November 2019

Characterization of Sediments in South Menomonee Canal and Milwaukee AOC PFAS Sampling

Field Sampling Plan

Prepared for Wisconsin Department of Natural Resources and U.S. Environmental Protection Agency
Great Lakes National Program Office
EPA GLRI Grant No. GL-00E02392

November 2019
Characterization of Sediments in South Menomonee Canal and Milwaukee AOC PFAS Sampling

Field Sampling Plan

Prepared for
Wisconsin Department of Natural Resources
3911 Fish Hatchery Road
Fitchburg, Wisconsin 53711

U.S. Environmental Protection Agency
Great Lakes National Program Office
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Prepared by
Anchor QEA, LLC
290 Elwood David Road, Suite 340
Liverpool, New York 13088-2104

Project Number: 191779-02.01
\\helios\D_Drive\Projects\WI_DNR\Milwaukee_AOC\Deliverables\FSP\2019-11-01 FINAL\SMC_MKE_AOC_FSP_FINAL_2019-11-01.docx

TABLE OF CONTENTS

TABLES (IN TEXT)

TABLES (ATTACHED)

FIGURES (ATTACHED)

APPENDICES

ABBREVIATIONS

AVS/SEM	acid volatile sulfide and simultaneously extracted metals
BUI	Beneficial Use Impairment
CEC	Coleman Engineering Company
CFR	Code of Federal Regulations
COC	contaminant of concern
DNR	Wisconsin Department of Natural Resources
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FFS	*Menomonee and Milwaukee Rivers Focused Feasibility Study*
FSP	*Field Sampling Plan*
GEL	GEL Laboratories, LLC
GLLA	Great Lakes Legacy Act
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Agreement
GPS	global positioning system
IDW	investigation-derived waste
IGLD85	International Great Lakes Datum of 1985
JSA	Job Safety Analysis
KK	Kinnickinnic
LWD	low water datum
MDEQ	Michigan Department of Environmental Quality
mg/kg	milligrams per kilogram
MGP	Manufactured Gas Plant
MKE AOC	Milwaukee River Estuary Area of Concern
Mudpuppy	*R/V Mudpuppy II*
NAD83	North American Datum of 1983
NAPL	nonaqueous phase liquid
NOAA	National Oceanic and Atmospheric Administration
OU1	Operable Unit 1
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEC	probable effects concentration
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PPE	personal protective equipment
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan

RA	Remedial Action
RAP	*Milwaukee Estuary Stage 1 Remedial Action Plan*
SEDD	staged electronic data deliverable
Sigma	The Sigma Group
SIR	Site Investigation Report
SMC	South Menomonee Canal
SOP	Standard Operating Procedure
SOW	*Scope of Work for Characterization of Sediments in the South Menomonee Canal and Milwaukee AOC PFAS Sampling Request for Proposal*
SSP	Site Safety Plan
TOC	total organic carbon
TPAH	total polycyclic aromatic hydrocarbons
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
UWM	University of Wisconsin at Milwaukee

1 Introduction

This *Field Sampling Plan* (FSP) describes the approach and procedures to collect field data to characterize sediments within the South Menomonee Canal (SMC) and screen sediments for perfluoroalkyl and polyfluoroalkyl substances (PFAS) in the Milwaukee River Estuary Area of Concern (MKE AOC). This FSP has been prepared for the Wisconsin Department of Natural Resources (DNR) under the U.S. Environmental Protection Agency (EPA) Great Lakes Restoration Initiative (GLRI) grant (EPA GLRI Grant No. GL-00E02392).

1.1 Project Objectives

The project objectives were initially outlined in the DNR's *Scope of Work for Characterization of Sediments in the South Menomonee Canal and Milwaukee AOC PFAS Sampling Request for Proposal* (SOW) released on September 13, 2019 (DNR 2019). The following primary objectives of this work are to provide the information necessary to define the nature, degree, and extent of sediment contamination within the SMC Investigation Area and conduct a preliminary PFAS investigation throughout the MKE AOC:

- Objective 1: Characterize the chemical and physical properties of sediments within the SMC Investigation Area.
- Objective 2: Determine prevalence and distribution of PFAS within sediments and surface water across the MKE AOC.

Specific data quality objectives (DQOs) have been developed to facilitate achievement of the overall objectives and are presented in Section 3 and Table 6 of the *Quality Assurance Project Plan* (QAPP; Appendix B). The results of this investigation will be used to identify areas, if any, that may require further investigation or remedial action. The information obtained during this investigation may also assist the DNR and MKE AOC stakeholders in determining the areas where no additional assessment is needed.

1.2 FSP Organization

This FSP is organized into 11 sections as follows:

- Section 1 (this section) presents the project purpose and the objectives of the FSP.
- Section 2 provides a site description and brief overview of the site history and previous investigations.
- Section 3 provides the DQOs, with additional data quality-related information provided in Appendix B (QAPP).
- Section 4 describes the field investigations and activities.
- Section 5 provides the process for characterization and disposal of investigation-derived waste (IDW).

- Section 6 summarizes health and safety procedures for the project, with more detailed health and safety requirements provided in Appendix C (Site Safety Plan; SSP).
- Section 7 describes sample documentation procedures.
- Section 8 presents the specifics of data quality control.
- Section 9 discusses data reporting.
- Section 10 presents a project schedule for conducting the investigations.
- Section 11 provides the list of references cited in this document.

2 Background

This section provides information on the background of the site, including a brief site description, an overview of the site history, and a review of previous investigations.

2.1 Site Description

The MKE AOC is one of five Great Lakes Areas of Concern in Wisconsin. It comprises portions of three rivers—Milwaukee, Menomonee, and Kinnickinnic (KK)—and the Inner Harbor, Outer Harbor, and nearshore areas of Lake Michigan, bounded by a line extending north from Sheridan Park to the City of Milwaukee's Linwood water intake. The MKE AOC was initially listed in 1987 under the Great Lakes Water Quality Agreement (GLWQA). This AOC was later expanded in 2008 to include legacy contaminated sediments in the Little Menomonee River located in the upper portion of the Menomonee River, along with Lincoln Creek and Cedar Creek located in the upper portion of the Milwaukee River. The lower estuary portion of MKE AOC is depicted in Figure 1.

