CITY OF BAINBRIDGE ISLAND

Water Quality and Flow Monitoring Program

Final
QUALITY ASSURANCE PROJECT PLAN
Bainbridge Island, Washington

April 2008

CoBI Contract No. – 250130

Final
Quality Assurance Project Plan

Water Quality and Flow Monitoring Program

City of Bainbridge Island

Washington

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Prepared For:
Department of Public Works
Water Resources Program
City of Bainbridge Island, Washington

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TABLE OF CONTENTS

List of Figures

List of Tables

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ACRONYMS AND ABBREVIATIONS

µg	micrograms
µS/cm	microSiemens per centimeter
BMP	Best Management Practice
$CaCO_3$	calcium carbonate
CAO	Critical Areas Ordinance
CFR	Code of Federal Regulations
CoBI	City of Bainbridge Island
CoC	chain of custody
CWA	Clean Water Act
DQO	data quality objective
Dx-G	Diesel extended gasoline
Ecology	Washington State Department of Ecology
EIM	Energy Information Management
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
GMA	Growth Management Act
GPS	Global Positioning System
L	liter(s)
LULC	land use/land cover
MDL	method detection limit
mg	milligrams
ml	milliliter
MS	matrix spike
mS/cm	milliSiemens per centimeter
MSD	matrix spike duplicate
Mv	millivolt
ng	nanogram
nw	northwest methods
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
ORP	Oxygen Reduction Potential
PCB	polychlorinated biphenyl
PD	Percent Difference
PIT	Passive Integrated Transporter
PM	project manager
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
PACs	performance and acceptance criteria
ppt	parts per thousand
PSAT	Puget Sound Action Team

ACRONYMS AND ABBREVIATIONS (CONTINUED)

RL	reporting limit
RPD	relative percent difference
SAP	sampling and analysis plan
SER	site evaluation report
SMA	Shoreline Management Act
SOP	standard operation procedure
TAI	Taylor Associates, Inc.
TEC	TEC Inc.
TMDL	total maximum daily load
TPH	total petroleum hydrocarbon
TOC	total organic carbon
VOA	volatile organic analysis
WQFMP	Water Quality and Flow Monitoring Program

1.0 PROJECT INFORMATION

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) for the City of Bainbridge Island (CoBI) Water Quality Monitoring Program (WQFMP) has been prepared to summarize the project background, detail the data quality objectives, establish the project management organization, and to present the quality assurance (QA) requirements and quality control (QC) procedures that are to be implemented for the program. The QAPP, along with relevant sections of the Site Evaluation Report (SER) and the Sampling and Analysis Plan (SAP), describes the field and laboratory activities associated with the WQFMP. The companion SAP includes a description of the sample types, locations, collection methods, handling, and custody requirements.

This QAPP defines the sampling and analysis methods, QC procedures, and QC criteria that will be implemented for the WQFMP to maximize data quality and ensure that program-specific data quality objectives (DQOs) are also achieved. These DQOs are discussed in this document. Guidance on the development of each DQO can be found in the U.S. Environmental Protection Agency (EPA) Guidance for the Data Quality Objectives Process. This QAPP has been developed by following guidelines provided by the Washington State Department of Ecology (Ecology), *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004.)

The intended use of this QAPP is designed for and includes only those sampling and data collection and management tasks as specified in the Centennial Clean Water Fund Grant Agreement, Part V, Scope of Work, Task 5 – Design and Implementation of a Pilot Monitoring Study (Ecology 2005). Activities described in this QAPP are all of those that will possibly be conducted during the pilot study portion of this program. However, the activities as described in this QAPP could also be utilized for the future full scale implementation of tasks described in the SAP. Section 8 of the SAP details both, the pilot study activities that are proposed based on findings in the SER and budgetary constraints and the future needs of the full scale implementation of the CoBI WQFMP. As described in Section 1.2 of the SAP, data collected as part of the WQFMP has the potential to support a multitude of different end-uses. The level of data quality required to support different decision rules will vary. Furthermore, the wide array of data collection activities that will possibly be conducted under this program are subject to change as more information becomes available and future work is better defined. Consequently, this QAPP will likely need to be updated as programmatic requirements change to support future requirements. These future updates would likely be detailed in the yearly WQFMP Technical Memorandum as described in Section 8 of the SAP.

1.2 BACKGROUND

Bainbridge Island is located in Kitsap County, Washington in the Puget Sound (Figure 1-1). The jurisdiction of the CoBI encompasses the entire island. A primary goal of CoBI is to protect and restore surface and nearshore water quality in the twelve Bainbridge Island watersheds. Activities essential to accomplishing this goal include:

- Assisting the community in making sustainable choices that prevent or reduce water pollution problems, including non-point-source stormwater pollution, aquatic habitat degradation, and threats to human health.
- Documenting the historic water quality conditions and trends for the surface and nearshore waters of Bainbridge Island.

- Determining baseline and dynamic water quality conditions for the surface and nearshore waters of Bainbridge Island.
- Execution of a long-term water quality monitoring program to ensure that unimpaired waters remain in compliance with Washington State water quality standards, and that designated beneficial uses of impaired waters are restored.
- Implementation of management actions to protect and restore impaired waters.

There are a number of regulations in state and federal law that require ambient water quality monitoring. Section 305(b) of the Clean Water Act (CWA) (Title 33 U.S. Code Chapter 26) requires that states report to the EPA on how well waters of the state support their designated beneficial uses and section 303(d) requires states to identify waters that do not meet water quality standards. The National Pollutant Discharge Elimination System (NPDES) Phase II requirements also necessitate monitoring. At the State of Washington level, Ecology requires water quality monitoring to ensure that the designated beneficial uses of receiving waters are protected (Washington Administrative Code 173-201A-170). The Puget Sound Action Team (PSAT) Puget Sound Restoration and Recovery Plan (PSAT 2005) and the Puget Sound Initiative (PSAT 2006) both emphasize water quality monitoring and cleanup efforts.

Figure 1-1
Regional Location of Bainbridge Island and Boundary of the
CoBI Water Quality and Flow Monitoring Program

In addition to federal and state regulations, several CoBI ordinances and programs as well as the CoBI Comprehensive Plan emphasize the importance of protecting and restoring a high level of water quality in the freshwater and nearshore-marine environments of the island.

The following section outlines the specific program objectives of the CoBI WQFMP:

- Characterize the water quality (i.e., chemical, physical, and biological) conditions in Bainbridge Island streams, lakes, wetlands, and nearshore-marine areas.
- Identify short-term changes or long-term trends in water quality conditions over time.
- Collect water quality data related to surface and stormwater regulatory requirements (e.g., NPDES Phase II).
- Gather information for use in developing pollution prevention measures or water quality treatment Best Management Practices (BMP).
- Determine the effectiveness of pollution prevention measures and water quality treatment BMP systems.
- Determine if water quality program goals are being met and whether water bodies on and around the island comply with water quality regulations.
- Provide opportunities for public outreach and water quality data to support public education programs.
- Support reporting of water quality conditions to the public, including shellfish harvest restrictions, recreational beach closures, and drinking water advisories.
- Respond to emergency situations such as oils spills, chemical leaks, sewage spills, and flooding events.

Water quality monitoring data may be used to support a number of other activities. These activities include load assessment to support Total Maximum Daily Load (TMDL) investigations, water quality cleanup programs, wastewater discharge permitting, water resource management, and watershed management by local government.

As defined in the CWA, water quality includes chemical, physical, and biological components. Therefore, a comprehensive water quality and flow monitoring program needs to address each of these components in order to fully assess water quality conditions. In accordance with the CWA, the surface and nearshore waters of Bainbridge Island must meet established water quality standards and support their designated beneficial uses. These designated beneficial uses include:

- contact recreation,
- drinking water supply,
- fishing and shellfish harvest, and
- aquatic biota and habitat.

The CoBI WQFMP has been designed to ensure that these designated beneficial uses are supported and that the waters of Bainbridge Island meet Washington State water quality standards established for these uses. Ultimately, it is the objective of this program to meet the goal of the CWA to protect and restore the chemical, physical, and biological integrity of the waters of Bainbridge Island.

An effective water quality monitoring program should be designed to systematically collect physical, chemical, and biological information, and analyze, interpret and report those measurements based on a carefully planned design, which follows a standardized framework (Figure 1-2).

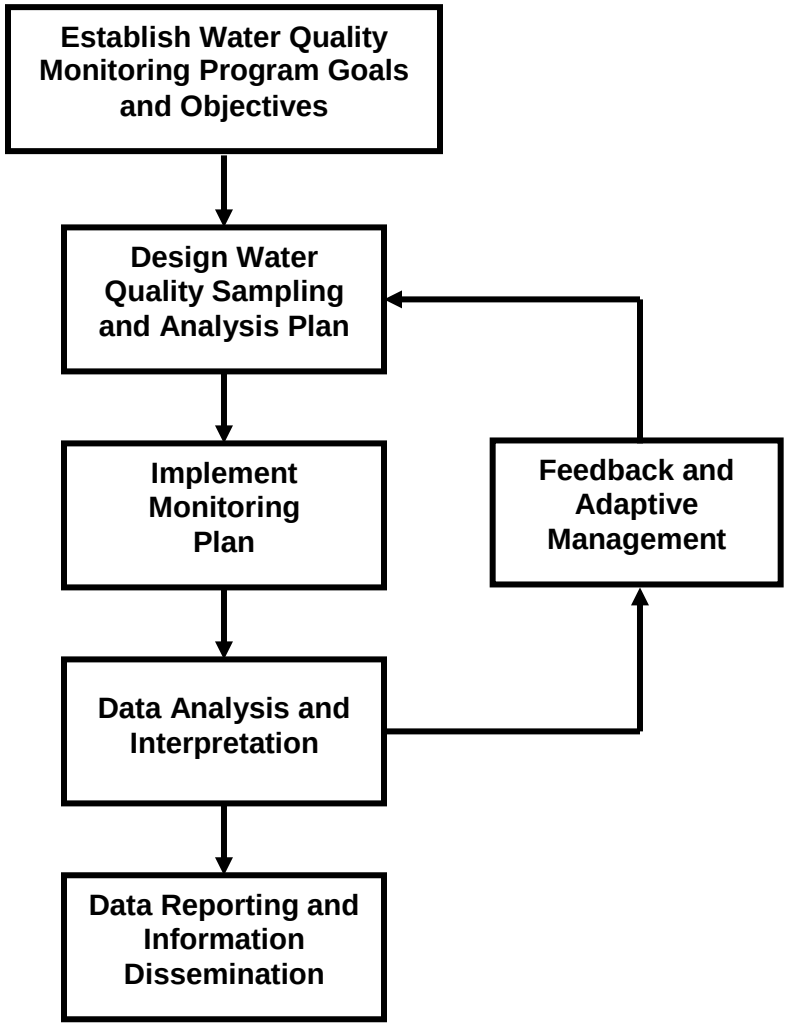

Figure 1-2. Conceptual Framework for Water Quality and Flow Monitoring Program

The SAP is an integral part of the overall QAPP that will provide the foundation of the Bainbridge Island WQFMP. The SAP includes standard methods and protocols for fieldwork and laboratory components of the monitoring program and addresses occupational health and safety issues, as well as QA procedures. Data analysis may include statistical and trend analysis, as well as interpretation of results based on water quality standards and criteria. It is important to remember that the design of a monitoring program is an iterative process (i.e., feedback and adaptive management), as indicated in Figure 1-2, and that earlier components in the structure should be refined on the basis of findings in later stages.

