Appendix C

Water Quality Monitoring Program

Environment

Submitted to:
Public Works & Government Services Canada
Marathon, Ontario

Submitted by:
AECOM

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Water Quality Monitoring during Capping Operations, Marathon Environmental Remediation Contract Number EA754-093130/A
Final

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1.0 Introduction

In July 2009 Public Works and Government Services Canada contracted with AECOM to prepare Detailed Engineering Design, construction oversight, and Environmental Assessment pursuant to the Canadian Environmental Assessment Act for a Thin Layer Cap sediment management option to address historical mercury and polychlorinated biphenyl (PCB) contamination in Peninsula Harbour, Marathon, Ontario. The work was authorized on July 23, 2009 under contract/purchase requisition number EA754-093130/A. This document provides one component of the overall design development defined in the work scope Required Services (RS) 6, “Develop construction monitoring plans to address turbidity and water quality during construction operations.” In compliance with the requirements of RS 7, this document includes revisions required to address comments on the RS 6 design level submission based on comments received.

1.1 Site Background

Peninsula Harbour is an approximately 12 km^2 embayment off the northern shore of Lake Superior that was identified as an Area of Concern in 1985 as part of the review by the Water Quality Board of the International Joint Commission (Figure 1). Elevated concentrations of mercury and PCBs in sediment and fish were identified within Jellicoe Cove in the southeastern portion of the Harbour, and as a result, the area has been the focus of a number of investigations. The information presented in this background summary as well as that used to develop this construction monitoring plan is based on these previous investigations, primarily the Remedial Action Plan (RAP) Stage 1 (1991) and Stage 2 (1999), the Report on the Chemical and Physical Characteristics of the Sediment in Jellicoe Cove, Peninsula Harbour, October 2003 (Biberhofer and Dunnet 2005), and Review of Existing Studies on Mercury Contamination and Bioaccumulation (Golder 2005) as well as notes on other studies summarized in the above reports.

Jellicoe Cove is approximately 97 hectares in area and is bounded from the rest of Peninsula Harbour by Skin Island. A broad area less than 4 m in depth stretches along the eastern portion of the Cove, and depths increase to the west, reaching a maximum of 28 m to the southwest of Skin Island (Figure 2). Bedrock shoreline occurs along the western and eastern heads of the Cove, and a portion of the southwestern shoreline has been armoured with large boulders and rubble. Sediment within the Cove has been identified in previous investigations as predominantly silty sand, with some western areas dominated by fine-grained material (ENVIRON 2007). Fibrous materials attributed to historical pulp mill operation/discharge have been identified in cores collected within the cove. Jellicoe Cove has been characterized as predominantly depositional, with an approximate depositional rate of 1 to 2 mm per year. Given its sheltered orientation and the lack of significant land-based flow, bottom currents within the Cove have been reported as relatively low (<0.2 m/s) and with wave heights less than 0.5 m (Skafel 2007). Based on available information, estimated bottom currents due to incoming waves are highest on the west side of the cap area, decreasing to the east, ranging from 0.44 m/s to 0.09 m/s

(Environmental Hydraulics Group, 1993)[1]. The Jellicoe Cove has an industrial shoreline due to many decades of industrial activity.

Outside of Jellicoe Cove, the remainder of Peninsula Harbour covers approximately 1,070 hectares with a maximum depth of 37 m. Steep slopes, cliffs, and exposed rock characterize much of the approximately 19 km shoreline. Two small creeks, Shack Creek and another unnamed watercourse, drain into the Harbour just north of Jellicoe Cove. Given the predominance of hard substrate in much of the shallow area, there are no significant coastal wetlands along the shoreline of the Harbour that would support extensive growth of aquatic vegetation. Fish habitat within the Peninsula Harbour Area of Concern has been impacted by the historical industrial activity. Historical lake trout spawning grounds along the shorelines of Jellicoe and Beatty Coves have been destroyed through the accumulation of organic matter from mill operations (Foster, 2011).

There have been numerous investigations of sediment quality in Jellicoe Cove since its designation as an area of concern, with mercury identified as the primary contaminant of concern and with elevated concentrations of PCBs as well. Golder (2005) provides a review of mercury-related investigations; highest concentrations were found at depth in the sediment with surficial sediment concentrations typically below 30 ug/g. Richman (2004) provided the most recent PCB data, with surficial sediment concentrations ranging from below a detection limit (20 ng/g) to a maximum of 240 ng/g total PCBs.

1.2 Planned Capping Operations

The preferred remedy selected by Environment Canada (EC) and the Ontario Ministry of Environment (MOE) for Jellicoe Cove is installation of a thin layer cap. The capping will include placement of an approximate 15 to 20 cm thick layer of clean sand on top of previously identified mercury and PCB contaminated sediments. The capping area will cover approximately 252,000 m^2 of the southern portion of Jellicoe Cove, including approximately 200,000 m^2 where total mercury exceeds 3 ug/g in surficial sediments and an additional 52,000 m^2 where elevated PCB concentrations in surficial sediments have been identified (Figure 2). Some consolidation of underlying sediment is expected following placement of the cap, but given the thickness of the intended cap and the nature of the underlying sediment, settlement is expected to be less than a few centimetres. The intent of the thin layer cap is not complete isolation of the underlying contaminated sediment, but rather enhancement of the natural recovery of the site.

The capping operation equipment will be determined in part through the tender process as the capping specifications are performance based. While it is possible that alternative methods for sand deployment may be proposed, it is anticipated that the work will be performed mechanically, using one or two capping barges consisting of barge-mounted derrick cranes and/or backhoes, and approximately two to three deck barges (material barges). In addition, two to three tug boats and two support vessels will likely be used. A general summary of the operation is anticipated to include the following components:

- Clean capping material is transported to the project area by truck or on larger barges and offloaded/stockpiled onshore.

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[1] Accordingly, a coarse sand gradation will be used in this western area to provide protection against bottom currents due to wave action. A medium sand will be placed in the remainder of the cap, while also offering a finer grained substrate for habitat development.

- The capping barge is positioned over the capping area by tugs and secured using multi-point anchor systems.
- At the stockpile area/loading dock, capping material is loaded onto smaller deck barges and brought alongside the capping barge.
- The capping barge bucket will swing over and grab capping material from the deck barge, and place the capping material over the target location. After release, the capping material will descend through the water column to the targeted placement location on the lake bottom.
- The capping barge will advance in a capping lane using the anchor system, and be repositioned within the cap area when necessary by tug assist.
- The capping operation is constrained by a 1 May through 31 August annual window in an effort to minimize any potential impact to local fish populations. The operation will include an initial pilot phase to evaluate and optimize the specific technique and procedures at the start of the project to address changed conditions such as the grain size of the capping material and/or the deployment water depth.