Though the MKE AOC contains multiple rivers and reaches, the site and the work described herein includes the following areas of interest:

- SMC Investigation Area
  - SMC
  - Burnham Canal
- MKE AOC PFAS Investigation Areas:
  - Milwaukee River downstream (Milwaukee River Reach 4)
  - Operable Unit 1 (OU1) of the Menomonee and Milwaukee rivers (Menomonee River Reaches 4 and 5), along with SMC
  - KK River downstream (KK River Reaches 2 and 3), along SkipperBud's slip
  - Outer Harbor
  - Lake Michigan outside of the breakwater

The SMC Investigation Area encompasses approximately 17 acres of surface area and 0.9 river miles, from the headwater of the canal to the confluence with the Menomonee River. This area is part of the Inner Harbor and includes a federal navigation channel. The federal navigation channel within the SMC is authorized to 21 feet below the low water datum (LWD) of 577.5 feet (International Great Lakes Datum of 1985 [IGLD85]). According to the SOW, the future of the federal navigation channel within the SMC is uncertain and may remain as is, be deauthorized, or be reauthorized to a depth for current marine vessel use, such as 16 feet below the LWD (577.5 feet IGLD85) (DNR 2019). The SMC Investigation Area also includes a portion of the Burnham Canal downstream of the currently inoperative Canadian Pacific Railway swing bridge. In total, this SMC Investigation Area is approximately 17.6 acres.

The MKE AOC PFAS Investigation Area consists of five discrete areas: Milwaukee River Reach 4; Menomonee River Reaches 4 and 5; KK River Reaches 2 and 3; the Outer Harbor; and Lake Michigan outside of the breakwater. These areas have been identified to provide a general characterization of PFAS within the MKE AOC, particularly in materials targeted for future removal actions.

The Milwaukee River downstream area is herein referred to as Milwaukee River Reach 4. Milwaukee River Reach 4 is approximately 2.3 miles long, beginning at the former North Avenue Dam and continuing to the Menomonee River confluence. The river passes through downtown Milwaukee, with shoreline consisting primarily of sheetpile bulkheads, and includes 17 bridge crossings. The banks are urbanized with a mix of residential and commercial properties.

OU1 of the Menomonee and Milwaukee rivers (described in *Menomonee and Milwaukee Rivers Focused Feasibility Study* [FFS; CH2M 2019]) consists of 1.9 river miles on the Menomonee River from the West Canal Street Bridge to the confluence with the Milwaukee River. This area includes Menomonee River Reaches 4 and 5. Menomonee River Reach 4 extends from the 25th Street Bridge to the 16th Street Bridge. The Former West Side Manufactured Gas Plant (MGP [Bureau for Remediation and Redevelopment Tracking System No. 02-41-556251]) is located immediately downstream of the 25th Street Bridge. Menomonee River Reach 5 begins at the 16th Street Bridge and extends 1 mile downstream to the confluence with the Milwaukee River. This portion of the river consists of mixed industrial and commercial use. The shoreline is mostly sheetpile bulkhead walls and a few portions of concrete bulkhead.

The KK River downstream of Becher Street to the mooring basin encompasses KK River Reaches 2 and 3. KK River Reach 2 is defined as Becher Street Bridge downstream to the South Kinnickinnic Bridge. KK River Reach 2 is a mixture of industrial and commercial use. The shoreline consists mostly of sheetpile bulkhead walls with some docks, piers, and slips. Water depths in Reach 2 range from 2 to 19 feet. KK River Reach 3 is defined as the KK River immediately downstream of the South Kinnickinnic Street Bridge to the end of the Municipal Mooring Basin (Turning Basin). KK River Reach 3 also includes the SkipperBud's slip and adjacent navigation channel. KK River Reach 3 is a mixture of industrial and commercial uses. The shoreline is primarily sheetpile bulkhead wall with portions of natural shoreline at the SkipperBud's slip. Water depths in Reach 3 range from 12 to 27 feet.

The Outer Harbor includes the area from the confluence of the KK River and Milwaukee River at the Daniel Hoan Memorial Bridge out to the boundaries of the breakwater. This portion of the harbor includes industrial, commercial, and public park space. The shoreline consists of a mix of sheetpile bulkhead wall, concrete bulkhead, armor stone revetment, and sand beach. Water depths in the Outer Harbor range from approximately 7 to 32 feet.

Lake Michigan immediately outside of the breakwater is open lake, with water depths ranging from 30 to 50 feet near the harbor. The breakwater consists of sheetpile bulkhead wall, armor stone revetment, and concrete bulkhead. The navigation channel is maintained approximately 500 feet east of the harbor entrance.

2.2 Site History

Under the GLWQA, the DNR completed the Milwaukee Estuary Stage 1 Remedial Action Plan (RAP) in 1991 (DNR 1991). Updates to the RAP have been periodically performed, with the most recent update in December 2017 (DNR 2017). The RAP identifies the project areas as requiring additional sediment characterization.

Historical sampling in the MKE AOC has identified various contaminants of concern (COCs), including metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) resulting from historical industrial discharge. There are multiple Superfund sites, Great Lakes Legacy Act (GLLA) sites, and other known contaminated sites within the MKE AOC. A summary of known contaminated sites within the MKE AOC and their status is provided in Table 1.

Table 1
Known Contaminated Sites within MKE AOC

Location	Status	Superfund	GLLA
Burnham Canal Superfund Site	Design in progress	X	
Cedar Creek Superfund Site	In progress	X	
Moss-American Superfund Site	RA complete	X	
Solvay Coke Superfund Alternative Sites	Investigation underway	X	
Estabrook Park	RA complete		X
Lincoln Park and Milwaukee River Channels Phases 1 and 2	RA complete		X
Milwaukee River Reach 4	Investigation complete		X
KK River	RA complete		X
Inner Harbor	Assessment needed		X
Former MGP Menomonee River (Energies West Side)	FFS complete		X
Former MGP Milwaukee River (Energies Third Ward)	FFS complete		X
Milwaukee Die Cast Facility Discharge	In progress		

Notes:

Source: CH2M 2019
FFS: Focused Feasibility Study
RA: Remedial Action

Within the RAP, EPA identified existing Beneficial Use Impairments (BUIs) for the MKE AOC (DNR 2017), as summarized in Table 2. Of the 11 BUIs, 10 are listed as impaired and 7 are linked to contaminated sediment in the MKE AOC. Additional data collection described in this FSP will supplement the historical and ongoing data characterization efforts in the overall MKE AOC. The ultimate goal is the removal of BUIs, which is expected to include remediation of the contaminated sediments identified through these data characterization efforts.