1.3 PROJECT DESCRIPTION

The primary goal of the CoBI WQFMP is to develop and implement a comprehensive monitoring program that will identify water quality and water flow problems and define thresholds for initiation of management responses for areas within the CoBI's jurisdiction and surrounding marine environment.

Following the synthesis of data from past monitoring and regulatory efforts, a complete water quality and flow monitoring strategy has been developed. This strategy will culminate in the implementation of a 1-year pilot program, using a subset of Bainbridge Island watersheds and their associated nearshore receiving waters, BMP structures and outfalls to test and refine the design, sampling methods, and data QA procedures of the monitoring program.

Results of this pilot study will be combined with feedback from CoBI, Ecology, project stakeholders, and other interested parties to develop a final water quality and flow monitoring plan. In conjunction, a program specific data management system has been developed so that data collection, entry, and analysis will be standardized to meet long-term water quality monitoring objectives. To reach the identified water quality goals, CoBI has identified the following steps:

- Synthesize existing water quality information for the CoBI to provide guidance related to development of the monitoring design and better define existing challenges;
- Prepare a monitoring strategy for the CoBI's surface and nearshore waters;
- Partner with local citizens and organizations to design and implement the plan and coordinate efforts;
- Implement a pilot program based on the elements of the monitoring program at two or more freshwater and nearshore systems;
- Develop and maintain a project specific data collection and management system which can be integrated with a Geographic Information System (GIS) and the Ecology Information Management (EIM) database management system;
- Report on the results of the pilot project;
- Disseminate the data to regional and state agencies; and
- Identify the information, including data, needed to meet project objectives.

By implementing the preceding steps, CoBI aims to restore or protect designated beneficial uses, restore 303(d) listed water bodies, and to prevent the degradation of healthy water bodies. This QAPP addresses mainly the short-term pilot program activities as detailed in the SAP, however, it could be used in the future as a basis for the long-term water quality and flow monitoring objectives.

1.3.1 WQFMP Strategy

As previously discussed, one of the main reasons for instituting a WQFMP includes the need to verify if water resources are supportive of their designated uses. Monitoring also provides data that can be used to determine if there are significant trends in water quality due to human activities in the watershed or for use in pollutant-loading estimates for use in TMDL programs. Additionally, water quality monitoring provides a means for detecting pollution problems and contamination of natural systems due to anthropogenic impacts. This type of monitoring often includes the assessment of reference conditions in natural, undeveloped water bodies for use in

comparison with impacted sites. In most cases, water quality monitoring is multi-objective in nature, with the data being utilized for a variety of purposes.

Consistent with EPA and Ecology water quality monitoring guidance, two principal types of indicators, condition and stressor, have been utilized in the CoBI WQFMP. Condition indicators are physical, chemical, or biological characteristics of an ecosystem that can provide a measure of the condition of water resources with respect to some environmental reference value, such as ecological integrity. Stressor indicators are characteristics of the environment that can be expected to change the condition of water resources if their intensity or magnitude is altered (EPA 1998). Landscape-level measures of land use/land-cover (LULC) are examples of this type of indicator.

Because the protection and restoration of designated beneficial uses is a primary goal of the CoBI WQFMP, it is important that the selected indicators specifically address the designated uses of each water-body. Table 1-1 lists the water quality indicators, recommended by the EPA, for beneficial uses as they apply to Bainbridge Island. The recommended indicators have been prioritized into "core" (primary) and "supplemental" (back-up) indicators based on accuracy, reliability, representiveness, and cost-effectiveness.

The CoBI WQFMP will utilize several of these indicators to measure water quality on the Island. The parameters selected will depend on the water body monitored and the designated beneficial uses that are applicable. In general, the suite of indicators will include a mixture of physical, chemical, and biological parameters.

Table 1-1. EPA Recommended Water Quality Indicators for Monitoring Designated Beneficial Uses

Designated Beneficial Uses	Aquatic Biota & Habitat	Contact Recreation	Drinking Water Supply	Fishing & Shellfish Harvest
Core Indicators	Biological Integrity[1] Dissolved Oxygen (DO) Temperature Conductivity Turbidity pH Physical Habitat Streamflow (flow rates) Nutrients Sediment Contamination Landscape Characteristics (LULC)[2] Lake Eutrophic Condition Wetland Water level Fluctuation (WLF)	Pathogens Litter Nuisance-Plant Growth Chlorophyll-A Streamflow Nutrients Turbidity Sediment Contamination Landscape Characteristics (LULC)[2] Lake Transparency (Secchi Depth) Wetland Water level Fluctuation (WLF)	Pathogens Trace Metals Hydrocarbons Organics Water Toxicity Nutrients Salinity Sediment (TSS & TDS) Streamflow Landscape Characteristics (LULC)[2]	Pathogens Mercury[3] Trace Metals[3] Chlordane[3] Sediment Contamination Landscape Characteristics (LULC)[2]
Supplemental Indicators	Water Toxicity Sediment Toxicity Trace Metals Hydrocarbons Organics	Water Toxicity Sediment Toxicity Trace Metals Hydrocarbons Organics		Sediment Toxicity Water Toxicity

Notes:
1 EPA recommends at least two biological communities be monitored, with at least two assemblages per community utilized.
2 LULC = measured using GIS.
3 As measured in fish or shellfish tissue.

The CoBI WQFMP is composed of four focus areas: (1) freshwater / sediments (streams, wetlands, and lakes), (2) marine and nearshore areas water and sediment, (3) stormwater outfalls, and (4) stormwater BMP structures. Table 1-2 outlines the water quality monitoring activities applicable to each of these focus areas.

Table 1-2. Recommended Water-Quality and Flow Monitoring Activities

Monitoring Activity	Monitoring Frequency	Monitoring Equipment	QA/QC Requirements
BMP Structure Sampling	Targeted	GPS Unit Digital Camera Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Lake & Wetland Transparency Monitoring	Annual (Summer)	GPS Unit Digital Camera Secchi Disk Field Data Forms	Utilize established protocols Fieldwork training Independent data review
Lake & Wetland Water Level Fluctuation Monitoring	Weekly to Monthly	GPS Unit Digital Camera Stage Gage Field Data Forms	Utilize established protocols Fieldwork training Independent data review
Lake & Wetland Sediment Sampling	3-5 Years	GPS Unit Digital Camera Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Lake & Wetland Water Quality / Chemistry Sampling	Event Targeted	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Landscape Assessment	2-3 Years	GIS	Utilize established protocols Watershed, riparian, and shoreline scales Independent data review
Nearshore-Marine Bacterial (FC) Sampling	Monthly	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review

Table 1-2. Recommended Water-Quality and Flow Monitoring Activities

Monitoring Activity	Monitoring Frequency	Monitoring Equipment	QA/QC Requirements
Nearshore-Marine Sediment Sampling	3-5 Years	GPS Unit Digital Camera Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Nearshore-Marine Water Quality-Chemistry Sampling	Event Targeted	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Outfall Bacterial (FC) Sampling	Monthly	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Outfall Flow Monitoring	Weekly to Monthly	GPS Unit Digital Camera Flow-Monitor Flow-Meter Field Data Forms	Utilize established protocols Fieldwork training Independent data review
Outfall Water Quality-Chemistry Sampling	Event Targeted	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Stream Bacterial (FC) Sampling	Monthly	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review

Table 1-2. Recommended Water-Quality and Flow Monitoring Activities

Monitoring Activity	Monitoring Frequency	Monitoring Equipment	QA/QC Requirements
Stream Flow Monitoring	Weekly to Monthly	GPS Unit Digital Camera Flow-Monitor Flow-Meter Field Data Forms	Utilize established protocols Fieldwork training Independent data review
Stream Macroinvertebrate Surveys	Annual (Fall)	GPS Unit Digital Camera Surber Kit Field Data Forms	Utilize established protocols Fieldwork training Independent data review
Stream Sediment Sampling	3-5 Years	GPS Unit Digital Camera Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review
Stream Water-Chemistry Sampling	Event Targeted	GPS Unit Digital Camera Data-Logger Sampling Gear Field Data Forms	Utilize established protocols Fieldwork training Laboratory QA/QC Independent data review

1.4 PROJECT ORGANIZATION

The organizational structure for the CoBI Water Quality Monitoring Study is presented in Figure 1-3. This figure identifies the members of the CoBI and consultant project management and planning team, as well as the field data collection staff. Decision-makers, and interested parties, such as Ecology, EPA, Kitsap County, CoBI City Council, Bainbridge Island Watershed Council, PSAT, etc. have not been specifically identified. Their omission from the listing below does not imply a lack of project involvement or non-responsibility for oversight / regulatory direction or guidance. A placeholder for regulatory agencies and project stakeholders has been added to Figure 1-3 to represent the expected route of direction that would be implemented during the project.