1.3 Potential Water Column Impacts

Potential Impacts Related to Capping Operations

As part of the design of this construction monitoring program, the following potential water impact sources related to a capping operation such as the one proposed for Jellicoe Cove have been taken into consideration:

- Anchor Placement and Handling – Multiple anchors will be required for positioning each capping barge. The anchor lines will generally be at least 100 m in length and require tensioning and paying out to advance the barge. Placement of the anchors as well as adjustment (causing the cables to periodically rise above and fall back to the sediment surface) has the potential to resuspend bottom sediments.
- Material Transfer – Transfer of capping material to the stockpile area on shore (if brought in by large barge) and from the stockpile area to the deck barges, will involve handling the material over water by conveyor or direct mechanical means) with the potential for spillage of capping material into the water at the loading dock.
- Placement of Cap Material – The capping methodology is not prescribed in the construction documents to permit flexibility for different approaches based on contractor equipment and experience. Consequently, cap material placement may occur above the water surface, below the water surface and/or deeper in the water column. Potential water quality impacts associated with each method are identified below.
  - Transit of Capping Material through the Water Column – As the capping material is released at the water surface over the target location, it will undergo an initial convective descent (because of the density difference with the surrounding water), accelerating and drawing water into its mass. In shallow water, water less then 3m in depth, the released material will generally reach the bottom with minimal water entrainment. In deeper water, the varying fall rates of different sized particles within the bucket load will cause some vertical spreading of the material as it transits to the bottom. With limited ambient currents, minimal (<1%) loss to the water column is expected (Ruggaber 2000).

- Capping Material Impact to the Bottom – As the capping material reaches the bottom, it will generally spread radially outward from the center of impact, potentially causing resuspension of in-situ sediment at the immediate sediment-water interface.
- Cap Consolidation and Release of Porewater – With increasing thickness of capping material placed over ambient sediment, the increased loading can cause consolidation of the underlying material with the accompanying release of sediment pore water up through the cap.

- Vessel Operation in Shallow Water – Operation of tugs and support vessels in shallow water may result in potential resuspension of bottom sediments from propeller or jet wash. The potential for resuspension increases in static operations where a tug may be pushing against a barge with greater than normal thrust to hold position.

In general, the potential water column impacts described above are expected to be minimal for the capping operation for Jellicoe Cove given the following site and operation-specific factors:

- The use of “clean” capping material with a limited fraction of fine material will result in limited potential release to the water column. The technical specifications for this project require the percentage of fines to be less than or equal to 6% of the material.
- The relatively low application rate (estimated bucket size of 3 m^3 - 8 m^3 and maximum production rate of 2,000 m^3/day) is expected to have minimal impact on ambient sediment during placement.
- The sediment contamination at the site contains PCBs but no separate phase NAPL has been observed or measured on site; therefore, the potential release of surface sheens is not expected.
- The thin layer cap being placed is expected to cause limited compaction of underlying sediment, resulting minimal release of porewater.
- The Cove area is characterized by a relatively low current regime and limited wave action which will significantly limit dispersion during performance of the capping program.

Potential Water Quality Impacts Common to All On-Water Operations

Standard environmental considerations that are common to all on-water, vessel-based work and regulated by the Canadian Coast Guard are not covered by this plan, however, these operations will be covered under the contractor’s spill control planning and response document. These include, but are not limited to:

- Fuel/oil transfer
- Spill notification and response
- Waste containment
- Discharge from vessels

Specifics on equipment requirements and procedures are expected to follow those detailed in Canadian Coast Guard regulations (www.ccg-gcc.gc.ca).

1.4 Construction Water Quality Monitoring Objectives

Taking into account the site- and operation-specific factors related to the planned capping that are noted above, the water quality monitoring program for this operation was designed with the following overall goal:

- The physical operations and the potential disturbance of the existing contaminated sediments during capping do not result in acute impact to organisms within the water column outside the immediate capping area.

Given the timing of the capping operation as well as its physical location (not extending fully across a waterway or mouth of an inlet), procedures for monitoring the safe passage of fish in the area are not included in this plan. Given the lack of NAPL as a sediment contaminant, specific procedures for monitoring for surface sheens/films are not included in this plan although general observation requirements for noting sheens and floating debris will be part of all operations and monitoring briefings.

2.0 Monitoring Methods

2.1 Overall Approach

The overall approach for water quality monitoring during construction is to use field-measured turbidity as real-time assessment of the potential release of suspended solids from the operation to the water column. Measurements will be performed using a boat-based nephelometer that can provide a direct readout of turbidity levels as it is lowered through the water column or towed beneath the monitoring vessel.

The depth of real time monitoring and water sample collection:

- ≤ 2 m - one measurement point at mid depth
- ≥2 m and < 4m - two measurement points; 0.5 m below the surface and 0.5 m above the bottom
- ≥ 4 - three measurement points; 0.5 m below the surface, mid depth, and 0.5 m above the bottom

Turbidity measurements will be obtained at the Shack Creek, the control and the background sampling stations within Jellicoe Cove to establish pre-cap background conditions. Turbidity measurements from these stations will be depth averaged and used as background levels for the TSS/Turbidity criteria.

The shoreline near the Project area is mainly industrial and heavily impacted. Two small nearshore areas to the southeast and southwest side of the cap have been identified as potential fish habitat, however it is unknown (can not be verified 100%) whether or not it is a sensitive fish habitat. Should sensitive fish habitat be found in these areas, precautions will be taken (e.g. turbidity curtains may be used and the turbidity within the curtain area must meet the turbidity criteria specified in Table 1).

The measurements from baseline and initial intensive monitoring will be used to validate the relationship between turbidity and TSS as outlined in Table 1.

The turbidity measurements from initial intensive, standard and conditional monitoring will be compared to the turbidity criteria outlined in Table 1. The Departmental Representative will establish the background turbidity levels based on data collected from the background stations. The monitoring will include the following components:

<u>Baseline Monitoring</u>

Prior to the start of intensive in-water work, turbidity, suspended solids, dissolved oxygen, temperature, specific conductance, PCB and Hg levels will be characterized for the Cove at eight sampling locations. Turbidity, dissolved oxygen, temperature and specific conductance will be measured using boat-based continuous reading monitors. Suspended solids, PCB and Hg in water will be measured by water sample collection and laboratory analysis. The goal of baseline monitoring is to:

- o Establish background conditions.
- o Develop correlations between TSS and turbidity which will allow real time turbidity monitoring to be applied as a construction phase water quality control criteria, correlated to TSS water quality criteria;

Baseline monitoring stations will include:

- Shack Creek station (to assess sediment input from Shack Creek)
- the control station (south-west of entrance to Jellicoe Cove),
- three locations within the cap, and
- three stations outside the cap area (north, south-west and north-east).