Table 2
Status of Beneficial Use Impairments in the MKE AOC

Beneficial Use Impairment	Status	Linked to Contaminated Sediment
Fish tumors or other deformities	Impaired	X
Bird or animal deformities or reproductive problems	Suspected	X
Restriction on fish and wildlife consumption	Impaired	X
Restrictions on dredging activities	Impaired	X
Degradation of benthos	Impaired	X
Degradation of phytoplankton and zooplankton populations	Impaired	
Loss of fish and wildlife habitat	Impaired	X
Degradation of fish and wildlife populations	Impaired	X
Beach closings	Impaired	
Eutrophication or undesirable algae	Impaired	
Degradation of aesthetics	Impaired	

Notes:
"X" indicates BUIs are linked to contaminated sediment.
BUI: Beneficial Use Impairment

2.3 Review of Previous Investigations

This section provides a summary of identified pertinent historical information associated with the MKE AOC, with a focus on the SMC Investigation Area, as well as the other areas within the MKE AOC that will be included in the PFAS investigation. Preliminary sampling locations have been selected based on the review of information in this section and are described in Section 4.

Previous investigations of sediment within the SMC Investigation Area by the U.S. Army Corps of Engineers (USACE) were focused on areas of shoaling. The USACE conducted sediment sampling in the MKE AOC federal navigation channel as part of the *Milwaukee Sediment Sampling and Analysis Report* (RTI Laboratories 2011). This investigation characterized sediments located in the federal navigation channel to support removal and disposal activities. Within the SMC Investigation Area, USACE collected 5-foot cores in five locations by vibracore. The cores were homogenized over the entire core length, terminating near the currently authorized dredge elevations. For COCs, PCB

results were less than 1 milligram per kilogram (mg/kg), but metals (cadmium, copper, lead, and zinc) and benzo(a)pyrene exceeded the probable effects concentration (PEC) for at least one sample. On average, copper, lead, and zinc were all approximately 10% higher than the PEC.

USACE also conducted a Condition of Channel Bathymetric Survey within the MKE AOC in June 2018 and August 2019. This survey included the SMC but did not extend into the Burnham Canal portion of the SMC Investigation Area. The survey results for June 2018 were provided in the SOW, Appendix G, and the survey results for August 2019 can be found on the USACE Milwaukee Harbor website.[1] Additional bathymetry surveys have been conducted throughout the MKE AOC. These surveys and a dredging history have been requested from the USACE. Results of these requests will be provided by Anchor QEA in the forthcoming Site Investigation Report (SIR).

The *Final Site Characterization Report – Assessment of Contaminated Sediments in the Kinnickinnic River Mooring Basin in the Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin* (CH2M 2016a) was completed in January 2016. This investigation was conducted by using vibracore sampling techniques at 13 locations, with core recovery ranging from 2.3 to 13.0 feet. Sediment samples were collected from an average of seven intervals per vibracore location at intervals of 0 to 0.5 foot below the sediment surface, and then continuously in 1-foot intervals. At one location, a sediment grab sample was collected for the top 0.5 foot, due to a utility crossing. Samples were analyzed for total metals, cyanide, PAHs, alkylated PAHs, acid volatile sulfide and simultaneously extracted metals (AVS/SEM), total organic carbon (TOC), and PCBs. Additional samples were collected for toxicity testing in the top 0.5 foot. The results of this investigation provided a sediment characterization and a preliminary assessment of contamination within the KK River Mooring Basin and indicated moderate to significant sediment contamination for PAHs, PCBs, and in particular metals. This investigation identified that further investigation, along with a remedial alternative analysis, would likely be warranted.

The *Final Site Characterization Report – Menomonee River Sediment Investigation, Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin* (CH2M 2016b) was completed in July 2016, following the field investigation within Menomonee River and Little Menomonee River conducted in late 2015. Sediment samples were collected at 50 locations using manual coring, piston sampler, direct-push technology, and petite ponar (grain size only). At all 50 locations, samples were analyzed for total metals, cyanide, PAHs, and TOC; at 13 locations, samples were analyzed for PCB Aroclors; and at 22 locations, samples were analyzed for grain size. This investigation provided a preliminary assessment of contamination within the study area and identified areas where further investigation is warranted.

[1] The USACE Milwaukee Harbor website can be accessed at the following link: https://www.lre.usace.army.mil/Missions/Operations/Milwaukee-Harbor-WI/.

3 Project Data Quality Objectives

In order to ensure that the field investigations will provide data that meet project objectives, a seven-step DQO process was performed. Details of the DQO process, including the analytical approach, and performance or acceptance criteria assigned to each investigation component, are provided in the QAPP included as Appendix B of this FSP. These DQOs and descriptions are summarized in Table 3.

Table 3
Summary of DQOs for MKE AOC

DQO Number	DQO Description
DQO 1	Determine the horizontal extent of contaminated sediment (metals, PAHs, and PCBs) in the SMC Investigation Area.
DQO 2	Determine the vertical extent of contaminated sediment (metals, PAHs, and PCBs) in the SMC Investigation Area.
DQO 3	Define the geotechnical engineering properties of sediment within the SMC to support Remedial Action evaluations.
DQO 4	Evaluate phosphorus loading from surface sediment to the water column.
DQO 5	Document the presence, if any, of PFAS in the top 4 feet of sediments and surface water within the MKE AOC above Lake Michigan background and screening levels established by other states (e.g., Michigan).

4 Field Investigations

This section summarizes field sampling activities to support site characterization. Specifically, planning and pre-sampling activities are described, followed by sampling rationale, sampling methodology, sample processing methodology, and decontamination procedures for each of the two investigations—SMC Investigation and MKE AOC PFAS Investigation.

Field work described in the following sections will follow Standard Operating Procedures (SOPs) included in Appendix A. Quality assurance procedures to be followed during the field sampling activities are described in the QAPP (Appendix B). Finally, field work will be conducted safely in accordance with the SSP (Appendix C).

4.1 Planning and Pre-Sampling Activities

Prior to commencing work, Anchor QEA will perform the following communications and notifications:

- Complete utility clearance through Diggers Hotline.
- Obtain necessary survey permits or notifications from USACE for sampling.

The project team consisting of DNR, EPA Great Lakes National Program Office, and Anchor QEA will participate in a project kickoff meeting to discuss project health and safety requirements, coordination and lines of communication, field sampling procedures, sample processing, documentation, decontamination, and waste handling. Additionally, field personnel will discuss activities to be performed, as well as pertinent health and safety concerns prior to initiating work each day.