Ms. Jalyn Cummings is the CoBI WQFMP Project Manager (PM). She is responsible for all aspects of the WQFMP, including management, planning and implementation. She serves as the day-to-day manager and point of contact for the TEC Project Team (TEC Inc., Battelle Marine Sciences and Taylor Associates, Inc.). Her responsibilities include:

- budgeting and executing project activities;
- interacting with project personnel, regulatory agency personnel, and other organizations/personnel as needed;
- responsible for the final approval of all activities associated with the project, including field and laboratory tasks and services;
- reviewing and approving any internal or contractor prepared plans, drawings, and reports; and
- ensuring completion of projects in accordance with the established schedules and budgets.

Mr. Peter Namtvedt Best is a CoBI Long Range Planner and serves as project support. He supports the program as directed by the PM. He provides technical support to the contractor team and acts as a liaison between the CoBI and the contractor team when required by the PM.

Mr. Jason Strayer is the TEC Team Program Manager. He is responsible for ensuring sufficient staffing and equipment resources are available to Mr. Rupert. He is also responsible for ensuring overall CoBI satisfaction with the Water Quality Monitoring Study.

Mr. Brian Rupert is the TEC Team PM. He is responsible for overall coordination of project activities. He prepares program schedules and reports and is responsible for review and approval of all final deliverables. He communicates directly with the CoBI PM. He reports program status to the CoBI PM and implements the directives of the CoBI WQFMP. He coordinates various activities with the analytical laboratory PMs, the TEC Team QA Manager, TEC Team Project Chemist, and the field team to implement the requirements of the SAP and QAPP. His other responsibilities include:

- administering the SAP;
- budget oversight for all project tasks, including water quality sampling;
- day to day implementation of field activities;
- supervising field team personnel performing on-site sampling activities;

- oversees all field activities, including site evaluations, and site establishment, including all site set-ups;
- participates in all client, stakeholder and agency meetings;
- design of the project database; and
- aided in the design of the pilot study with the Taylor Associates team members.

Mr. Rupert is also the TEC Field Manager. He ensures that proper field sampling methods are utilized and that samples are delivered to the appropriate laboratory for analysis. Specific responsibilities include:

- aiding the TEC Team PM with site inspections and preparation of the SER;
- reviewing and understanding the procedures contained in the QAPP and SAP
- conducting on-site sampling activities;
- maintaining a record of field activities in a log book (one book per field crew);
- ensuring that the calibration frequencies are maintained for field equipment and that each operator understands the proper usage, maintenance, and storage of each instrument; and
- preparing sampling project documentation associated with sampling activities.

Dr. Chris May was the WQFMP Monitoring Plan Designer. He worked closely with the TEC Team, Ms. Cummings, and the various stakeholders to establish monitoring goals. He was the lead developer of the WQFMP monitoring plan. Dr. May also participated in certain field activities, conducted training for CoBI staff and volunteer groups, attended public and regulatory meetings and provided guidance to all aspect of the program and related tasks.

Mr. Dave Metallo is the Project Technical Advisor. He is a member of the Taylor Associates Inc. staff and a TEC Team Member. Mr. Metallo's contribution to the WQFMP included compilation of the historic background data and subsequent technical summary report to the CoBI, creation of the electronic data and documents library, design of the program database, technical designer and field lead for the Site Evaluation event and lead author of the SER, co-author of the SAP Plan, co-author of the QAPP, lead designer of the Pilot Study event and lead document reviewer. He has participated in planning meetings with the City project staff and has attended and presented at public open house forums. He is also responsible for overall technical guidance for this project.

Ms. Jill Brandenberger is the Project Chemist, a member of the Battelle staff and TEC Inc. Team. Ms. Brandenberger conducts analytical laboratory oversight. She ensures that samples and subsequent data have been managed, analyzed and reported correctly and that samples were received and processed for their planned and required analysis. She also assures that analyses are assigned to the proper analysts when samples are analyzed by Battelle. She monitors that data are submitted on time, and the final data reports meet project requirements. She will also resolve all laboratory QA issues and provide a thorough review of the final data report and narrative that will be used for various programmatic needs. Further Ms. Brandenberger is responsible for the review of the design and content of the QAPP and its applicable content.

Mr. Rich Tremaglio is the TEC QA Manager. He is responsible for:

- approving this QAPP, and any subsequent changes to this QAPP;

- providing guidance to the PM and other project staff regarding QA issues/concerns;
- developing and initiating additional QA procedures as needed;
- identifying instances of nonconformance or other deviations from the established QA procedures and notifying the TEC PM of such instances;
- recommending corrective actions and verifying the implementation of such corrective actions as needed, and
- Review of all project deliverables.

Taylor Associates, Inc. (TAI), in conjunction with Mr. Metallo, were the Pilot Study Design Team. TAI took the lead in the design of the WQFMP Pilot Study. TAI helped the CoBI make final Pilot Study site selections, establish and set up all monitoring stations and required equipment, refined the data collection protocols and procedures and took the lead advisory role in the field testing of the monitoring equipment. TAI also provided technical guidance regarding flow monitoring tasks at all of the Pilot Study stations and conducted critical management of certain aspects of the flow data and its data base. TAI coordinated with the contracted testing labs to ensure adherence with data reporting requirements, conducted quality control of collected field data and provided the City with summary data interpretation. The pilot study followed protocols and sample timing as described in the appropriate volumes and sections of the Monitoring Plan. Responsibility for this project task was shared among the various TEC Team members and CoBI WQFMP PMs.

Coordination between the CoBI PM, Project Technical Advisor, TEC Team PM, Field Team Leader, QA Manager, Project Chemist and Laboratory Manager/s will be maintained to ensure that the pilot study design and future tasks are implemented correctly in accordance with the provisions of this QAPP, as well as the SAP and pertinent safety and regulatory guidance.

1.5 PROJECT SCHEDULE

The Water Quality and Flow Monitoring Program schedule is as shown in Table 1-3.

Table 1-3. Water Quality and Flow Monitoring Program Milestones

Milestone	Due/Start Date	Finish Date
Submit City Draft Monitoring Plan (QAPP, SAP, & SER)	April 24, 2006	April 24, 2006
Review of City Draft Monitoring Plan	April 24, 2006	May 10, 2006
Submit Committee Draft Monitoring Plan	July 19, 2006	July 19, 2006
Convene Monitoring Plan Review Committee	May 19, 2006	May 19, 2006
Review of Committee Draft Monitoring Plan	July 21, 2006	August 20, 2006
Submit Ecology Draft	September 27, 2006	September 27, 2006
Review of Ecology Draft Monitoring Plan	September 29, 2006	October 31, 2006
Ecology Comment Resolution	November 2, 2006	November 17, 2006
Implementation of Preliminary Monitoring Plan (pilot study)	November 20, 2006	October 31, 2007
Submit Final Draft Monitoring Plan	December 12, 2007	January 31, 2008
Review Final Draft Monitoring Plan	February, 1, 2008	March 1, 2008
Final Monitoring Plan	April 1, 2008	April 30, 2008

Note: Schedule subject to change due to field and review issues

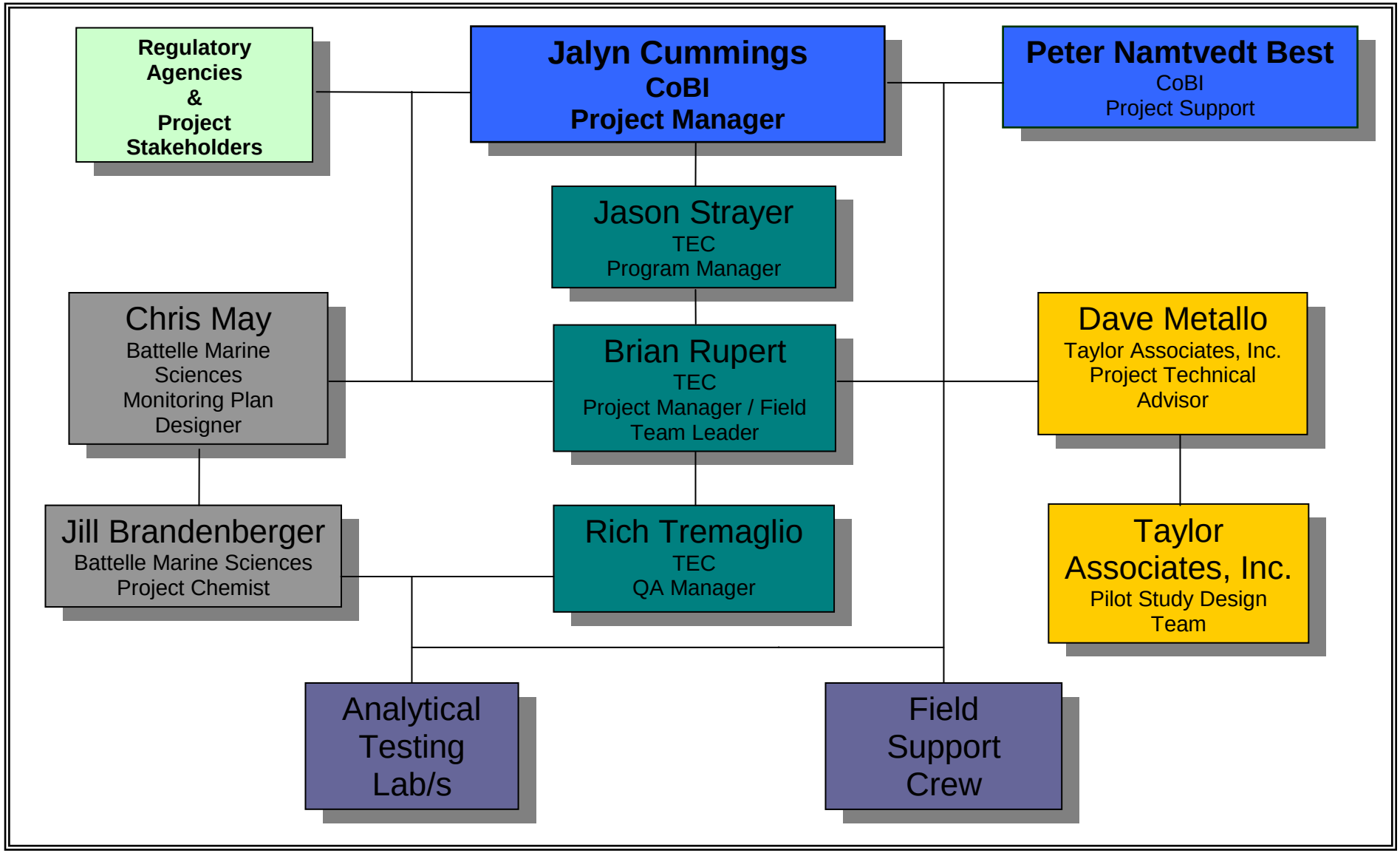

Figure 1-3. Project Organization for CoBI Water Quality Monitoring Study

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2.0 DATA QUALITY

As previously stated, the sampling and analysis activities conducted under the WQFMP will support an array of end uses. The sampling design and information collected will not necessarily support a decision between two alternatives, or determine compliance with a standard or regulation. Rather the process will support the long-term monitoring of water quality to support many end points. Performance and acceptance criteria (PACs) have been defined for this project in accordance with Ecology guidance.