Baseline locations within the cap area will be selected to reflect a range of depth, current, underlying substrate and contaminant conditions. The Shack Creek station was included to measure sediment input from Shack Creek.

Monitoring will occur at each location at depths indicated in Table 1. PCB and Hg samples will be collected in the lower depth only. TSS samples will be collected at all identified depth increments (Table 1).

Sampling Summary:

- Real time measurements (Turbidity and etc): 24 readings
- TSS water samples: 24 samples
- PCB/Hg water samples: 8 samples (8 stations at 0.5 m above bottom)

Initial Intensive Monitoring

During the first two weeks of operations, real time measurements (turbidity, temperature, specific conductance, and dissolved oxygen) will be taken every two hours up to a maximum of 5 times a day during daylight hours. Measurements will be taken at 25 m increment from the capping barge up to 200 m in the direction of the plume at depths prescribed in Table 1. Real time monitoring data will also be conducted at Shack Creek, the control station and one of the background sampling locations to be selected by the Departmental Representative.

Water samples will be taken for the analysis of TSS at 25 m and 100m from the capping barge twice a day at water depths prescribed in Table 1 during the first week. Samples will be taken to provide a range of TSS measurements to establish a relationship between TSS and turbidity. Up to 84 water samples will be analyzed for TSS. The samples will be analyzed on site to allow comparison between TSS and turbidity.

Water samples will be taken for the analysis of mercury and PCB at 25 m from the capping barge at 0.5 m above the bottom twice a day during the first week. Samples/ will be taken when the area with the highest mercury/PCB contaminated sediment is capped. Approximately 14 samples will be collected and compared to the CCME Guidelines for mercury for the protection of aquatic life during capping operation.

Sampling Summary:

- Real time measurements (Turbidity and etc): up to 1680 readings (8 stations X 3 depths (can vary) 5 times/day (every two hours to a maximum of 5 times/day) X 14 days) **plus** a total of 126 readings from Shack Creek, the control and one background station which will be selected on the windward side of the capping barge within Jellicoe Cove as determined by the Departmental Representative (3 stations X 3 depths X 1 reading/day X 14 days)

- TSS water samples: up to 84 samples (2 stations (25 m and 100 m) X 3 depths (can vary) X 2 times/day X 7 days)
- PCB/Hg water samples: 14 samples (1 station (25 m from capping barge) X 1 water depth (0.5 m above bottom) X 2 times/day X 7 days)

Standard Monitoring

During the remainder of the capping operations, real time monitoring will be performed as required by the Departmental Representative (a minimum of two days per week) at pre-defined distances from the operation. These locations are established as 100 m from the capping operation. Moreover, if turbidity curtain is used and if the capping operation is within 100 m from the turbidity curtain, the real time monitoring will also be performed at 10 m to the landside of the turbidity curtain., The direction of the locations relative to capping operations will be selected according to plume location as determined by a Departmental Representative. Monitoring will occur at depths as defined in Table1. Monitoring will include real-time measurements of turbidity, temperature, specific conductance, and dissolved oxygen. Conditional monitoring will be performed if there is an exceedance of the turbidity criteria.

Real time monitoring will also be conducted at Shack Creek, the control station and one of the background sampling locations (windward side of the capping barge) to be selected by the Departmental Representative.

Sampling Summary:

- Real time measurements (Turbidity and etc): up to 12 readings (1 station (100 m or 10 m from the silt curtain) X 3 depths X 2 times/day X 2 days/week) **plus** a total of 18 readings from Shack Creek, the control and one background station within Jellicoe Cove as determined by a Departmental Representative (3 stations X 3 depths X 1reading/day X 2 days).

Conditional Monitoring

Additional monitoring will be performed if there is a major change to the operation, such as major equipment or procedural change or if a visual suspended solids plume extending 50 m or more from the operation develops.

Additional monitoring will include real time monitoring (turbidity, DO, temperature and specific conductance) at the compliance boundary, Shack Creek, the control station and one background sampling locations.   Monitoring will be performed until three (3) consecutive turbidity readings at the compliance boundary are in compliance. The monitoring can then return to normal monitoring procedure.   The number of monitoring events during conditional monitoring will vary and will be determined by the Departmental Representative.

2.2 Definition of Monitoring Zones and Criteria

The compliance boundary for assessing turbidity levels will be set at 100 m from the point of operation or expected suspended solids release point (e.g. the release point for the capping material, anchor placement point, or vessel operation in shallow water). As the capping operation moves, the compliance boundary will be adjusted to follow its progress. An example compliance boundary is depicted in Figure 3, showing two capping rigs in operation.

Turbidity measured at the compliance boundary will be compared against a site-specific criteria specified in Table 1. The criteria are based on suspended solids and have two levels with specific actions to the operations noted. Given that the capping operation is focused on a relatively small area (which permit avoidance of the area by fish), is not continuous (i.e., the operation will shut down periodically based on logistics and operator down-time) and criteria are at levels of potential sub-lethal effects, the criteria specified are considered protective.

The background turbidity level will be established by the Departmental Representative based on data from background stations. Turbidity curtains may also be used if consistent exceedance of turbidity readings at the 100 m compliance boundary (see Figure 3) occurs.

A screening level modeling exercise was conducted in order to simulate the short-term fate of the capping material placed at the site and predict potential water quality effects. STFATE is a model of discrete sediment disposal from barges or hoppers or continuous discharges from pipelines or confined disposal facilities. The model simulates the release of capping material capturing the descent, dynamic collapse, and passive transport-dispersion of the released material. STFATE was used to model a single release of capping material for the analysis of turbidity caused by suspended sediments released during the proposed capping activities.

The results predict that the maximum total suspended solid (TSS) values that would be generated from placement of medium sand (equivalent to PWGSC specifications) would be approximately 7 mg/L at a location 100 meters away from the placement point. This result was obtained using a conservative current velocity input. The results of the exercise support that the TSS/ turbidity compliance requirements in Table 1 can be efficiently managed without increasing the potential for an unwarranted shut down of operations.