For consistency within the site investigation activities, all sampling locations will be surveyed using the following coordinate system:

- Horizontal datum: Wisconsin State Plane, South Zone, North American Datum of 1983 (NAD83), U.S. feet
- Vertical datum: IGLD 85, feet

Information obtained during all field work will be recorded in the field database or logbook, as appropriate, following procedures described in SOP 01 – Field Records (Appendix A).

4.2 South Menomonee Canal Investigation

The SMC Investigation Area targeted for investigation comprises 0.9 river mile from the headwater of the canal to the confluence with the Menomonee River, as well as 0.6 acre of the Burnham Canal downstream of the Canadian Pacific Railway swing bridge (total area of approximately 17.6 acres). As described in Section 2, the SMC Investigation Area includes a federal navigation channel that is authorized to a depth of 21 feet below the IGLD85 low water depth of 577.5 feet. Bathymetric data

collected by the USACE indicate that water depths in the project area at the time of the survey (i.e., August 2019) were between 20 and 23 feet below the low water depth of 577.5 feet IGLD85 in the center of the channel, shallowing to depths between 15 and 20 feet below the low water depth of 577.5 feet IGLD85 in nearshore areas and at the headwater of the canal.

Previous sediment investigations within the SMC Investigation Area by the USACE were limited (five locations performed within the navigation channel of the SMC [RTI Laboratories 2011]) and focused on areas of shoaling. Sediment cores were advanced to an elevation of 556.5 feet IGLD85, corresponding to the authorized project depth (i.e., 21 feet below low water depth of 577.5 feet IGLD85), and all recovered sediments were homogenized into one sample for analysis. The following subsections describe proposed sampling efforts to further investigate various properties of SMC Investigation Area sediment.

4.2.1 Sampling Rationale

This site investigation will collect environmental data to: delineate horizontal and vertical extent of metals, PCBs, and PAHs in sediment (DQOs 1 and 2); understand geotechnical engineering properties of sediment (DQO 3); and estimate phosphorus loading from surface sediment to the water column (DQO 4). Proposed sampling locations were selected based on review of the 2019 USACE bathymetric survey and the sediment sampling performed in SMC for USACE by RTI Laboratories in 2011. To more fully characterize sediment within the assessment area, sediment cores will be collected from a total of 35 locations, with 22 locations to characterize the SMC between the Menomonee River and Interstate 94, 11 locations to characterize the SMC from Interstate 94 to the canal termination, and 2 locations to characterize Burnham Canal downstream of the currently inoperative Canadian Pacific Railway Burnham swing bridge (Figure 2). Proposed locations were placed in a triangular grid pattern throughout the SMC and Burnham Canal to target both the navigation channel centerline and the side slope or area between the navigation channel and the shoreline. A total of nine locations were placed at the navigation channel centerline, with spacing approximately 450 feet between each location (Figure 2). An additional 26 locations were located in pairs targeting both sides of the navigation channel. In general, proposed side slope sampling locations are spaced 450 feet apart and 40 feet from the navigation channel centerline location.

In addition to delineating metals, PCBs, and PAHs, geotechnical parameters (grain size with hydrometer, Atterberg limits, specific gravity, and moisture content) will be analyzed at four locations (10% of the total samples) and will be selected to represent a range of physical sediment types visually observed in the field. As shown in Figure 2, two channel and two side slope cores are targeted for analysis of geotechnical parameters. Dedicated geotechnical cores will be collected at these locations to ensure sufficient sample volume for analysis.

Finally, sediment and surface water samples for phosphorus testing will also be collected at three locations within the SMC Investigation Area. Two of the three locations (SMC-19-13 and SMC-19-35) target side slopes or nearshore areas, while the third location (SMC-19-28) targets the main channel in an area of shoaling shown on the 2018 USACE bathymetric survey.

4.2.2 Sampling Methodology

4.2.2.1 Metals, PAHs, PCBs, and Geotechnical Sediment Sampling

Sediment cores will be collected from 35 locations within the SMC Investigation Area using a vibracore from EPA's sampling vessel, the *R/V Mudpuppy II* (*Mudpuppy*). The sample locations, sample IDs, and associated analyses corresponding to each location are summarized in Table 4. Sediment characterization will target soft depositional sediments overlying native material. Sediment cores will be advanced until native materials are encountered or until refusal. According to previous studies, the subsurface native material is a firm grey clay (CH2M 2019), which should be visually distinguishable from the overlying depositional soft sediment. The thickness of sediment overlying native material is expected to vary; therefore, sediment core lengths will vary based on the substrate encountered at each location.

Sediment cores at each location will be advanced to native material up to a maximum penetration depth of 20 feet, or until refusal, with an acceptability criteria of a minimum of 70% sediment recovery (see SOP 03 – Sediment Sampling). To expedite core collection, core tube lengths of 15 feet or less will be attempted first; if native material is not identified, longer 20 foot core tubes will be attempted. Up to three attempts will be made per location to achieve the target recovery for acceptance. After three attempts, the core with the highest percentage of recovery will be used for sampling and analysis. Cores retrieved during sampling will be handled to minimize potential disturbance that may impact preservation of discrete sampling depths. Overlying water will be drained from the top of the core tube, and the core will be capped and labeled onboard the *Mudpuppy* at the time of collection. Sediment cores will be secured, stored, and transported upright, throughout the duration of the field sampling program to the extent possible. Cores greater than 5 feet in length may be cut, capped, and labeled on the *Mudpuppy* to facilitate safe handling and transport.

First sampling cores will be taken in the center of the channel at sites SMC-19-28 and SMC-19-31, respectively (Figure 2). Less sediment is expected in the center of the channel and allows the project team to better understand the native clay elevation to help better inform field decisions. Following these two samples, it is anticipated that sampling effort will start in the westernmost end of the SMC working downstream toward the confluence with the Menomonee River. The sediment cores will be collected within 10 feet of the planned location. Navigating and recording as-sampled location coordinates will be performed with GPS receivers capable of submeter accuracy (see SOP 02 –

Navigation and Boat Positioning). Vibracore sampling methodology will be performed in accordance with the *Mudpuppy's* SOP. Water depths and core penetration depths at the time of sample collection will be recorded. The date and time of depth measurements will also be noted to ensure that target depths for analytical samples can be appropriately tied to IGLD85 elevation based on local U.S. Geological Survey (USGS) and National Oceanic and Atmospheric Administration (NOAA) gauging station data once the sampling is completed for subsurface mapping and 3D modeling. As shown in Figure 2, USGS gauging station 04087142 is located on the Menomonee River at 16th Street.