The PAC process for the CoBI WQFMP is summarized in Table 2-1. This table presents the process steps used to determine the way in which existing information and newly collected data will be summarized and used for management.

Table 2-1. Performance and Acceptance Criteria Process

STEP 1: State the Problem In accordance with the CWA and Washington State water quality standards, the CoBI must assure that surface and near-shore waters of Bainbridge Island meet water quality standards and support designated beneficial uses (contact recreation, drinking water supply, fishing and shellfish habitat, and aquatic biota and habitat).
STEP 2: Identify the Study Question How can CoBI restore or protect designated beneficial uses, restore 303(d) listed water bodies to water quality standards, and prevent degradation of currently healthy systems?
STEP 3: Identify Types of Information Needed Collected data will support numerous end uses, including but not limited to water quality and water flow issues and will help define thresholds for initiation of management responses. Specific sources of data include: 1. Existing water quality information 2. Data management tools 3. Baseline physical water quality conditions for surface and nearshore marine waters Indicators critical for the monitoring of relevant areas are presented in *Table 1-1 EPA Recommended Water Quality Indicators for Monitoring Designated Beneficial Uses* of this QAPP.
STEP 4: Establish Study Design Constraints The physical boundaries of the study are those of the watersheds located within the jurisdiction of the CoBI and adjacent nearshore marine waters. Chemical and physio-chemical sample collection and analysis, benthic macroinvertebrate sampling (benthic index of biological integrity), and other data collection activities will be limited by budgetary constraints, manpower limitations, and logistical issues. Water quality monitoring will be prioritized based on need and resource availability.
STEP 5: Develop the Analytic Approach Existing data and data collected in the initial water quality and flow-monitoring study will be used to develop future monitoring plans to identify baseline conditions, establish target water quality standards, and delineate thresholds of concern for water quality and water flow in CoBI's watersheds and nearshore marine waters. Information quality will be maximized by using data quality indicators as described in the next section.
STEP 6: Develop a Strategy for Information Synthesis Data management for this project is described in Section 4.0. Data will be managed electronically and will be available via database and GIS tools. Specific synthesis and analysis will be conducted according to the desired end use of the data.
STEP 7: Optimize the Design for Collecting Information SAP Section 5 (freshwater resources), Section 6 (marine near-shore resources), and Section 7 (storm water monitoring) describe in detail the planned sampling locations, frequencies, and methodologies to be used for collecting new information for the WQFMP.

2.1 MEASUREMENT QUALITY OBJECTIVES

Measurement quality objectives (performance and acceptance thresholds) for the newly collected data are expressed in terms of accuracy, precision, and sensitivity. Furthermore, the experimental design will take into account representativeness, comparability, and completeness goals. Accuracy and precision are monitored through the analysis of quality control samples. Sensitivity is assured by selecting analytical methods appropriately to achieve required resolution and detection limits. Comparability and representativeness are primarily addressed through proper design of the SAP. Completeness is assured through lose adherence to the SAP. Definitions related to measurement objectives are provided below.

Accuracy

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations. Analytical accuracy will measured with matrix spikes and surrogates. Acceptable limits will be established in conjunction with the analytical laboratory and in accordance with the laboratory's quality assurance plan prior to sample analysis.

Precision

Precision is defined as the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. Precision will be measured with field and laboratory duplicate samples and matrix spike duplicate samples. Acceptable limits will be established in conjunction with the analytical laboratory and in accordance with the laboratory's quality assurance plan prior to sample analysis.

Sensitivity

Sensitivity is the capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Sensitivity is assured primarily through the selection of appropriate analytical methods, equipment, and instrumentation, and is expressed in terms of method detection limits (MDL) and reporting limits (RL). The analytical laboratory will conduct method detection limit studies in accordance with the Code of Federal Regulations (CFR) 40 Part 136 for each method of interest by instrument, matrix, and compound of interest.

Comparability

Comparability is a measure of the confidence with which one data set can be compared to another. This is a qualitative assessment and is addressed primarily in sampling design through use of comparable sampling procedures or, for monitoring programs, through accurate re-sampling of stations over time. In the laboratory, comparability is assured through the use of comparable analytical procedures and ensuring that project staff are trained in the proper application of the procedures.

Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population. This is a qualitative assessment and is addressed primarily in the sample design, through the selection of sampling sites, and procedures that reflect the project goals and environment being sampled. It is ensured in the laboratory through 1) the proper

handling, homogenizing, compositing, and storage of samples, and 2) analysis within the specified holding times so that the material analyzed reflects the material collected as accurately as possible.

Completeness

Completeness is the amount of data collected as compared to the amount needed to ensure that the uncertainty or error is within acceptable limits. The goal for data completeness is 100%; however, the project will not be compromised if 90% of the samples collected are analyzed with acceptable quality.

2.2 SPECIAL TRAINING/CERTIFICATION

Training Requirements

The PM is responsible for determining specific training and certification needs, and for ensuring that any required training is documented. Individuals developing and implementing this QAPP must receive, at a minimum, orientation to the project's purpose, scope, and methods of implementation. This orientation is the responsibility of the CoBI PM or designee. Field and data management personnel must have documented experience or direct training in the procedures that they will be performing for this project, including any applicable Standard Operating Procedures (SOPs). If these personnel do not have this experience or training then they must work under the direct supervision of trained personnel.

Special Training

Special training and certification required for the WQFMP include the following:

- all field personnel will be briefed on the sampling and data quality objectives in the QAPP and SAP;
- field personnel will be briefed on emergency procedures and safety; and
- field personnel will be trained on field sampling techniques and sample handling requirements detailed in the SAP.

The Field Team Leader is responsible for identifying worker certification needs for the field unit and ensuring that all team members are adequately trained. A field orientation must be conducted to establish guidelines for field observations between crews to ensure repeatability within the limits of this qualitative approach. This orientation is the responsibility of the Field Team Leader.

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3.0 DATA GENERATION AND ACQUISITION

3.1 SAMPLING PROCESS DESIGN

This section summarizes all aspects of possible data generation and acquisition from tasks that were implemented during the 2006-2007 program pilot study and for future implementation of the WQFMP. Summary of the water quality monitoring activities will help to ensure that appropriate methods for sampling, measurement and analysis, data collection, data handling, and QC activities are used and documented. Where appropriate, references to specific sections of the SAP are used to ensure that the required information is available to the project team members.

The data collection design for the project is summarized in Section 3 of the SAP. Included below are descriptions of the following:

- sample types to be collected;
- chemical, physical, and biological parameters to be determined;
- measurements to be obtained in the field;
- measurements to be gained from laboratory analysis; and
- locations and schedule for sampling and measurements.

3.1.1 Sampling Analyte List

Tables 3-1 through 3-4 present sample methodology, holding times, detection limits, preservations, sample size and the require collection containers for the listed analytical parameters. New or pre-cleaned sample containers will be used. Physio-chemical data will be collected using YSI™ (or similar) multi-parameter probes in the field. All other analysis will be performed at a fixed laboratory on the composite samples collected in certified-clean and analysis-appropriate containers.

Table 3-1. Analytical Parameters for Fresh and Marine Water Sample Collection

Analytical Parameter	Analytical Method	Detection and Reporting Limits		
		MDL[1] Value	RL [1A] Value	Units
Physical Field Parameters				
Conductivity	YSI meter	0	0.1	mS/cm
pH	YSI meter	0	0.01	pH units
Dissolved Oxygen (DO)	YSI meter	0	0.01	mg/L
Dissolved Oxygen (DO %sat)		0	0.1	% air saturation
Salinity	YSI meter	0	0.01	ppt
Temperature	YSI meter	-5	0.01	°C
Oxidation Reduction Potential (ORP or eH)	YSI meter	-999	0.1	mV
Turbidity	YSI meter	0	0.1	NTU
Secchi Transparency Depth	Direct observation	NA	0.1	FT
Total Dissolved Solids	YSI meter	0	0.01	g/L