2.3 Field Equipment and Methods

Positioning – The monitoring vessel will be equipped to allow for positioning by the following two methods:

- A high resolution global positioning system (GPS) capable of determining position with an accuracy of approximately 1 to 2 m will be used for recording all monitoring/sampling locations and for setting the monitoring zone boundary when the barge position is known; however, it is noted that if there is a loss of signal to operate the high resolution GPS, a lower resolution approach may be used to prevent stoppage in operations. Under no circumstance will operations continue if the precision of the positioning system is less than 5 m.
- An electronic rangefinder and hand bearing compass will be used for setting the monitoring zone boundary when the barge position is not known.

In-Situ Measurements – Field measurements of turbidity, temperature, conductivity, dissolved oxygen, and depth will be made using a multi-parameter water quality meter such as a YSI 6820 or equivalent capable of providing direct readout of measurements at the surface. The turbidity and dissolved oxygen sensors will be calibrated at the start of each monitoring week following standard procedures in the instrumentation manual. See Attachment 1 for an example Standard Operating Procedure (SOP) detailing the proposed turbidity monitoring methods.

Water Sampling – The collection of water samples will be conducted using a pump and tubing system, with the inlet of the tubing attached to the body of the water quality meter to ensure that the sensor measurements and analytical results are representative of similar parcels of water. Tubing will consist of C-FLEX Teflon™ or similar. The internal volume of the tubing system will be calculated and the pumping rate measured using a graduated container. A minimum of five tubing volumes will be pumped through the system prior to collection of water samples for analysis. Depth intervals for sample collection are as specified in Table 1.

Appropriate sampling methodology will be used for the analysis of mercury and PCBs. These water samples should be submitted to a CALA accredited laboratory for analysis by the Departmental Representative.

Field Observations – A field log sheet will be completed at each station where samples are collected and/or measurements performed. The log sheet will include station ID, date, time, position, depth/measurements, status of capping operation, meteorological observations, and any other pertinent observations (e.g. capping material type, production rates, support vessel/tug operations) that may impact or help interpret the condition of the sample/measurement.

2.4 Analytical Methods

A summary of analytical requirements and methods is provided in Table 2.

2.5 Health and Safety

Performance of the water quality monitoring is expected to fall under the general project-wide health and safety plan. If needed, an addendum will be prepared by the selected monitoring contractor to provide procedures and hazard analyses that may be specific to their performance of the monitoring.

3 Documentation and Reporting

3.1 Field Measurement Reporting

The physical location for each monitoring/sampling location will be saved electronically by the GPS system at the time of collection as well as the noted coordinates and/or the range/bearing of the specific operation being monitored. A field log sheet will be completed for a set of turbidity measurement transects and for sample collection. These forms and related log book entries will be scanned daily and transmitted to the Departmental Representative, with the original hardcopies maintained in the project file.

3.2 Sample Identification and Numbering

All samples and turbidity monitoring locations will be documented with the following information:

- Identifier noting the position relative to the operation being monitored
- Date, time, and depth of sample/measurement point
- Sample collection depth
- Site name
- Required analyses

3.3 Chain of Custody

For samples being sent to a laboratory for analysis, chain of custody forms should replicate sample label information and include container type, mass/volume, preservation, analysis required, QC sample information, and destination laboratory. Custody begins as soon as a sample is collected, and all sample transfers are documented on the COC form. The sampler is to relinquish custody to the lab (if directly delivered), to a lab courier, or can relinquish samples at the time that they are packaged/sealed for common carrier transport.

3.4 Analytical Data Reporting

Laboratory analytical data will be reviewed for accuracy and completeness. A memorandum will be completed for each set of samples analyzed summarizing the events surrounding the sampling effort, providing a summary table of analytical results, and including the complete laboratory package as an electronic attachment.

3.5 Plan Deviations and Modifications

As noted in Section 2.5 above, some modification of this plan is expected once underway and initial data are reviewed. Example deviations include relocating the compliance boundary because of an access or safety constraint or equipment malfunction that causes an alternate measurement or collection approach. Example modifications include reductions/increases in the frequency of monitoring or a change in the turbidity criterion. Modifications may be required, for example, due to major changes in construction methodology or equipment, observations of visible plumes in the water column or extreme weather or lake conditions. Subsequent documentation of deviations/modifications should include email transmissions, phone records, logbook entries, and in some cases project memos. All related documentation is to be maintained in the project file.

3.6 Data Management and Retention

All hardcopy records will be maintained in the project file, and electronic records will be maintained in a secure, backed system for the duration of the project. Following completion of the project, a copy of the project file and electronic records will be transferred to the Departmental Representative.

4 References

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Tables

Table 1 – Summary of TSS and Turbidity Criteria (all referenced to above background)

Criteria	Shallow Curtain Protected Area (If Required)		Non Curtained Area	
	TSS (mg/L)	Turbidity (NTU)	TSS (mg/L)	Turbidity (NTU)
Primary Criteria - exceedance requires immediate notification of contractor and cessation of operation to evaluate cause	45	15	150	50
Measured at:	10m to the land side of the silt curtain		100 m from the capping operation	
Secondary Criteria - exceedance requires immediate notification of contractor to evaluate cause and continued monitoring; second exceedance within a one(1) hour period requires cessation of operation to evaluate cause	25	8	90	30
Measured at:	any location within 10 m to the land side of the silt curtain		100 m from the capping operation	

Notes:

- TSS is the controlling criteria; turbidity may be adjusted following review of site-specific TSS-turbidity relationship
- The background level will be determined by averaging TSS/Turbidity at all depths from the reference site
- criterion compared to water column average with depth of measurements noted below
- depth of real time and water sample collection:
  - ≤ 2 m - one measurement point at mid depth
  - > 2m and < 4m - two measurement points; 0.5 m below the surface and 0.5 m above the bottom
  - ≥ 4 m - three measurement points; 0.5 m below the surface, mid depth, and 0.5 m above the bottom

Table 2. Summary of Analytical Requirements and Methodologies

Parameter	Sample Volume	Container	Preservation	Holding Time	Analytical Method
TSS	1L	HDPE	4°C	7 days	MOEE E3365A
Total aqueous mercury	1L	Amber glass	4°C	7 days	MOEE CV-AAS, HGWATER-E3060B
Total aqueous PCB	1L	Amber glass	4°C	7 days	MOEE PSAOC-E3270

Figures

Figure 1. Peninsula Harbor and Surrounding Area.