Once collected, sediment cores will be transported and processed as described in Section 4.2.3.

4.2.2.2 Phosphorus Sediment and Surface Water Sampling

Phosphorus testing within the SMC Investigation Area will be performed on sediment and site water collected from three locations using direct-push sampling techniques (see SOP 03 – Sediment Sampling). Two undisturbed cores and one segmented core will be collected from each of the three locations. Sediment cores for phosphorus analysis will be 2 inches in diameter and will be collected from Coleman Engineering Company's (CEC's) sampling vessel. Each core will be no more than 3 feet in length, targeting approximately 21 to 24 inches of recovered surficial sediments. Undisturbed cores will be cut to contain 12 to 15 inches of headspace (i.e., not 100% full) to accommodate the phosphorus testing procedure. Each core will be capped, sealed, and labeled at the time of collection. Undisturbed cores will be stored upright until transported to the Wisconsin State Laboratory of Hygiene. Cores for processing will be transported to a landside core processing area. Water depth, penetration, and recovery will be recorded at the time of sample collection. The locations for phosphorous testing will be co-located, to the extent practical, with three of the SMC Investigation Area sediment sampling locations and are depicted in Figure 2 and summarized in Table 4.

In addition to sediment, 3.5 gallons of site water will be collected from each location for a total minimum of 10 gallons from the three locations. Site water will be collected from the water surface into 2-gallon plastic buckets with sealed lids. New plastic buckets will be purchased locally from a hardware store and will be cleaned and inspected prior to use in accordance with SOP 08 – Equipment Cleaning/Decontamination (Appendix A).

One sediment core from each of the three sample locations will be processed by experienced core sample processing staff in general accordance with procedures outlined in SOP 04 – Sediment Core Processing (Appendix A) and as detailed herein. The sediment cores will be split longitudinally, screened with a photoionization detector, logged using the Unified Soil Classification System to include soil type, color, consistency, odors, and visible evidence of discoloration or sheens, and then

photographed. After the lithologic logs are completed, sediment cores will be subsampled at the following target intervals for phosphorus testing:

- 0 to 1 foot below sediment surface
- 1 to 3 feet below sediment surface

Sediment from each depth interval will be homogenized in a stainless-steel bowl using stainless-steel or polypropylene-based utensils, then transferred to the appropriate container provided by the laboratory (i.e., Wisconsin State Laboratory of Hygiene). Alternatively, disposable aluminum pans and plastic utensils may be utilized. Equipment and materials that are re-used for sediment homogenization will be decontaminated between sediment samples in accordance with SOP 08 – Equipment Cleaning/Decontamination (Appendix A).

Field Scribe, a data collection application created by Anchor QEA, will be used for on-site sample management. Sampling coordinates, sample IDs, core penetration, core recovery, lithology, and analytical testing requirements for each sample from each core will be entered at the time of core processing, and sample labels and chain-of-custody forms will be printed on site to efficiently and accurately provide information to the laboratory. Field data collected at the time of core collection will be documented on the Sediment Core Collection Log (Attachment 2 of SOP 3 – Sediment Sampling; in Appendix A). The Sediment Core Collection Log will accompany the sediment core when transported to shore for processing.

Collected water and sediment samples will be sealed and labeled. Samples and undisturbed cores will then be transported to the Wisconsin State Laboratory of Hygiene in Madison, Wisconsin, under appropriate chain-of-custody protocols (SOP 06 – Sample Custody). Sample submission and chain-of-custody protocols may include specific procedures based on coordination with DNR and the Wisconsin State Laboratory of Hygiene All laboratory analysis and data interpretation will be performed by the Wisconsin State Laboratory of Hygiene outside of this project. Conclusions may be incorporated into the SIR, as appropriate.

4.2.3 Sample Processing Methodology

Sediment cores collected by the *Mudpuppy* will be transported to a landside core processing area to facilitate concurrent core processing. Sediment cores will be processed in a dedicated space within The Sigma Group's (Sigma) building located near the SMC Investigation Area at 300 West Canal Street, Milwaukee, Wisconsin 53233. Each core will be processed by experienced core sample processing staff in accordance with procedures outlined in SOP 04 – Sediment Core Processing (Appendix A).

Prior to opening each core, cores will be weighed. Bulk density will be calculated using the core weight, recovered sediment volume (based on the inner diameter of the core tube), and total length of recovered sediment. Sediment cores will then be split longitudinally, screened with a photoionization detector, logged using the Unified Soil Classification System to include soil type, color, consistency, odors, and visible evidence of discoloration or sheens, and then photographed. Core processing staff will assess and record the strength parameters of fine-grained (e.g., silts and clays) sediments using a handheld pocket penetrometer for compressive strength and torvane for shear strength, where appropriate. A minimum of one set of strength tests will be performed on a representative portion of sediment from a given depth interval.

After the lithologic logs are completed, sediment cores will be subsampled at the following target intervals for analytical testing:

- 0 to 1.0 feet below sediment surface
- 1.0 to 2.5 feet below sediment surface
- 2.5 to 4.0 feet below sediment surface
- 4.0 to 6.0 feet below sediment surface
- 6.0 to 8.0 feet below sediment surface
- 8.0 to 10.0 feet below sediment surface
- 10.0 to 12.0 feet below sediment surface
- 12.0 to 14.0 feet below sediment surface
- 14.0 to 16.0 feet below sediment surface
- 16.0 to 18.0 feet below sediment surface
- 18.0 to 20.0 feet below sediment surface

The target sample intervals listed above are general guidelines. Native materials, when encountered, will be segmented separately and not homogenized with overlying sediments. Therefore, bottom intervals may be less than 2 feet. For example, if native material is observed at 9 feet, the bottom 8- to 10-foot interval will be split into two sample intervals—one sample of sediment from 8- to 9-foot depth and one sample of only native material from 9- to 10-foot depth. Depth intervals will be divided based on sample volume present. If there is insufficient sample volume to fill required containers, materials will be included in the previous depth interval and noted appropriately. It has been assumed that average recovered cores will be 10 feet in length. However, the thickness of sediment overlying native material is expected to vary, and decisions regarding sample analyses may need to occur during field activities. Sediment cores will be segmented as shown above and samples for segments beyond 10 feet will be collected and archived for potential analysis based on the total number of samples collected in the field. Additionally, if native material (i.e., grey clay) is encountered in more than one depth interval within a sediment core, the samples below native material will be archived and released for analysis based on the results of the samples above native material.