Table 3-1. Analytical Parameters for Fresh and Marine Water Sample Collection

Analytical Parameter	Analytical Method	Detection and Reporting Limits		
		MDL[1] Value	RL [1A] Value	Units
Conventionals				
Hardness (as $CaCO_3$)[1]	EPA 6010	2	0.34	mg/L, $CaCO_3$
Total Suspended Solids (TSS)	EPA 160.2 2540 D-97	5	1.0	mg/L
Total Organic Carbon (TOC)[2]	EPA 9060	0.090	1.5	mg/L
Biologicals				
Fecal Coliform[6] (membrane filtration)	SM9222D	1	1	CFU/100 ml
Nutrients				
Chlorophyll a (marine water only)	SM10200H	NA	1.0	mg/L Chl
Nitrogen(Nitrate + Nitrite)	EPA 353.2 4500 NO3 I	0.001	0.01	mg/L
Ammonia Nitrogen	EPA 350.1 4500-NH3 D-97	0.003	0.1	mg/L
Total Nitrogen (TKN)	EPA 351.2M	0.24	0.60	mg/L
Total Phosphorus	SM 4500P-BE	0.006	0.016	mg/L
Total Metals[4]				
Aluminum[3]	EPA 200.8	0.86	20	µg/L
Copper	EPA 200.8	0.16	0.5	µg/L
Lead	EPA 200.8	0.07	1.0	µg/L
Zinc	EPA 200.8	0.18	4.0	µg/L
Dissolved Metals[4]				
Copper	EPA 200.8	0.16	0.5	µg/L
Lead	EPA 200.8	0.07	1.0	µg/L
Zinc	EPA 200.8	0.18	4.0	µg/L
Organics (Semi-Volatiles and PAH compounds)				
2-methylnaphthalene	EPA 8270D	0.557	1	µg/L
Acenaphthene	EPA 8270D	0.581	1	µg/L
Acenaphthylene	EPA 8270D	0.552	1	µg/L
Anthracene	EPA 8270D	0.544	1	µg/L
Benz(a) anthracene	EPA 8270D	0.600	1	µg/L
Benzo(a)pyrene	EPA 8270D	0.472	1	µg/L
Benzo(g,h,i)perylene	EPA 8270D	0.614	1	µg/L
Bis (2-ethylhexyl) phthalate	EPA 8270D	0.678	1	µg/L
Butyl benzyl phthalate	EPA 8270D	0.733	1	µg/L
Chrysene	EPA 8270D	0.699	1	µg/L
Dibenzo (a,h) anthracene	EPA 8270D	0.688	1	µg/L
Di-n-butyl phthalate	EPA 8270D	0.800	1	µg/L

Table 3-1. Analytical Parameters for Fresh and Marine Water Sample Collection

Analytical Parameter	Analytical Method	Detection and Reporting Limits		
		MDL[1] Value	RL [1A] Value	Units
Fluoranthene	EPA 8270D	0.632	1	µg/L
Fluorene	EPA 8270D	0.599	1	µg/L
Indeno (1,2,3,-cd) pyrene	EPA 8270D	0.597	1	µg/L
Naphthalene	EPA 8270D	0.559	1	µg/L
Phenanthrene	EPA 8270D	0.630	1	µg/L
Pyrene	EPA 8270D	0.678	1	µg/L
Total benzofluoranthenes	EPA 8270D	0.719	2	µg/L
Total Petroleum Hydrocarbons (TPH)[5]				
Gasoline Range	Ecology NWTPH-G	0.070	0.25	mg/L
Diesel Range	Ecology NWTPH-Dx	0.018	0.25	mg/L
Pesticides (Chlorinated, Organo-Phosphorous, Nitrogen-based and Herbicides)				
Banned Compounds				
2,4'-DDD	EPA 8081A	NA	0.1	µg/L
2,4'-DDE	EPA 8081A	NA	0.1	µg/L
2,4'-DDT	EPA 8081A	NA	0.1	µg/L
4,4'-DDD	EPA 8081A	0.006	0.1	µg/L
4,4'-DDE	EPA 8081A	0.023	0.1	µg/L
4,4'-DDT	EPA 8081A	0.011	0.1	µg/L
Dieldrin	EPA 8081A	0.017	0.1	µg/L
Gamma-BHC (Lindane)	EPA 8081A	0.008	0.05	µg/L
Heptachlor	EPA 8081A	0.011	0.05	µg/L
Chlorpyriphos	EPA 8270D-SIM	3.03	40	ng/L
Current Use Permitted Compounds				
Diazinon	EPA 8270D-SIM	6.19	40	ng/L
Malathion	EPA 8270D-SIM	5.87	200	ng/L
2,4-D	EPA 8151A	0.079	1.0	µg/L
MCPP (Mecoprop)	EPA 8151A	17.84	50	µg/L
Pentachlorophenol (PCP)	EPA 8041	0.071	0.25	µg/L

Notes:
1 MDL = Method Detection Limits (those values listed for Physical parameters are the expected min resolution).
1A RL = Reporting Limit
2 Hardness conducted only on freshwater samples
3 TOC analyzed only if PAH analysis is performed
Aluminum analyzed only on freshwater samples
4 Reductive Precipitation Sample Preparation needed for all marine water samples slated for metals analysis
5 TPH analysis will be conducted on all water samples as an initial screening mechanism. Those samples that produce detections above the RL will then be further tested for PAH compounds.
6 Fecal coliform may be analyzed by other Ecology approved methods, including MPN9221,

Table 3-2. Associated Analytical Information for Fresh and Marine Water Constituents

Parameter	Minimum Sample Size (ml)[a]	Container	Preservation Technique	Holding Time
pH	Direct Measurement	Probe	None	Analyze Immediately[b]
Conductivity / Salinity / Total Dissolved Solids	Direct Measurement	Probe	None	Analyze Immediately[b]
Turbidity	Direct Measurement	Probe	None	Analyze Immediately[b]
Dissolved Oxygen (mg/L and %air)	Direct Measurement	Probe	None	Analyze Immediately[b]
Temperature	Direct Measurement	Probe	None	Analyze Immediately[b]
eH / ORP	Direct Measurement	Probe	None	Analyze Immediately[b]
Hardness (as $CaCO_3$)	100	Glass or Polyethylene	Refrigerate, 4°C HNO_3 to pH<2	6 Months
Total Suspended Solids	1,000 to 4,000[c]	Glass or Polyethylene	Refrigerate, 4°C	7 Days
Total Organic Carbon (TOC)	25	Polyethylene	Cool, 4°C, H2SO4 to pH<2.0	28 days
Fecal Coliform	100	Polyethylene	Cool, 4°C, $Na_2S_2O_3$	24 hours
(Nitrate + Nitrite) Nitrogen	100	Polyethylene	Cool, 4°C, H2SO4 to pH<2.0	28 days
Ammonia Nitrogen	400	Polyethylene	Cool, 4°C, H2SO4 to pH<2.0	28 days
Total Nitrogen (TKN)	500	Polyethylene	Cool, 4°C, H2SO4 to pH<2.0	28 days
Total Phosphorus	50	Polyethylene	Cool, 4°C, H2SO4 to pH<2.0	28 days
Chlorophyll a	25 to 1,000[c]	Glass or Polyethylene (Dark)	Store filters frozen (-20°C) in the dark[e]	28 Days[e]
Metals (total and dissolved fractions)	1,000 each fraction	Polyethylene or Teflon™	Refrigerate, 4°C, HNO_3 to pH<2[f]	6 Months (preserved)
Semivolatile Organics / PAHs	1,000 to 2,000	Amber Glass	Refrigerate, 4°C	7 Days[e] / 40 days after extraction
TPH - G	120	Teflon septum VOA vial	Refrigerate, 4°C, HCL to pH<2.0	14 Days
TPH - Dx	1000	Amber Glass	Refrigerate, 4°C, HCL to pH<2.0	14 Days
Pesticides (chlorinated pesticides & herbicides, organophosphorus pesticides)	3,000	Amber Glass	Refrigerate, 4°C	7 Days

Notes:

a. Minimum sample size for one laboratory analysis. If additional QC analyses are required, the field sample size should be adjusted accordingly.

b. Immediately means as soon as possible after the sample is collected, generally with 15 minutes. These parameters should, ideally, be measured in the field.

c. The volumes specified are only estimates; the actual volume collected and filtered depends on concentration and analytical methodology used and may be larger than those presented in the Table.

d. Holding time to extraction. After extraction, maximum holding time is 40 days to analysis.

e. Samples collected for the analysis of chlorophyll a must be kept cold until sample filtration. Filtration should occur as soon as possible after the sampling. The filter may be immersed in 90 percent acetone solution and frozen which may significantly extend the holding time, however, this method is not approved for the use on projects that come under regulatory scrutiny. Prolonged exposure of the filter to air can result is a loss of chlorophyll a.

f. When it is not feasible to preserve metals samples in the field, preservation must be completed as soon as possible. Metals samples not preserved within 24 hours must sit at least 16 hours after preservation before analysis begins. Metals samples should always be filtered within 24 hours of collection.

Table 3-3. Analytical Parameters for Terrestrial and Marine Sediment Sample Collection

Analytical Parameter	Analytical Method	Detection and Reporting Limits		
		MDL[1] Value	RL[1A] Value	Units
Physical Field Parameters				
Grain Size (3 fractions)	ASTM D422	NA	Actual measurement to 0.01 g	grams
Conventionals				
Total Organic Carbon (TOC) [2]	Plumb	104	200	mg/Kg
Total Metals				
Aluminum[3]	EPA 6010	1.36	50	µg/Kg
Copper	EPA 6020	0.10	0.5	µg/Kg
Lead	EPA 6020	0.17	1.0	µg/Kg
Zinc	EPA 6010	1.06	0.6	µg/Kg
Organics (Semi-Volatiles and PAH compounds)				
2-methylnaphthalene	EPA 8270D-SIM	NA	67	µg/Kg
Acenaphthene	EPA 8270D-SIM	2.47	6.7	µg/Kg
Acenaphthylene	EPA 8270D-SIM	3.00	6.7	µg/Kg
Anthracene	EPA 8270D-SIM	3.85	6.7	µg/Kg
Benz(a) anthracene	EPA 8270D-SIM	3.17	6.7	µg/Kg
Benzo(a)pyrene	EPA 8270D-SIM	3.67	6.7	µg/Kg
Benzo(g,h,i)perylene	EPA 8270D-SIM	1.95	6.7	µg/Kg
Bis (2-ethylhexyl) phthalate	EPA 8270D	23.8	20	µg/Kg
Butyl benzyl phthalate	EPA 8270D	1.77	20	µg/Kg
Chrysene	EPA 8270D-SIM	2.72	6.7	µg/Kg
Dibenzo (a,h) anthracene	EPA 8270D-SIM	2.81	6.7	µg/Kg
Di-n-butyl phthalate	EPA 8270D	5.9	20	µg/Kg
Fluoranthene	EPA 8270D-SIM	3.37	6.7	µg/Kg
Fluorene	EPA 8270D-SIM	3.35	6.7	µg/Kg
Indeno (1,2,3,-cd) pyrene	EPA 8270D-SIM	2.33	6.7	µg/Kg
Naphthalene	EPA 8270D-SIM	1.67	6.7	µg/Kg
Phenanthrene	EPA 8270D-SIM	2.33	6.7	µg/Kg
Pyrene	EPA 8270D-SIM	3.86	6.7	µg/Kg
Total benzofluoranthenes	EPA 8270D-SIM	2.69	13.4	µg/Kg
Total Petroleum Hydrocarbons (TPH) [4]				
Gasoline Range	5035/NWTPH-G	3.09	5	mg/Kg
Diesel Range	NWTPH-Dx	0.41	5	mg/Kg
Pesticides (Chlorinated, Organo-Phosphorous, Nitrogen-based and Herbicides)				
Banned Compounds				
2,4'-DDD	EPA 8081A	NA	3.3	µg/Kg
2,4'-DDE	EPA 8081A	NA	3.3	µg/Kg