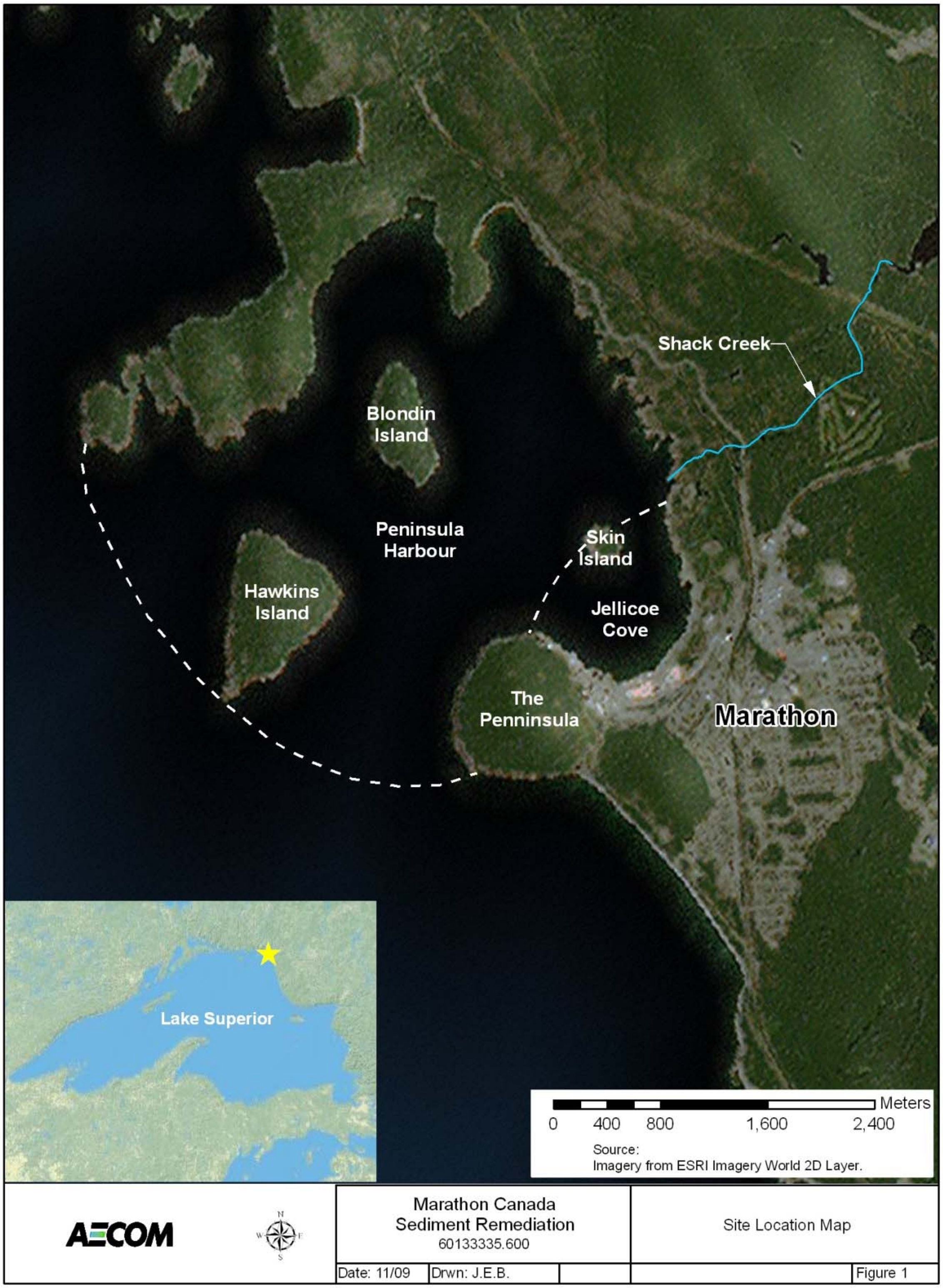


Figure 2. Bathymetry of Jellicoe Cove Showing Planned Cap Area.