Sediment from each depth interval will be homogenized in a stainless-steel bowl using stainless-steel or polypropylene-based utensils, then transferred to the appropriate container provided by the analytical laboratory (i.e., CT Laboratories or Eurofins TestAmerica). Alternatively, disposable aluminum pans and plastic utensils may be utilized. Equipment and materials that are re-used for sediment homogenization will be decontaminated between sediment samples.

Field Scribe, a data collection application created by Anchor QEA, will be used for on-site sample management. Sampling coordinates, sample IDs, core penetration, core recovery, lithology, and analytical testing requirements for each sample from each core will be entered at the time of core processing, and sample labels and chain-of-custody forms will be printed on site to efficiently and accurately provide information to the laboratory. Field data collected at the time of core collection will be documented on the Sediment Core Collection Log (Attachment 2 of SOP 3 – Sediment Sampling; in Appendix A). The Sediment Core Collection Log will accompany the sediment core when transported to shore for processing.

4.2.4 Sample Containers, Preservation, Packaging, and Shipping

Once samples are prepared, the samples will be checked and chain-of-custody forms will be generated and checked prior to transport to the laboratory per SOP 06 – Sample Custody (Appendix A). Sample containers will be placed in a secure area and stored on wet ice or under refrigeration at 4°C, pending shipment to the analytical laboratory per SOP 07 – Sample Handling, Packaging, and Shipping (Appendix A). Samples for analytical testing of metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc, and mercury), PAHs (total PAHs [TPAH-18]), PCB Aroclors, TOC, and total solids will be shipped to CT Laboratories in Baraboo, Wisconsin. Samples for geotechnical testing, including grain size, Atterberg limits, specific gravity, and moisture content, will be shipped to Eurofins TestAmerica's laboratory in Burlington, Vermont.

4.2.5 Decontamination Procedures

Re-usable field sampling equipment that comes into contact with contaminated media will be decontaminated prior to use, between sampling locations, and prior to leaving the site, in accordance with SOP 08 – Equipment Cleaning/Decontamination (Appendix A).

When practicable, disposable equipment will be used for sampling, homogenizing, and subsampling procedures (e.g., core liners, bowls, spoons, aluminum pans). However, when equipment is reused, decontamination steps will be followed to ensure that samples are not cross-contaminated. Detailed decontamination procedures are outlined within SOP 08 – Equipment Cleaning/Decontamination. In general, decontamination of sampling equipment and tools will consist of the following:

- Pre-rinse with site water.

- Clean with non-phosphate detergent and potable water, using a brush to remove all visible particulate matter and surface films.
- Rinse thoroughly with potable water.

Standard decontamination practices will be followed for all investigation activities. No petroleum-based oils, greases, or other petroleum products will be used on any sampling equipment that may potentially come into contact with sampled media.

Large equipment (e.g., boats) used in field sampling activities will be inspected, and if necessary, cleaned to remove oil, grease, mud, or other foreign matter, including vegetation, prior to leaving the site.

4.3 MKE AOC PFAS Investigation

The purpose of the PFAS special study is to perform preliminary sampling of sediments and surface water to understand if PFAS are present in the MKE AOC. Areas targeted for sampling correspond with portions of the MKE AOC that have a high potential to be remediated through dredging; therefore, unlike the SMC Investigation Area, sampling of native materials for PFAS is not necessary. Data obtained through this study will be used to assess future management options for the MKE AOC sediments.

Sediment and site water samples will be collected from a total of 14 locations in the MKE AOC. The sample locations, sample IDs, and associated analyses at each sample location are shown in Figures 3 through 5 and summarized in Table 5. Because of the specialized, ultra-clean sampling techniques required for PFAS sampling, these samples will be collected separate from the SMC field effort using CEC's sampling vessel and the University of Wisconsin – Milwaukee's (UWM's) research vessel, *R/V Neeskay*.

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits. PFAS are used in a wide variety of products; therefore, to prevent cross-contamination, field personnel should be familiar with and follow the Michigan Department of Environmental Quality (MDEQ) General PFAS Sampling Guidance (MDEQ 2018). The PFAS sample processing, containers, preservation, packaging, and shipping methods described herein and in the attached SOPs have been designed to mitigate potential for false positives. In addition, the amount of handling, from the time the sampling is collected, to the time it is received at the laboratory will be minimized, to the extent practicable, for samples being analyzed for PFAS.

4.3.1 Sampling Rationale

This site investigation will collect environmental data to: document the presence, if any, of PFAS in sediments and surface water within the MKE AOC (DQO 5) and to understand geotechnical engineering properties of sediment (DQO 3). The following six areas within the MKE AOC were targeted for PFAS sampling:

- Reach 4 of the Milwaukee River
- Reaches 4 and 5 of the Menomonee River, along with the SMC
- Reaches 2 and 3 in the KK River, along with SkipperBud's slip
- Confluence of the Milwaukee River, KK River, Inner Harbor, and Outer Harbor
- Outer Harbor
- Lake Michigan outside of the breakwater

Proposed locations within each of these areas were selected using a judgmental sampling design, taking into consideration: 1) existing chemical conditions in sediment; 2) the location of former industrial operations; 3) areas that may be identified for dredging in the future for navigational or remedial purposes; and 4) providing overall spatial coverage for the areas identified by the DNR in the SOW. Areas of known or observed nonaqueous phase liquid (NAPL) were specifically avoided during sample location selection.

In the Milwaukee River, shoal areas downstream of former tannery operations have been targeted (see Locations MKE-19-01, MKE-19-02, and MKE-19-03 in Figure 3), with an additional location placed on a shoal near the confluence with the Menomonee River (see Location MKE-19-04 in Figure 3). In the Menomonee River, PFAS locations are proposed within two areas of interest identified in the FFS and the confluence of the SMC and Menomonee River (see Locations MKE-19-05, MKE-19-06, and MKE-19-07 in Figure 4).

One PFAS location is proposed in Reach 2 of the KK River within the area previously remediated, along with one location within SkipperBud's slip, and an additional central channel location in Reach 3 (see Locations MKE-19-08, MKE-19-09, and MKE-19-10, respectively, in Figure 5). PFAS sampling locations near the confluence of the rivers and the harbor, as well as within the Outer Harbor, are proposed to be collected at core locations sampled by the USACE in 2011 to provide paired datasets (RTI Laboratories, 2011). The location in Lake Michigan was selected randomly and will be used to represent background reference data.