Table 3-3. Analytical Parameters for Terrestrial and Marine Sediment Sample Collection

Analytical Parameter	Analytical Method	Detection and Reporting Limits		
		MDL[1] Value	RL[1A] Value	Units
2,4'-DDT	EPA 8081A	NA	3.3	µg/Kg
4,4'-DDD	EPA 8081A	1.089	3.3	µg/Kg
4,4'-DDE	EPA 8081A	1.306	3.3	µg/Kg
4,4'-DDT	EPA 8081A	1.369	3.3	µg/Kg
Dieldrin	EPA 8081A	1.282	3.3	µg/Kg
Gamma-BHC (Lindane)	EPA 8081A	0.764	1.7	µg/Kg
Heptachlor	EPA 8081A	0.803	1.7	µg/Kg
Chlorpyriphos	EPA 8270-SIM	0.6	4.0	µg/Kg
Current Use Permitted Compounds				
Diazinon	EPA 8270D-SIM	1.52	4.0	µg/Kg
Malathion	EPA 8270D-SIM	1.08	20	µg/Kg
2,4-D	EPA 8151	13.8	33	µg/Kg
MCPP (Mecoprop)	EPA 8151	4660	8330	µg/Kg
Pentachlorophenol (PCP)	EPA 8270-SIM	NA	33.5	µg/Kg

Notes:
1 MDL = Method Detection Limits
1A RL = Reporting Limit
2 TOC analyzed only if PAH analysis is performed
3 Aluminum analyzed only on terrestrial sediment only
4 TPH analysis will be conducted on all sediment samples as an initial screening mechanism. Those samples that produce detections above the RL will then be further tested for the specified PAH compounds.

Table 3-4. Associated Analytical Information for Fresh and Marine Sediment Constituents

Parameter	Minimum Sample Size (g)[a]	Container	Preservation Technique	Holding Time
Grain Size Analysis	Lab Determined	Lab Determined	NA	NA
Total Organic Carbon (TOC)	25	Polyethylene	Frozen, H_2SO_4 to pH<2.0	6 Months
Total Metals	200	Clear Wide Mouth	Refrigerate, 4°C	6 Months
Semivolatile Organics / PAHs	200	Amber Glass	Refrigerate, 4°C	7 Days / 40 days after extraction
TPH - G	60	2 oz CWM jar w/ Teflon septum lid	Refrigerate, 4°C	14 Days
TPH - Dx	120	4 oz CWM jar	Refrigerate, 4°C	14 Days
Pesticides (chlorinated pesticides & herbicides, organophosphorus pesticides)	400	Amber Glass	Refrigerate, 4°C	7 Days

Notes:
a. Minimum sample size for one laboratory analysis. If additional QC analyses are required, the field sample size should be adjusted accordingly. The volumes specified are only estimates; the actual volume collected and filtered depends on concentration and analytical methodology used and may be larger than those presented in the Table.
CWM = clear wide mouth jar

3.2 SAMPLING PROCEDURES

3.2.1 Sampling Equipment and Procedures

Flow will be measured using a combination of area/velocity and ultrasonic meters, weir/level loggers, and pressure transducers. Other industry standard meters and physical measurement methods would also be acceptable where appropriate. Flow data will be collected either automatically where datalogger equipped meters are deployed or obtained by physical measurement methods throughout the sampling period in an attempt to gain the most continuous per station records as possible. Gaps in the flow data record (e.g. during those times when equipment maintenance occurs, out of service conditions, etc.) will be documented to supplement the overall per station records.

Freshwater stream and outfall stations will be sampled, whenever possible, with Isco™ automatic samplers. Analytical water quality samples collected at each location will be analyzed by a fixed analytical laboratory. Conductivity, pH, temperature, DO, salinity, oxidation-reduction potential (ORP), turbidity and total dissolved solids will also be measured with an *in situ* YSI™ probe co-located with the automatic sampler. In addition, fecal coliform grab samples will be retrieved from the stream adjacent to the sample intake line. Sections 5 and 7 of the SAP detail the overall sampling approach. Section 8 of the SAP lists those specific stations proposed for use during the pilot study. Selected pilot study locations are described in further detail in the SER.

3.2.2 Preliminary Planning Activities

At a minimum, the PM, Field Team Leader and field team members will conduct the following preliminary planning activities prior to each sampling event:

- have individuals read or review pertinent sections of the SAP and QAPP and sign an Agreement and Acknowledgement Sheet prior to their first sampling or flow monitoring event only;
- review the SAP and QAPP to ensure that each individual is aware of the protocols and procedures contained therein;
- participate in a readiness review meeting to ensure that the field crew understands and are properly trained to perform the scope of work described in the SAP;
- coordinate with laboratory staff to ensure that sample retrieval and delivery is properly anticipated (especially if a weekend transfer will occur);
- determine that all appropriate forms, labels, and logs are available for use during the sampling event;
- establish accountability and responsibility for sampling team personnel for each activity to be performed; and
- perform a preliminary inspection, inventory, and pre-cleaning of all field equipment; ensure preventative maintenance is current; and setup, calibrate, and recheck all field instrumentation.

3.3 MEASUREMENT PROCEDURES

3.3.1 Analytical Methods for Field Measurements

Due to the physical and chemical instability of several parameters commonly associated with the collection of water samples – including conductivity, pH, temperature, DO,and turbidity –

immediate analysis of such parameters using field instruments is necessary. The methods of measurement are specific to the parameter measured and the field instrument used.

3.3.2 Analytical Methods for Laboratory Measurements

One or more Washington State-certified analytical, biological, and taxometric testing facilities will be contracted to perform the various program-required analyses. Base upon the specific goals of the sampling event, samples will be analyzed for some or all of the indicator analytes identified in tables 3-1 and 3-3. Tables 3-2 and 3-4 provide detail as to the minimum sample size required, container, preservation technique and holding time for each analyte or group of analytes.

Quantitative Analysis

The analytical laboratory will perform the analysis of organic parameters according to EPA Method 8270, following low-level detection procedures developed for the National Oceanic and Atmospheric Administration Status and Trends Program.

The method of analysis for low-level trace metals will depend on the concentrations of trace metals detected in the field samples. Reported analysis will be based on the method that achieves a clear detectable signal, or the method that best achieves the reporting limit.

3.4 QUALITY CONTROL

Quality Control (QC) can be described as an integrated system of activities in the area of quality planning, assessment, and improvement to provide the project with a measurable assurance that the established standards of quality are met. QC checks, including both field and laboratory QC checks, are the specific operational techniques and activities used to fulfill the QA requirements.

3.4.1 Laboratory Quality Control

Quality Control Samples

The study design and QC samples are intended to assess the major components of total study error, which facilitates the final evaluation of whether environmental data are of sufficient quality to support subsequent decisions. The QC sample requirements are designed to provide measurement error information that can be used to initiate corrective actions with the goal of limiting the total measurement error.

Typical QC samples and frequency applicable to analytical chemistry laboratories are detailed in Table 3-3. Actual, event specific QC samples will be identified for each sampling event of the program. Table 3-4 defines the typical accuracy and precision for QC samples, along with corrective actions that must be implemented if QC criteria are not met. Actual, event specific limits will be identified for each sampling event of the program. Table 3-5 provides formulas for the calculation of QC sample assessment statistics.

Table 3-5. Typical Definitions, Requirements, and Frequency for Laboratory QC Samples

QC Sample	Definition	Frequency*
Method or Procedural Blank (MB)	A combination of solvents, surrogates, and all reagents used during sample processing, processed concurrently with the field samples. Monitors purity of reagents and laboratory contamination.	1 per sample batch; a processing batch MB must be analyzed with each sequence.
Method Blank Spike	A sample of laboratory pure water analyzed following the same step-by-step procedure used on the samples, including all reagents and solvents, spiked with the analytes of interest; measures the effectiveness of the method without matrix effects. At least one method blank spike should be run a each time the analysis is performed.	1 per sample batch
Matrix Spike (MS)	A field sample spiked with the analytes of interest is processed concurrently with the field samples; monitors effectiveness of method on sample matrix; performed in duplicate for sediments. An MS must be processed for each distinct matrix.	1 per sample batch
Laboratory Duplicate Sample	Second aliquot of a field sample processed and analyzed to monitor precision; each sample set should contain a duplicate.	1 per sample batch
Recovery Internal Standards (RIS)	All field and QC samples are spiked with recovery internal standards just prior to analysis; used to quantify surrogates to monitor extraction efficiency on a per sample basis.	Each sample analyzed for organic compounds
Surrogate Internal Standards (SIS)	All field and QC samples are spiked with a known amount of surrogates just prior to extraction; recoveries are calculated to quantify extraction efficiency.	Each sample analyzed for organic compounds

Notes: *A batch is defined as 20 field samples processed simultaneously and sharing the same QC samples.