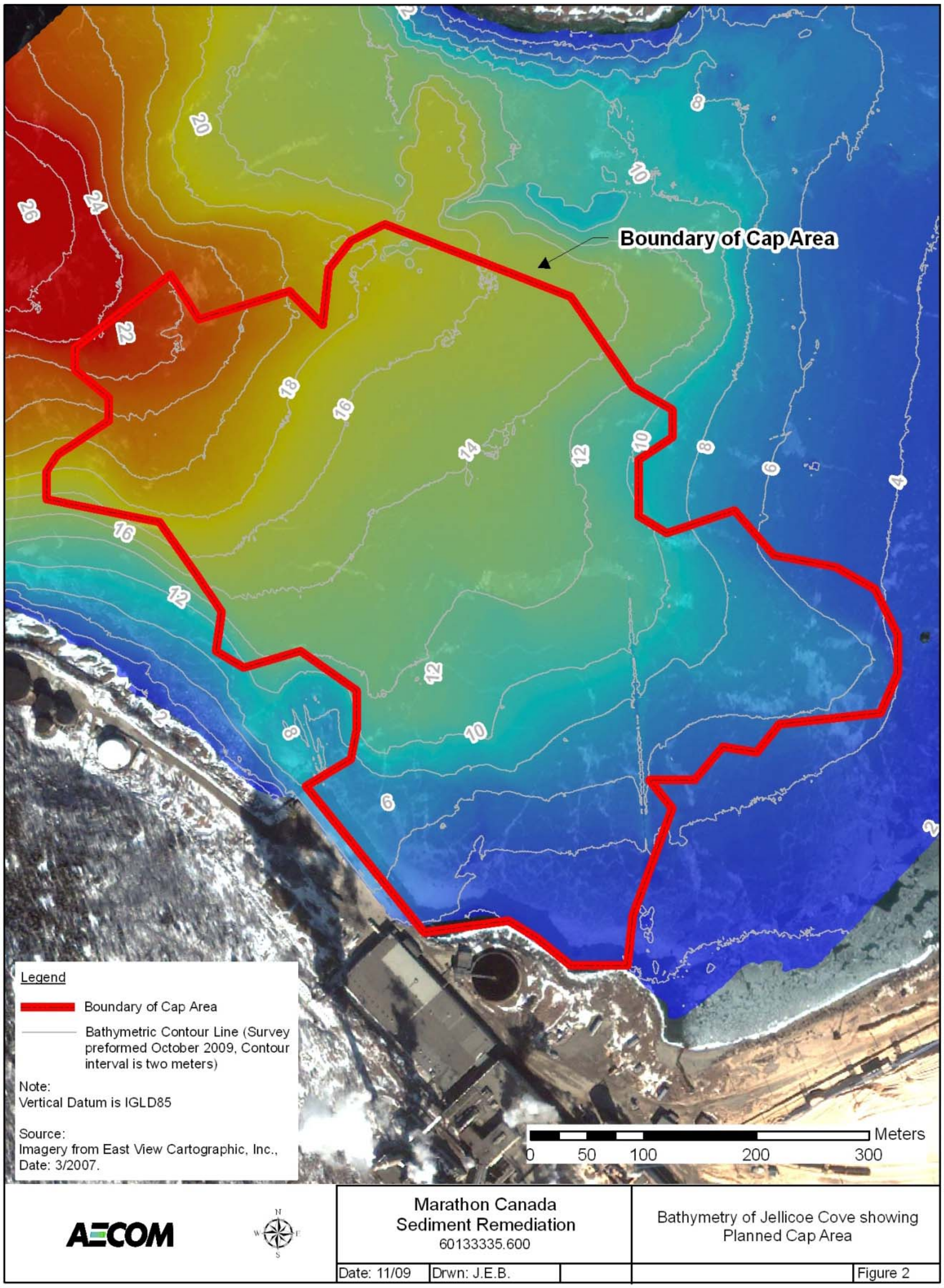
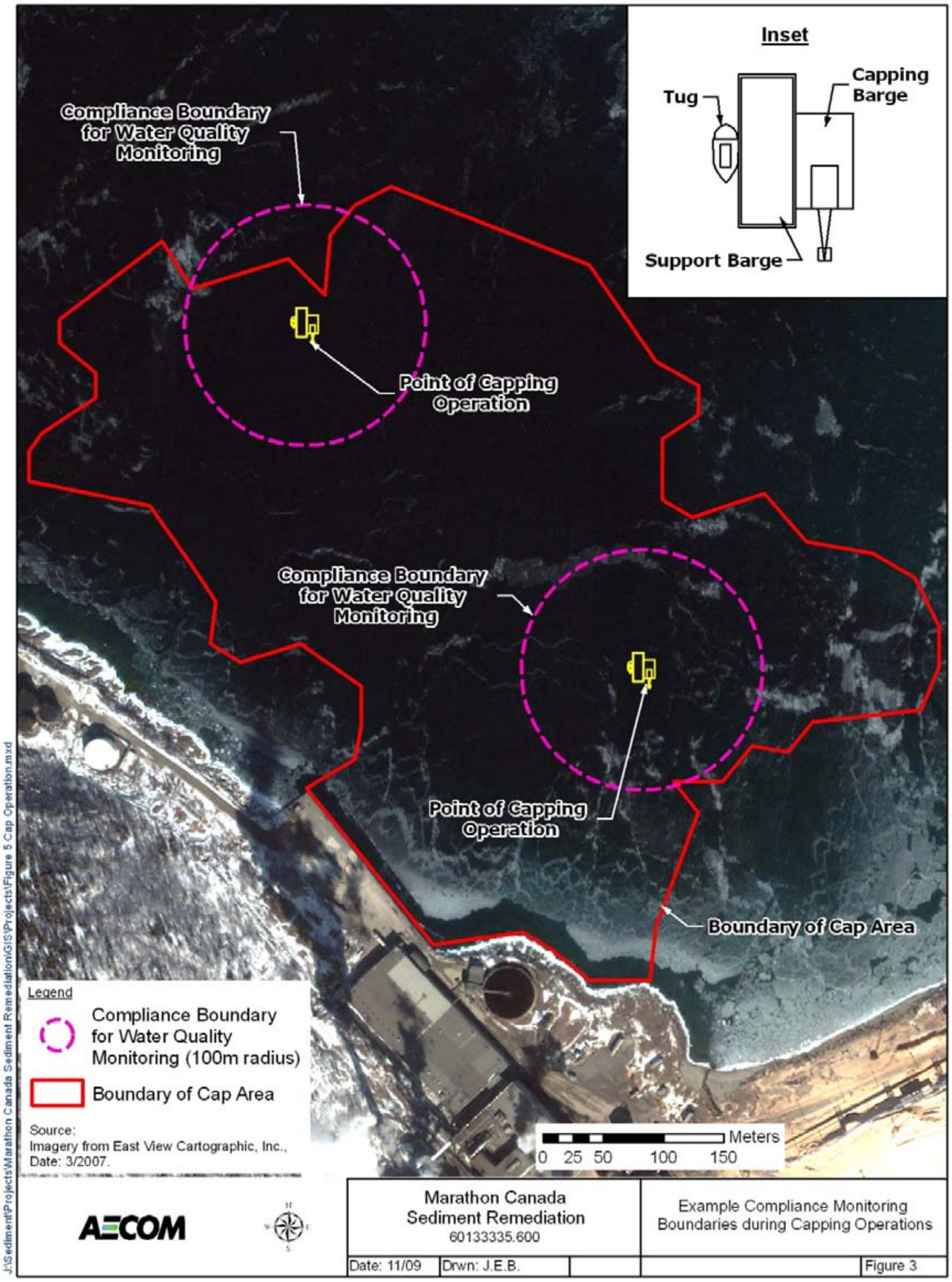


Figure 3. Example Compliance Monitoring Boundaries during Capping Operations.



Attachment 1

SOP - CTD/Turbidity Data Collection and Water Sampling

AECOM

Standard Operating Procedure
Restoration Project

CTD/Turbidity Data Collection and Water Sampling

Procedure Number: FI-02

Revision No.: 1

Revision Date: June 2009

Prepared by

____________________________ Date: __________________________

____________________________ Date: __________________________

____________________________ Date: __________________________

Annual review of this SOP has been performed
and the SOP still reflects current practice.

Initials: ________ Date: ________
Initials: ________ Date: ________

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Standard Operating Procedure
Restoration Project
CTD/Turbidity Data Collection and Water Sampling

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Standard Operating Procedure
Restoration Project
CTD/Turbidity Data Collection and Water Sampling

1.0 Scope and applicability

1.1 This project Standard Operating Procedure (SOP) defines the operating procedures for the collection of water samples and physical water property data using conductivity, temperature and depth (CTD)/turbidity sensors from a boat or other sampling platform during sample/data collection activities. This SOP also provides for the moored deployment of CTD/turbidity instrument sensors. Specialized handling of trace metal or trace organic samples is beyond the scope of this SOP.