At each location, a surface water sample will be collected prior to collecting a sediment sample. Both surface water and sediment will be analyzed for PFAS. In order to collect a sediment sample, the sampling device must be lowered through the water column. There is a potential for cross-contamination of the sampler as it is lowered through the water column, if PFAS are present in the

surface water. By analyzing surface water, sediment, and equipment rinsate blanks, the actual source of PFAS can reasonably be identified.

4.3.2 PFAS Surface Water Sampling Methodology

Site water for PFAS analysis will be collected using CEC's sampling vessel or the *R/V Neeskay*. Prior to initiation of sampling, all sample platforms and sampling equipment will be inspected for potential sources of PFAS contamination and decontaminated, in accordance with the Michigan Department of Environmental Quality General PFAS Sampling Guidance (MDEQ 2018). This inspection will include a screening of personal items, personal protective equipment (PPE), and field gear potentially containing PFAS compounds and a review of PFAS sampling protocols with all field staff.

Site water sample locations will be co-located with sediment sampling locations. At each of the 14 targeted locations, water samples will be collected prior to the initiation of sediment sampling activities to minimize the potential effects from bottom disturbance of sediment during sediment sampling. A global positioning system (GPS) will be used to navigate to each location, and water depth will be recorded using an electronic depth finder. The sampling vessel will be held in position using power during water sampling to avoid use of anchors or spuds that may disturb the sediment surface, to the extent practicable, based on conditions at the time of sampling. If spuds are necessary to stabilize the boat, water sampling will not be conducted until turbidity due to spudding dissipates. In the Milwaukee River, Menomonee River, KK River, and the river confluence area, 11 samples will be collected from a pontoon boat.

For the three sample locations in the Outer Harbor and Lake Michigan, the UWM's *R/V Neeskay* will be used to collect the samples. These three locations are believed to be in areas that will be more exposed to wind and waves; therefore, the larger *R/V Neeskay* is being used.

Water sampling will be conducted in accordance with procedures detailed in SOP 05 – Water Sampling (Appendix A). Water quality data, including dissolved oxygen, temperature, pH, and turbidity, will be collected from each location using a sampling sonde. Water quality measurements will be collected from two-thirds of the water depth (as measured from the water's surface). The sampling sonde will be calibrated daily. Water quality data will be gathered prior to water sampling. Water samples will also be collected from two-thirds of the water depth using a PFAS-free Kemmerer Bottle sampler. This sampler is open on both ends so it can be lowered into the water and closed using a messenger that triggers the top and bottom of the sampling bottle to close, providing a site water sample from a discrete water depth. The Kemmerer Bottle will be retrieved, and the site water sample will be distributed directly to the sample containers supplied by the analytical laboratory.

Site water samples will be placed on wet ice and transported to shore prior to being shipped to GEL Laboratories, LLC (GEL), in Charleston, South Carolina, for PFAS and total suspended solids (TSS)

analysis. Site water samples will be shipped to the analytical laboratory via overnight delivery under appropriate chain-of-custody protocols.

4.3.3 PFAS Sediment Sampling Methodology

Sediment samples for the PFAS analysis from the Outer Harbor and Lake Michigan locations are believed to be in areas that will be more exposed to wind and waves. Like the surface water samples, these three locations will be collected from the UWM's *R/V Neeskay*. Sediment samples from the Outer Harbor and Lake Michigan will be collected with a surface grab sampler (Eckman dredge or equivalent device) to target surface sediment.

For the remaining areas, sediment cores will be collected using a pontoon-mounted, direct-push sampling system. The pontoon system is equipped with spuds capable of holding the vessel in place in water depths up to 25 feet and can access reaches of the rivers and canals with low bridge clearance. The CEC vessel will navigate to the proposed sample locations using GPS for horizontal and vertical positioning with submeter accuracy. The samples will be collected within 10 feet of the planned location. The proposed sampling location will be determined in accordance with SOP 02 – Navigation and Boat Positioning (Appendix A). Recording as-sampled location coordinates will be performed with GPS receivers capable of submeter accuracy. Following the collection of the water sample, the sampling vessel will be secured on the targeted location using spuds. Water depths at each location will be verified by using either a telescoping survey rod or lead line (for deeper water). The date and time of depth measurements will be noted to ensure that target sample depths can be appropriately tied to IGLD85 elevation based on local USGS and NOAA gauging station data once the sampling is completed. As shown in Figures 3 through 5, three gauging stations are located within the MKE AOC PFAS Investigation Area—USGS gauging station 04087142 located on the Menomonee River at 16th Street; USGS gauging station 04087170 located in the Milwaukee River at the mouth; and NOAA station ID 9087057 located in the Outer Harbor.

The direct-push sampling system will be used to advance polycarbonate tubing into the sediment. SOP 03 – Sediment Sampling (Appendix A) provides guidance and details regarding sediment sampling procedures for CEC equipment. The tubes will be attached to a drive head and hydraulically advanced to depth using drive rods. Depending on the substrate encountered, either a piston-type sampler or direct-push sampler may be used. Sediment cores for PFAS analysis will target the upper 4 feet of sediment. Up to three attempts will be made per location to achieve a minimum of 70% sediment recovery. After three attempts, the core with the highest percentage of recovery will be retained for processing and analysis. In an effort to expedite the field schedule, a jon boat will be used, as weather conditions permit, to shuttle collected cores back to shore from the sampling vessel. This will allow the sampling vessel to remain dedicated to sample collection, avoiding multiple trips back to the dock throughout the day to drop off collected cores. Sigma will provide the jon

boat and crew to transport collected sediment cores. Samples collected from the *R/V Neeskay* will be transported to the processing area at the end of the day.

Water depths at the time of sample collection will be recorded to ensure that target depths for analytical samples can be appropriately tied to IGLD85 elevation once the sampling is completed for subsurface mapping and modeling.

4.3.4 PFAS Sample Processing Methodology

Sediment cores and water samples collected for PFAS analysis will be transported to the Sigma building in Milwaukee for processing and packaging. Sediment cores will be processed in a dedicated space within Sigma's building located on the Menomonee River in Milwaukee. Prior to processing samples to be analyzed for PFAS, the processing area will be screened for potential sources of cross-contamination (SOP 4 – Sediment Core Processing). Each core will be processed by experienced core sample processing staff in accordance with procedures outlined in SOP 04 – Sediment Core Processing (Appendix A).