Table 3-6. Typical Measurement QC Criteria

QC Parameter	Acceptance Criteria	Corrective Action
Accuracy		
Matrix Spike (MS)/MS Duplicate (MSD)	Organic compounds: 40 - 120% recovery. DRO: 75-125 % recovery. Metals: 70 - 130% recovery.	Review data to assess impact of matrix. If other QC data are acceptable and no spiking error occurred, then flag associated data. If QC data are not affected by matrix failure or spiking errors occurred, then re-process MS. If not possible, then notify client and flag associated data.
Surrogate Spike (SIS)	Organic compounds: 40 - 120% recovery.	Review data. Discuss with PM. Reanalyze, re-extract, and/or document corrective action and deviations.
Laboratory Control Sample (LCS)	Organic compounds: 40 - 120% recovery. Metals: 70 - 130% recovery.	Perform corrective action. Re-analyze and/or re-process sample batch. Batch data associated with failed LCS (LCS data outside control limits) cannot be reported. If batch cannot be re-processed, notify client, flag data, discuss impact in report narrative.
Instrument Check	Organic compounds: 85 - 115% recovery.	Perform corrective action. Re-analyze and/or re-process sample batch. Data outside control limits cannot be reported. If batch cannot be re-processed, notify client, flag data, discuss impact in report narrative.
Precision		
Laboratory Duplicates	Organic compounds (MSD): <30% relative PD (RPD). Metals: <30% RPD. XRF: <20% RPD. Immunoassay Extraction duplicate <30% RPD. Immunoassay Assay duplicate <30% RPD.	Review data to assess impact of matrix. If other QC data are acceptable, then flag associated data. If QC data are not affected by matrix failure, then re-process duplicate. If not possible, then notify client and flag associated data.
Physical Characterization		
Accuracy	TOC: Blank <Reporting Limit TOC: SRM (ICV) 85 – 115% recovery vs. certified value	Review data. Discuss with PM. Reanalyze and/or document corrective action and deviations. Flag data.
Precision: Duplicates	TOC: $\pm$ 20% RPD.	Review data. Discuss with PM. Reanalyze and/or document corrective action and deviations. Flag data.

Notes:

* Individual parameters included in the compound classes “Organic compounds” and “Metals” are defined in Table 3-1.

Table 3-7. Calculation of QC Assessment Statistics

Percent Recovery

The percent recovery is a measurement of accuracy, where one value is compared with a known/certified value. The formula for calculating this value is:

$$Percent\ Recovery = \frac{amount\ detected}{amount\ expected}\ x\ 100$$

Percent Difference (PD)

The PD is a measurement of precision as indicated by the difference in a measured value from a "real" value. It is used when one value is known or certified, and the other is measured. The formula for calculating PD is:

$$PD = \frac{X_2 - X_1}{X_1}\ x\ 100$$

where: X_1 = known value (*e.g.*, SRM certified value)
X_2 = determined value (e.g., SRM concentration determined by analyst)

Relative Percent Difference (RPD)

The RPD is a measurement of ***precision***; it is a comparison of two similar samples (matrix spike/matrix spike duplicate pair, field sample duplicates). The formula for calculating RPD is:

$$RPD = \left| \frac{2\ x\ (X_1 - X_2)}{(X_1 + X_2)} \right|\ x\ 100$$

where: X_1 is concentration or percent recovery in sample 1
X_2 is concentration or percent recovery in sample 2
Note: Report the absolute value of the result -- the RPD is always positive.

Relative Standard Deviation (RSD)

The RSD is a measurement of **precision**; it is a comparison of three or more similar samples (e.g., field sample triplicates, initial calibration, MDLs). The formula for calculating RSD is:

$$\%RSD = \frac{Standard\ Deviation\ of\ All\ Samples}{\text{Average of All Samples}}\ x\ 100$$

All QC sample failures and associated corrective actions will be documented. If data must be reported with failing QC results, then data qualifiers will be assigned to the QC sample data. Table 3-6 defines data qualifiers.

Rinsate Blanks

One rinsate blank (i.e., equipment blank) will be prepared by passing laboratory supplied American Society for Testing and Materials Type II deionized water through a single decontaminated sampler. This sampler will represent the type of equipment, set-up and cleaning / preparation that the other auto-samplers underwent prior to their deployment into the field. This will occur prior to the start of sampling activities. Ample time will be allotted to receive results from the rinsate testing in order to correct any set-up or procedural issues prior to field deployment.

The rinsate will be captured in 3.7-liter (L) (1 gallon) clear glass jars and taken to the approved testing facility for analysis. The rinsate blank will be analyzed for the same parameters as routine stream and outfall freshwater parameter samples collected through the samplers to evaluate the potential contamination from sample handling and set-up materials.

Table 3-8. Typical SW-846 Analytical Data Qualifiers

B	Analyte found in both sample and associated blank. The "B" will be reported on the result associated with the field samples, not the blank.
D	Dilution run. Initial run outside linear range of instrument. Organics only.
E	Estimate, result outside linear range of instrument. GC/MS only.
J	Estimated concentration between the MDL and RL.
U	The concentration is less than the MDL, or the analyte was not detected.
W	Post-digestion spike out of control limits.
N	Duplicate inject precision did not agree, organics only.

3.5 INSTRUMENT/EQUIPMENT MAINTENANCE

Preventative maintenance of field and laboratory equipment is essential to obtaining accurate data. This section presents general preventative maintenance procedures and schedules.

3.5.1 Field Instrument/Equipment Maintenance

Field instruments and equipment calibration and maintenance records (i.e., the frequency of calibration, the individual responsible for calibration, and the notes regarding the maintenance of the instrument) will be documented in the field logbook for each field instrument used during field activities.

Field instruments and equipment will be calibrated in accordance with instrument manuals prior to each sampling event. Flow monitors will be maintained and calibrated according to the manufacturer's recommendations, or when and if, data indicates the sensor is not calibrated properly. Field instruments and equipment will be maintained when routine inspections and/or equipment manufacturer's guidelines indicate the need for maintenance. Routine maintenance may include:

- removing surface dirt and debris;
- replacing/cleaning filters (when applicable);
- ensuring proper storage of equipment;
- inspecting equipment prior to each use;
- charging battery packs when not in use (when applicable); and
- maintaining spare and replacement parts in the field to minimize down time.

In the event that a piece of equipment needs repair, a list of the field equipment manufacturers' addresses, telephone numbers, and points of contact information will be maintained on-site during field activities.

3.5.2 Laboratory Equipment Maintenance

All analytical instruments and equipment are to be maintained according to SOPs and the manufacturers' instructions. Equipment/instrument maintenance requirements and frequency are defined in Laboratory SOPs and the Laboratory QAPP and are not reiterated here. They will be reviewed an accepted as required for individual sampling events. All routine maintenance and non-routine repairs are to be documented in a bound logbook. The information recorded should include analyst initials, the date maintenance was performed, a description of the maintenance activity, and (if the maintenance was performed in response to a specific instrument performance problem) the result of re-testing to demonstrate that the instrument

performance had been returned to acceptable standards prior to re-use. The return to analytical control is demonstrated by successful calibration.

3.6 INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

3.6.1 Automatic Sampler Calibration

The automatic Isco sampler should deliver accurate sample aliquot volumes. Calibration of this aliquot volume should be completed prior to each sample event and especially after a change in the aliquot setting has occurred (refer to the Isco User Manual for instructions). Should sample volumes vary significantly from the programmed values, the suction line will be checked for proper installation. The line needs to slope continuously downhill to the liquid source and drain completely after each sampling cycle. In addition, a comparison of the actual length of the suction line to the line length setting in the program will be compared to see that they match. Prior to each storm sampling event, the pump tubing will be checked for excessive wear, total pump counts (as indicated by the autosampler, should be less then the pre-programmed alarm setting) and replaced if necessary.

3.6.2 Field Probe Calibration

A multifunction YSI™ probe will be used to continuously collect data at each site during storm sampling events and at various long-term monitoring stations. This meter will measure conductivity, pH, DO, salinity, temperature, ORP, and turbidity. Methods for calibration of these field instruments will follow the specific instrument manufacturer's recommendations. A complete set of manufacturers' directions for calibration and maintenance will be available for project use, especially during pre-storm set-up and sampling events. The YSI™ multi-meters will be used both in conjunction with the auto-samplers and as autonomous field instruments, depending on specific field needs.

Calibration will be performed prior to the start of each sampling event using an instrument self-check and by using applicable calibration solutions. The levels of the standards are selected to bracket the range of the values expected in the samples. The PM is responsible for ensuring that the calibration frequencies are maintained and that each operator understands the proper usage, maintenance, and storage of each instrument. A calibration log will be maintained with each YSI in order to catalog the field calibration. Each log will contain the date of calibration, the operator's initials, the calibration measurements, and observations about the instrument or calibration procedures.

3.6.3 Laboratory Instrument Calibration

Laboratory instrument calibration will be performed in accordance with established EPA-approved methods to demonstrate that the analytical instrument is operating within design specifications and that the quality of the data generated can be replicated.

3.7 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

This section presents sample handling and custody procedures for the sampling activity. These procedures will ensure proper handling, chain of custody (CoC), and documentation of the samples from field collection through laboratory analyses.

Any supplies and consumables used in the sample collection process or instrument calibration, such as sample bottles, tubing, deionized water, calibration gases, etc., will be inspected upon receipt and prior to use. The sample bottles and deionized water will be certified clean and a certificate of acceptance will be included in the field files. The tubing should also come with a certificate of acceptance. At a minimum, the PM or Field Team Leader will inspect the tubing upon receipt for damage or previous notable non-project related environmental exposure.

Autosampler Tubing and Suction Line Preparation and Decontamination

Both the suction line and autosampler tubing (this includes pump head and distributor arm tubing) for all samplers will be cleaned and prepared for initial use by the approved analytical testing facility prior to its deployment into the field. This will be done by submitting the material to the approved testing facility in sealed packaging. The tubing and suction line will be autoclaved. Then it will be subjected to a chemical rinse. This rinse will consist of an acid and solvent wash to assure that the material is clear of any metals or organic residue. Once the material has been further confirmed clean by rinsate analysis it will be packaged in clean and sealed plastic and returned to the project staff for deployment.