1.2 The collection of water samples is limited to suspended solids concentrations (SSC), particulate organic carbon (POC), and dissolved organic carbon (DOC).

1.3 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Quality Assurance (QA) Manager and the Remedial Investigation (RI) Task Manager and communicated to the United States Environmental Protection Agency (USEPA) Remedial Project Manager. Deviations from this SOP will be documented in the field records. The ultimate procedure employed will be documented in the report summarizing the results of the sampling event or field activity.

2.0 Health and safety considerations

2.1 The health and safety considerations for the work associated with this SOP, including physical, chemical, and biological hazards are addressed in the site-specific Health and Safety Plan (HASP) and associated addendums . The major health and safety considerations for the work associated with water and CTD/turbidity data collections are the marine safety aspects of the program.

2.2 Daily safety briefs are to be conducted at the start of each working day before any work commences. These daily briefs are to be facilitated by the Site Safety Officer (SSO) or his/her designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

3.0 Interferences

Ensuring that the (in situ) sensors are maintained properly will help reduce interference risks related to these data collection efforts. Bio-fouling is generally the greatest concern related to moored systems, particularly when sensing turbidity. Data bias can arise related to suspended solids if the entire sample is not used during sample processing (USGS 2000) and special handling is required to minimize sea salt bias when processing seawater. However, these handling concerns should be addressed in laboratory SOPs.

4.0 Equipment and materials

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Water pump (diaphragm pump ca. 10 L/min or better; Shurflo™ or equivalent)
- CFLEX™ or equivalent polymer tubing (typical configuration requires 3/8 inch ID), a 50-foot length will be required
- Water sample containers per Field Sampling Plan (FSP)/Quality Assurance Project Plan (QAPP)
- CTD/turbidity instrument package (OBS3A or equivalent)
- Connective (serial) cabling
- Weight bearing line/cable and anchor weight
- Field laptop computer
- Chemical-free wipes
- Tap water supply
- Manufacturers operating manual
- Replacement batteries
- Survey vessel fitted with differential global positioning system (DGPS) navigational equipment
- Safety gear (work vests, HASP specified personal protective equipment [PPE])

Moored operations:

- Buoy, instrument caging, and connector deployment cable/chain
- Sufficient battery and memory capacity for the deployment period
- If station requirements are limited to turbidity, or pressure, then individual turbidity or pressure sensing systems (e.g., HOBO™ or equivalent) will be needed

Water sample processing for POC/DOC

- Glass fiber filters (GF/Fs), generally (pre-combusted) 25mm for POC
- Filter supports/holders
- Vacuum pump
- Forceps
- Aluminum foil (POC) packets
- Pre-cleaned Wheaton-33™ low extractable borosilicate glass vials (40-mL) or equivalent

5.0 Procedures

5.1 CTD/Turbidity Instrument Set-Up

Fasten the pump tubing to the CTD/turbidity sensor package avoiding any obstruction to the turbidity sensor. Attach the CTD instrument and the tubing inlet to the weighted deployment line at approximately 3 feet above the anchor weight. The tubing and the sensor cable should then be fastened (with plastic tape) to the weighted deployment line at regular intervals over the entire length. Refer to Section 2.1 "Mounting Suggestions" of the OBS-3A instrument manual (attached). Sensors should be inspected for cleanliness and to ensure they are free of corrosion.

Install the instrument batteries (3 D-size alkaline) and operating software according to Section 2.2 and 3.1 of the operating manual. A new configuration file should be named for each (multi-day) survey or mooring event to aid in data tracking. Refer to the QAPP for the survey/mooring naming conventions.

5.2 System Testing

Test the turbidity, temperature and conductivity sensors as outlined in Section 3.5 of the operating manual. Water density and barometric correction procedures are provided in Section 3.6 of the manual.

5.3 Calibration

The CTD and turbidity sensors are factory calibrated. CTD sensors should be returned to the manufacturer if they are not operating within the specified accuracy/precision limits. Initial checking can be accomplished in a large basin of water with known conductivity/salinity, temperature, and depth. Turbidity/optical backscatter (OBS) sensor calibration should be accomplished following Section 6.1 of the instrument manual once/at the start of each (multi-day) survey/mooring deployment.

5.4 Water Pump

Connect the pump to a 12-volt battery or directly to the vessel's 12-volt electrical system using appropriate electrical connections. The water pumps and associated tubing used on this data collection effort should be new and dedicated to the project. Water pumps should be rinsed with tap water before and after each sampling day. Between-station (or between sampling depth) rinsing is not generally required for major component (POC/DOC, SSC) sampling/analysis, however, the internal volume of water carried in the system (pump inlet to pump outlet) should be purged with a least one volume of water to ensure that a representative sample is collected. Attachment 1 provides additional water sample collection handling requirements for discrete water sample handling.

5.5 Deployment/Field Data Collection

5.5.1 Navigate to the station of interest using the navigational procedures outlined in SOP – Navigational Positioning.

5.5.2 Deploy the instrument group and attached sampling tube and begin CTD/turbidity data profiling as outlined in the FSP.

At the station of interest, the instruments (and sampling tubing) should be lowered through the water column until the anchor weight strikes the bottom, thus fixing the initial near bottom position of the gear at approximately 3 feet above the bottom. Based on the water depth provided by the CTD, field technicians will determine the water column structure and define the desired depths for data and sample collection. Water collections are then generally made upon instrument recovery (near-bottom water first, then intermediate depths as needed, and surface water last).

Once fixed at a given sampling point, the sampling tubing should be flushed with at least one system volume prior to the collection of any water samples, Given the small (typically 3/8-inch ID) tube diameter, tube flushing will be complete for a 25-50 foot tube well within 10 seconds, with a flow rate of 10 liter (L)/min or better. After flushing the tubing, the requisite volume of water can be collected for the parameter set of interest.

Moored CTD/turbidity instruments should be serviced at a frequency outlined in the FSP and will often correspond with other program data collection activities.

5.5.3 SSC water samples should be collected directly in pre-labeled plastic bottles and stored on ice in the dark (refer to the QAPP for containerization and storage specifications).

5.5.4 POC/DOC water samples should be collected in pre-labeled plastic bottles, held in the dark on ice (refer to QAPP), and processed within hours if possible. This can be performed either on deck, at the dock, or at the field facility (see Attachment 1).

5.5.5 All discrete water samples should be collected and stored/transferred to laboratories according to the procedures described in SOP – Sample Custody, and Packaging and Shipping.

