joy, 2006)
- for collecting freshwater sediments - SOP EAP040 *Standard Operating Procedure for Obtaining Freshwater Sediment Samples* (Blakley, 2008)

Any equipment used in collection or processing samples will be decontaminated prior to going to the field. Sample equipment will be washed thoroughly with hot tap water and Liquinox detergent, followed by sequential rinses of 10% nitric acid, de-ionized water, and finally pesticide-grade acetone. After decontamination, sampling equipment will be air-dried under a fume hood, covered with aluminum foil with dull side contacting equipment.

Table 11. Field quality control (QC) samples.

Analysis	Replicates	Transfer Blanks
Water		
PCB Congeners	1/event	1/event
Dieldrin	1/event	1/event
TOC	2/event	-
TSS	2/event	-
Sediment or Soil		
PCB Aroclors	1/event	-
Dieldrin	1/event	-
TOC	2/event	-
Grain Size	1/event	-

Laboratory

PCB congener analysis for the screening survey and grain size analysis for the source sampling will be performed by a contact laboratory under the direction of MEL. Contract laboratories selected for analysis of study samples will have specific knowledge and experience with the requested method. The contract laboratory will make available all routinely run control samples for sample batches. Table 12 shows laboratory control samples for this project.

Table 12. Laboratory quality control (QC) samples.

Parameter	Laboratory Control Sample (LCS)	Method Blank	Surrogate Spikes	Duplicates	Labeled Compounds	MS/MSD[1]
Water						
PCB Congeners	1/batch	1/batch	--	1/batch	all samples	--
Dieldrin	1/batch	1/batch	all samples	-	--	1/batch
TOC	1/batch	1/batch	--	1/batch	--	1/batch
TSS	1/batch	1/batch		1/batch	--	--
Sediment or Soil						
PCB Aroclors	1/batch	1/batch	1/batch	--	--	1/batch
Dieldrin	1/batch	1/batch	1/batch	--	--	1/batch
TOC	1/batch	1/batch	--	1/batch	--	--
Grain Size	--	--	--	1/batch[2]	--	--

[1] Matrix spike/matrix spike duplicate.
[2] Grain size is run in triplicate.

Data Management Procedures

Staff will record all field data and observations in notebooks on waterproof paper. Staff will transfer information in field notebooks to Excel spreadsheets after returning from the field. Data entries will be independently verified for accuracy by another member of the project team.

Case narratives included in the data package from MEL will discuss any problems encountered with the analyses, corrective action taken, changes to the requested analytical method, and a glossary for data qualifiers. Laboratory QC results will also be included in the data package. This will include results for surrogate recoveries, laboratory duplicates, matrix spikes, and laboratory blanks. The information will be used to evaluate data quality, determine if the MQOs were met, and act as acceptance criteria for project data.

Field and laboratory data for the project will be entered into Ecology's EIM system, except for the water quality data generated using the CLAM systems. The CLAM system is still considered under development. Until SOPs for this method have been approved, this data will not be included in EIM. However, it can be obtained by contacting the study author. Laboratory data will be downloaded directly into EIM from MEL's data management system.

Audits and Reports

MEL participates in performance and system audits of their routine procedures. Results of these audits are available upon request.

A draft report of the study findings will be completed by the principal investigator in October 2014 and a final report in January 2015. The report will include, at a minimum, the following:

- Map showing all sampling locations and any other pertinent features of the study area.
- Coordinates of each sampling site.
- Description of field and laboratory methods.
- Discussion of data quality and the significance of any problems encountered.
- Summary tables of the chemical and physical data.
- Results of the toxic contaminants related to available standards and ranking of surface water inputs.
- Discussion of any seasonal significance from data concentrations of toxic chemicals in the surface waters.
- Description of the screening process and result ranking to determine locations for the source identification sampling.
- Recommendations for follow-up actions, based on results from the source identification sampling.
- Complete set of chemical and physical data in the Appendix.

Upon study completion, all project data will be entered into Ecology's EIM system, except for the water quality data generated using the CLAM systems. The CLAM system is still considered under development. Until SOPs for this method have been approved, this data will not be included in EIM. However, it can be obtained by contacting the study author. Public access to electronic data and the final report for the study will be available through Ecology's Internet homepage (www.ecy.wa.gov).

Data Verification

Data verification is a process conducted by producers of data. Normally a MEL unit supervisor or an analyst experienced with the method verifies laboratory data. It involves a detailed examination of the data package using professional judgment to determine whether the MQOs have been met.

The principal investigator is responsible for the final acceptance of the project data. The complete data package, along with MEL's written report, will be assessed for completeness and reasonableness. Based on these assessments, the data will either be accepted, accepted with qualifications, or rejected and re-analysis considered.

Data verification involves examining the data for errors, omissions, and compliance with QC acceptance criteria. MEL's SOPs for data reduction, review, and reporting will meet the needs of the project. Data packages, including QC results for analyses conducted by MEL, will be assessed by laboratory staff using the EPA Functional Guidelines for Organic Data Review.

MEL staff will provide a written report of their data review which will include a discussion of whether (1) MQOs were met, (2) proper analytical methods and protocols were followed, (3) calibrations and controls were within limits, and (4) data were consistent, correct, and complete, without errors or omissions.

Data Quality (Usability) Assessment

After the project data have been reviewed and verified, the principal investigator will determine if the data are of sufficient quality to make determinations and decisions for which the study was conducted. The data from the laboratory's QC procedures, as well as results from field replicates, laboratory duplicates, and surrogate recoveries, will provide information to determine if MQOs have been met. A review of sample results will be performed following each seasonal sampling event to assess the need for modifications to the sampling or analysis program. Laboratory and QA staff familiar with assessment of data quality may be consulted. The project final report will discuss data quality and whether the project objectives were met. If limitations in the data are identified, they will be noted.