Once the tubing and suction line material has been deployed to a particular sampling site the material will remain at that location. Decontamination of the tubing and suction line will occur if one or more of the following conditions are meet: (1) the pump head tubing has been in service for greater than 1 million revolutions (as monitoring by the autosampler), (2) the required number of sampling events has been completed and data collection has ended at that location for the specified timeframe (i.e. yearly, quarterly, etc.), and/or (3) the sampler and its associated lines (any combination of the tubing or suction line) have been moved to a new location or demobilized from the field back into storage. Decontamination will be implemented as described above for the initial tubing preparation process. Again, the testing facility will conduct the procedure and document the final result with data from a rinsate blank.

After each subsequent sampling event, and while still in compliance with the three conditions listed above, each line set (autosampler tubing and suction line) will be back-flushed with 2-3 volumes or 1-liter minimum of laboratory grade deionized water. Care will be taken to advance the pump until the line has been clear of all standing water (excluding that portion of the line that remains in the sampling stream).

Prior to each new sampling event, and while still in compliance with the three conditions listed above, each line set (pump head tubing and sampling line) will be flushed with 2-3 volumes or 1-liter minimum of stream water. If at certain stations (i.e. outfall locations) where there is no flow water available then deionized water be used to re-flush the line set.

3.7.1 Special Handling Considerations

Sample collection and handling considerations associated with this project include:

- grab samples for fecal coliform analysis will be collected as near as midstream as can be safely accomplished at the selected sites;
- storm flow will be collected in either 3.7 L (1 gallon) clear glass bottles or smaller (e.g., 250 ml bottles) clear glass bottles depending on the site and potential for seawater contamination;
- a minimum of 8 liters of storm flow water will be collected for each storm event sampled;
- flow (in cubic feet/second) will be measured by at each location. The flow data will be downloaded on a periodic basis whereupon the data will be used to determine flow/ discharge rates (in cubic feet/second) for each site;
- conductivity, pH, temperature, DO and turbidity will be measured by placing the YSI™ probe approximately 1 foot downstream from the sampler inlet. These physical water quality values will be constantly recorded and downloaded from the Isco every 24-hours (refer to Section 5.4 of the SAP for more detail); and

- sample bottles will be sealed with a Teflon lid and loaded into coolers, packed in ice, and transported to the laboratory by the field sampling team.

3.7.2 Sample Holding Times and Preservation Requirements

All collected samples will be delivered to the laboratory within 24 hours of collection. The laboratory will then perform the required analysis as indicated in Tables 3-1 and 3-3 within the appropriate noted holding times.

3.7.3 Sample Packaging and Shipment

Once collected, each sample bottle will be labeled for off-site laboratory analysis and placed into a sample cooler. The sample coolers will serve as the shipping containers. Each sample container will be packed with ice to cool samples to 4°C during shipment. Samples are to be transported to the laboratory promptly to provide ample time for analyses to be conducted within the established maximum holding times.

Samples will be packed with shock-absorbent materials, such as bubble wrap, to prevent movement, or breakage of the sample bottles during transport.

There will be separate CoC forms for the grab and composite samples because they will be analyzed at different facilities. The CoCs for the grab and composite samples will be sealed in Ziploc bags and affixed to the inside of their respective coolers.

3.7.4 Sample Container Label Requirements

Each sample container will have a sample label affixed to the outside of the container in an obvious location. Information will be recorded on the label with water-resistant ink. The sample label will specify:

- project name;
- site-specific sample identification number;
- initials of individual sampling; and
- date and time of sample.

3.7.5 Field Records

It will be the responsibility of each field crew to maintain a field notebook, which will be kept as a permanent record of field sampling activities. The field notebook will be used to provide daily records of significant events, observations, and measurements during sampling activities. The notebook must be bound, with each page numbered and completed in waterproof ink. Each page will be signed by the user and dated. The PM will provide secure custody of these notebooks during periods of non-use.

The field notebooks are intended to provide sufficient data and observations to reconstruct events that occurred during sampling and to refresh the memories of field team members if called upon to give testimony during legal proceedings. The field notebook entries should be legible, factual, detailed, and objective. Corrections may only be made by lining-out errors, initialing and dating the lineout, and entering the corrected information.

The person conducting the sampling will complete an entry in the field notebook or a field log sheet for each sample collected, noting:

- sample location;
- site-specific sample identification number;

- sample type and collection equipment (e.g., grab sample);
- sample appearance (e.g., color, odor);
- field measurements;
- weather conditions;
- comments and relevant observations at time of sampling;
- signature and date of field notebook completion; and
- any field variances or deviation from the sampling plan.

3.7.6 Chain-of-Custody Record

Each sample container will be logged onto a CoC form prior to relinquishment to the laboratory representative. Information to be recorded on the CoC form includes:

- sample type/source (i.e., grab/surface water);
- analysis required;
- sample matrix (i.e., water);
- sample collector's name;
- dates/times of sample collection;
- sample identification numbers;
- type of preservation (including ice);
- QC sample designation (i.e., MSD);
- special handling instructions;
- destination of samples (i.e., lab address and phone number); and
- name, date, time, and signature of each individual possessing the samples.

The CoC form will accompany the samples to the laboratory and will be signed by each individual responsible for custody of each sample containers.

Custody will be defined as physical possession of the sample or having locked and/or sealed the sample in a tamper-resistant container after physical possession. At the time of custody transfer, the individual relinquishing the samples will observe and the individual receiving the samples will inspect the samples for integrity and number, then date and sign the CoC and any shipping forms. The signed original copy of the CoC form and all shipping forms will accompany the samples to the laboratory and will be returned to the QA Coordinator once the requisite sample analyses have been completed. In addition, electronic copies of the CoC forms will be sent via email to the PM following the conclusion of each sample event.

3.7.7 Laboratory Documentation

The documentation of all activities is critical for tracking data and evaluating the success of any activity. Laboratory documentation requirements are typically defined by the laboratory QAPP or SOPs.

3.7.8 Laboratory Documentation Standards

All data generated during the course of this project must be able to withstand challenges to their validity, accuracy, and legibility. To meet this objective, data are recorded in standardized formats and in accordance with prescribed procedures. The documentation of all environmental data collection activities must meet the following minimum requirements.

- Data must be entered directly, promptly, and legibly. All reported data must be uniquely traceable to the raw data. All data reduction formulas must be documented.
- Handwritten data must be recorded in ink. All original data records will include, as appropriate, a description of the data collected, units of measurement, unique sample identification (ID) and station or location ID (if applicable), name (signature or initials) of the person collecting the data, and date of data collection.
- Any changes to the original (raw data) entry must not obscure the original entry. The reason for the change must be documented, and the change must be initialed and dated by the person making the change.
- The use of pencil, correction fluid, and erasable pen is prohibited.

Any changes to the QAPP or SAP (e.g., QA procedures, analytical procedures, sampling locations and frequencies, etc.) must be documented in writing and approved by either the PM, Project Chemist, CoBI PM (or designee) and/or the Quality Assurance Manager prior to implementation of the changes. Minor deviations from the QAPP or SAP (e.g., those that would not impact the study objectives, design, or data quality) will be reported to and approved by the appropriate team leader and/or the Quality Assurance Manager. Major deviations (e.g., those that could impact the study objectives, design, or data quality) will additionally be reported to the Quality Assurance Manager, the Project PM, and the CoBI PM. A discussion of major deviations and potential impact on the project objectives will be included in the final report.

4.0 DATA MANAGEMENT

4.1 DATA MANAGEMENT PROCEDURES

The purpose of this section of the QAPP is to briefly describe the procedures that will be used to maintain data quality throughout the project. These operations include, but are not limited to, data recording, validation, transformation, transmittal, reduction, analysis, storage, and retrieval.

4.1.1 Data Recording

All field observations and laboratory results will be linked to a unique sample location by the sample identification system described in the SAP. Field observations/measurement data will be recorded in the project field notebook and/or on approved field forms, which ever is appropriate as determined by the PM. Manual data recording for this project will be kept to a minimum to reduce transcription errors. In addition, all data that are hand entered will be subjected to a 100% QC review by a second person to minimize data entry errors.

Physio-chemical data recorded by the YSI™ probe and rainfall data from the Isco rain gauges will be downloaded from the Isco sampler units every 24 hours.

4.2.2 Laboratory Data Package Requirements

In order for the data to be used for decision-making purposes, it is essential that it be of known and documented quality. Therefore, verification and validation of data requires that appropriate QA/QC procedures are followed, and that adequate documentation is included for all data. To meet this objective, each laboratory data package will contain five sections:

- Case Narrative,
- CoC Documentation,
- Summary of Sample Results,
- Summary of QA/QC Results, and
- Raw Data.

Should a laboratory vary from the established methodologies, SOPs for those methods will be included as an attachment to the data package. All data collected will be submitted to CoBI in a format acceptable to the CoBI Database Administrator and ultimately consistent with Ecology's EIM System format.

4.2 AUDITS AND REPORTS

4.2.1 Performance and System Audits

Assessments that may be conducted during environmental sampling projects include, but are not limited to, surveillance, management systems reviews, readiness reviews, technical systems audits, and performance evaluations.

4.3 DATA VERIFICATION AND VALIDATION

Data review includes data verification, validation, and oversight, as well as reconciliation of the data quality with user requirements. The data verification process includes the initial review of the data packages to ensure that the analyses requested have been provided. Data validation is the process of reviewing data and accepting, qualifying, or rejecting data based on sound criteria. Final validated data sets will be verified by the Project Chemist to ensure that is it complete and properly valid.

4.4 DATA QUALITY ASSESSMENT

4.4.1 Field Data Quality Assurance

Field measurements and observations will be made and documented during the project. Field data will be recorded either on standard forms or in a field notebook to provide a permanent record of field activities. The PM and Project QA Manager will ensure that all field data forms are evaluated for the factors listed below and will initial the forms when reviewed.

- A check for completeness of field records will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and the procedures specified in this QAPP and the companion SAP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.
- Identification of valid samples involves interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples. Records should note sample properties (e.g., clarity, color, and odor).

Data quality checks will be performed during the processing of field data. The purpose of these checks is to identify anomalous data (i.e., data that do not conform to the pattern established by other observations). The principal method of this data assessment will be the performance of routine checks to ensure that data are correctly transcribed and that identification codes and sampling information matches the corresponding information in the associated field documentation.

5.0 REFERENCES

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