6.0 Quality assurance / quality control

6.1 It is the responsibility of the Field Team Manager (FTM) or designee to check the instrument calibration/test information, to spot check adherence to the procedural requirements of this SOP, and to review the associated documentation for accuracy and completeness.

6.2 During boat-based transects, newly acquired data should be reviewed for reasonableness by the FTM or designee before moving off station.

6.3 Quality control (QC) samples will be collected in the field (i.e., duplicates, POC/DOC filter blanks) to assess field handling precision and in the laboratory (i.e. control sample, lab blanks) to assess measurement accuracy and precision at a frequency outlined in the QAPP.

7.0 Data and records management

7.1 Field records will be generated and maintained as outlined in SOP– Field Records and in the Data Management Plan (DMP). These documents cover all aspects of collection including chronology of events, station locations, time/date, sampler name, and data collected.

Instrument check/test records including turbidity sensor calibration records will be maintained in the field logbook. POC sample filtration volumes will be recorded on POC sample processing sheets (Attachment 1).

7.2 During boat-based surveys in situ CTD/turbidity data will be captured on a laptop PC using a data acquisition system that integrates instrument software and Hypack navigation software. Furthermore, acquired data should be downloaded on a daily basis to the AECOM Data Manager for permanent storage as specified in the DMP. Data collected from moored systems will be downloaded at regular intervals (during servicing surveys) and again transferred to the AECOM Data Manager for final upload/storage.

Data files recorded by the instrument may be tracked by date/time stamp and associated navigational data. Furthermore, sensor data files should be logged to track transect, start and end time, and the associated file sequence (Attachment 2). Note: as indicated in Section 5, each boat-based survey or mooring should provide a new configuration file name to aid data file tracking. The field laptop time/clock should be checked at the start of the survey against an accurate source (e.g., cell phone or DGPS time stamp) to ensure accurate time synchronization for these tidally sensitive data.

7.3 Field data will be maintained and distributed to the appropriate personnel as described in the DMP.

7.4 Deviations to the procedures detailed in the SOP must be recorded in the field logbook at the time of occurrence, summarized on a non-conformance report, and communicated to the RI Task Manager and the QA Officer no later than the end of the day.

8.0 Personnel qualifications and training

The individuals executing these procedures must have read, and be familiar with, the requirements of this SOP and the corresponding plans (e.g., HASP, QAPP, DMP, and FSP). Water quality data collection is a relatively simple procedure requiring minimal training. However, initial instrument calibration and sample/data collections should be supervised by the FTM or designee.

9.0 References

Campbell Scientific, Inc., 2008. OBS-3A Turbidity and Temperature Monitoring System Operators Manual. Revision 11/08.

USGS 2000. Comparability of Suspended-Sediment Concentration and Total Suspended Solids Data. Water-Resources Investigations Report 00-4191, Reston, VA. 20 pp.

10.0 Revision history

Revision	Date	Changes
0	March 2009	NA

Attachment 1

Suspended Solids Sample Handling

Samples collected for SSC can be either filtered in the field or simply containerized and transferred to a fixed laboratory for filtration and analysis. To simplify logistics on the program, SSC samples will be containerized as specified in the QAPP and transferred to a fixed laboratory.

Further, if total volatile solids are to be determined, no added sample is required as this measurement can be obtained from the same SSC filter after initial gravimetric analysis.

POC/DOC Sample Filtration

POC samples should be collected in triplicate for analysis. Whenever possible, POC/DOC water samples should be filtered immediately following sample collection in the following manner[1,2]:

- i. Place a pre-combusted filter on fritted filter base of the filtration apparatus and attach the filtration tower (store filters covered if not immediately used).
- ii. Thoroughly shake the sample container to suspend the particulate matter.
- iii. Measure and record the required sample volume using a graduated cylinder. Pour the measured sample into the filtration tower, no more than 50-mL at a time.
- iv. Filter the sample using a vacuum pulling no more than 10 inches of mercury.
- v. Transfer an aliquot of the filtrate to a small (~ 40-mL) borosilicate glass vial[3] and freeze without delay for DOC determination/storage.
- vi. If less than the measured volume of sample can be practically filtered due to clogging, measure and record the actual volume filtered.

Important: Do not rinse the filter following filtration

- vii. Air dry the filter after the sample has passed through by continuing the vacuum for 30 s.
- viii. Using Teflon™-coated flat-tipped forceps, fold the filters in half while still on the fritted glass base of the filter apparatus.
- ix. Transfer the filter pads to aluminum “packets”, seal completely, and either freeze or dry at 103-105°C (24 hr) and place in a desiccator for long-term storage.

[1]If storage of the water sample is necessary, place the sample into a clean amber bottle and store at 4°C until filtration is done.

[2]Before the program commences, obtain pre-combusted GF/F filters for the purpose of DOC filtration/POC collection or prepare a batch by pre-combusting GF/F glass fiber filters at 500 °C for 1.5 hr.

[3]Before the program commences, obtain pre-cleaned glass vials for DOC sample storage or prepare a batch by rinsing with 10% hydrochloric acid (reagent grade) and then deionized water (DIW). Approximately 30-mL are needed for the analysis; use Wheaton-33™ low (40-mL) extractable borosilicate glass vials or equivalent.

Particulate samples should have some coloration following filtration to ensure sample delectability. Under most circumstances, filtering 500 mL will be sufficient under low flow/low particulate conditions and 100 mL will be sufficient under high flow conditions when using a 25-mm diameter GF/F filter pad. Corresponding larger volumes will be required when using a 47-mm filter; smaller volumes when using a 13-mm filter. Refer to USEPA Method 440 for additional details.

Reference:

USEPA Method 440. Determination of Carbon and Nitrogen in Sediments and Particulates of Estuarine/Coastal Waters Using Elemental Analysis. Rev 1.4, 1997. National Exposure Research Laboratory, Office of Research and Development, USEPA Cincinnati, OH. 10 pp.

POC Sample Processing Form

Program: ______________________________

Recorded By: _________________________ ***Date***________________

Sample ID	Date/Time (filtered)	Volume (filtered)	Filtered By	Storage/Time*

*Stored in freezer/on dry ice without delay

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Attachment 2. In Situ Data Log

Program: ______________________________ ***Survey Name***________________

Recorded By: _________________________ ***Survey Date***________________

Transect Name/Location	**Time* EST__EDST__**		**File Name(s)**	**Comment**
	Start	**End**		

*Record as 24-hour; Check either Eastern Standard Time or Eastern Daylight Savings Time (EST/EDST).