Some analytes will be reported near the detection capability of the selected methods. MQOs may be difficult to achieve for these results. MEL's SOP for data qualification and best professional judgment will be used in the final determination of whether to accept, reject, or accept the results with qualification. The assessment will be based on a review of field replicates, along with laboratory QC results. This will include assessment of laboratory precision, contamination (blanks), accuracy, matrix interferences, and the success of laboratory QC samples meeting control limits.

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Appendices

Appendix A. Sample Site Locations

Figure A1. Burnt Bridge Creek and Cold Creek screening survey collection sites.

Figure A2. Burnt Bridge Creek at Rossiter Road screening survey collection site.

Figure A3. Burnt Bridge Creek and Burton Channel screening survey collection sites.

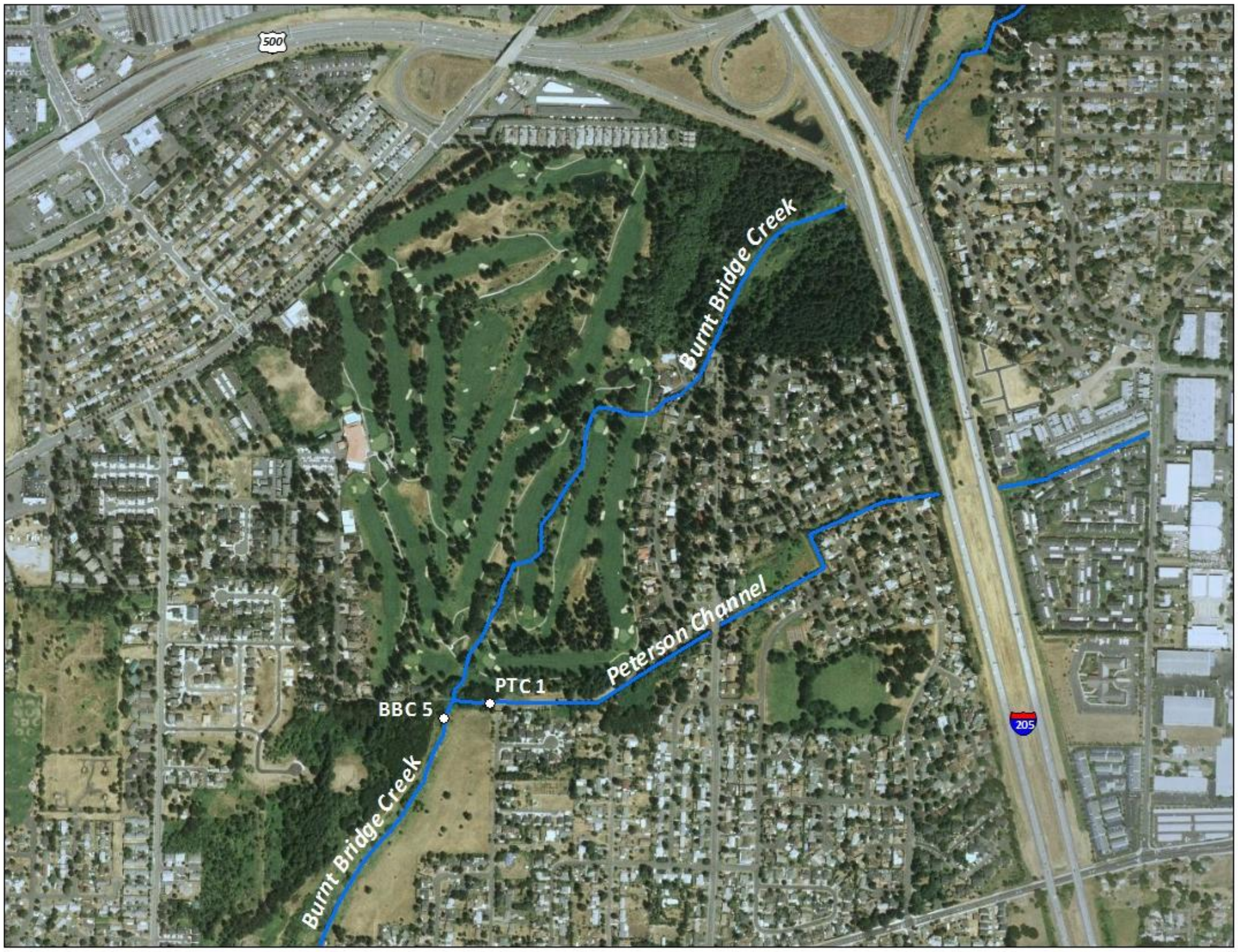

Figure A4. Burnt Bridge Creek and Peterson Channel screening survey collection sites.

Appendix B. Glossary, Acronyms, and Abbreviations

Glossary

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

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

Reach: A specific portion or segment of a stream.

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

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standard and are not expected to improve within the next two years.

Acronyms and Abbreviations

CLAM	Continuous Low-Level Aquatic Monitoring device
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
et al.	And others
GPS	Global Positioning System
i.e.	In other words
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
NTR	National Toxics Rule
PCB	polychlorinated biphenyls
QA	Quality assurance
QC	Quality control
SOP	Standard operating procedures
SPE	Solid Phase Extraction

TOC	Total organic carbon
TSS	Total suspended solids
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area

Units of Measurement

°C	degrees centigrade
dw	dry weight
L	liter
m	meter
ML	milliliter
ug/Kg	micrograms per kilogram (parts per billion)
mg/L	milligrams per liter (parts per million)
ug/L	micrograms per liter (parts per billion)
ng/L	nanograms per liter (parts per trillion)
pg/L	picograms per liter (parts per quadrillion)