Prior to opening each core, cores will be weighed. Bulk density will be calculated using the core weight, recovered sediment volume (based on the inner diameter of the core tube), and total length of core recovery. Sediment cores will then be split longitudinally, screened with a photoionization detector, logged using the Unified Soil Classification System to include soil type, color, consistency, odors, and visible evidence of impacts (e.g., sheen), and then photographed. Core processing staff will assess and record the strength parameters of fine grained (e.g., silts and clays) using a handheld pocket penetrometer and torvane, where appropriate. A minimum of one set of strength tests will be performed on a representative portion of sediment from a given depth interval.

After the lithologic logs are completed, sediment cores will be subsampled at target depths for analytical testing. A maximum of four depth intervals will be collected from each core, according to the following:

- 0 to 0.5 foot below sediment surface
- 0.5 to 1.0 feet below sediment surface
- 1.0 to 2.0 feet below sediment surface
- 2.0 to 4.0 feet below sediment surface

If actual recovery is less than the target depth of 4 feet below sediment surface, only sediment samples corresponding to the appropriate sample depths will be collected and submitted for analytical testing. Quality assurance/quality control (QA/QC) samples will be collected concurrently with the samples of the type and frequency outlined in the QAPP (Appendix B).

Sediment from each depth interval will be homogenized in a stainless-steel bowl using stainless-steel utensils, and transferred to the appropriate container provided by the analytical laboratory. All re-usable material and equipment used for sediment homogenized will be decontaminated between sediment samples. Disposable, one-time use materials may be used for homogenization, only if they comprise materials known to be free of PFAS or have been screened and determined to be free of PFAS.

Anchor QEA's custom data collection application, Field Scribe, will be used for on-site sample management. Sampling coordinates, sample IDs, core penetration, core recovery, lithology, and analytical testing requirements for each sample from each core will be entered at the time of core processing, and sample labels and chain-of-custody forms will be printed on site to efficiently and accurately provide information to the laboratory. Field data collected at the time of core collection will be documented on the Sediment Core Collection Log (Attachment 2 of SOP 3 – Sediment Sampling; in Appendix A). The Sediment Core Collection Log will accompany the sediment core when transported to shore for processing. Once sample collection is complete, sample containers will be placed in a secure area in coolers and maintained under refrigeration or on wet ice. Samples will be shipped to the analytical laboratory via overnight delivery on the day of sample collection under appropriate chain-of-custody protocols.

Waste generated during sediment sample processing (i.e., IDW) will be collected and handled as described in Section 5.

4.3.5 PFAS Sample Containers, Preservation, Packaging, and Shipping

Once samples are prepared, the chain-of-custody forms will be generated and checked against the sample IDs prior to transport to the laboratory, per SOP 06 – Sample Custody (Appendix A). Sample containers will be placed in a secure area and stored on wet ice or under refrigeration at 4°C, pending shipment to the analytical laboratory per SOP 07 – Sample Handling, Packaging, and Shipping (Appendix A). Sediment samples to be analyzed for PFAS and TOC, and site water samples to be analyzed for PFAS and TSS will be sent to GEL in Charleston, South Carolina.

4.3.6 PFAS Decontamination Procedures

Re-usable field sampling equipment that comes into contact with contaminated media will be decontaminated prior to use, between sampling locations, and prior to leaving the site, using PFAS-free protocols in accordance with SOP 08 – Equipment Cleaning/Decontamination (Appendix A).

When practicable, PFAS-free disposable equipment will be used for sampling, homogenizing, and subsampling procedures (e.g., core liners, bowls, spoons, pans). However, when equipment is reused, decontamination steps will be followed to ensure that samples are not cross-contaminated.

Decontamination of re-usable equipment to be utilized for the collection of sediment and water samples that will be lowered into the water column will consist of the following:

- Pre-rinse with site water.
- Clean with non-phosphate detergent and site water, using a PVC brush to remove all visible particulate matter and surface films.
- Rinse thoroughly with site water.
- Site water utilized for decontamination/cleaning will be sourced from the sample location and not retained. Use of site water will be minimized to the extent practicable.

Decontamination of re-usable equipment that comes into contact with sample media that will be analyzed for PFAS during sediment core processing will consist of the following:

- Pre-rinse with PFAS-free water.
- Clean with a solution of detergent and PFAS-free water, using a PVC brush to remove all visible particulate matter and surface films.
- Rinse with PFAS-free water and visually inspect for residual media (repeating rinse and wash until clean)
- Rinse thoroughly with PFAS-free water.

Products containing known PFAS will not be permitted during the PFAS special study investigation. Prior to the start of the investigation, field crews will screen clothing, PPE, equipment, and personal items for possible PFAS based on the Michigan Department of Environmental Quality's general PFAS Sampling Guidance (MDEQ 2018). Laboratory-grade PFAS-free water will be obtained from the testing laboratory. Alternatively, water to be used for decontamination and cleaning will be screened prior to the investigation to verify the absence of PFAS. Large equipment (e.g., boats) used in field sampling activities will be cleaned to remove oil, grease, mud, or other foreign matter, including vegetation, prior to leaving the site. Lubricants will not be utilized on sampling devices. Specific PFAS sampling protocols have been integrated in the SOPs (Appendix A) and will be followed by all field personal throughout the investigation.

5 Disposal of Investigation-Derived Waste

Potentially contaminated sediment, water, PPE, and other IDW materials generated during the field investigation will be collected and disposed of in accordance with SOP 09 – Investigation-Derived Waste Handling and Disposal (Appendix A). IDW will be segregated based on the investigation objectives. IDW will be classified into two categories: 1) solid materials consisting of sediments, used disposable sampling equipment (e.g., core liners, pans, spoons), used PPE, and other materials used in the handling, processing, and storage of sediment; and 2) liquid wastes such as decontamination water or excess water from sediment. To the extent practicable, liquids generated during sampling and sample processing operations will be separated from the solid material.

5.1 Solid Waste

IDW solid waste will consist of two types of materials—sediment solids and non-sediment solids. Sediment wastes include material in discarded cores or grab samples and excess sediment not used for sample analyses. Such material will be containerized into properly labeled 55-gallon (closed-top) drums pending characterization and disposal. Non-sediment wastes generated during the collection and processing of samples may include PPE and disposable sampling equipment, such as used core liners and caps, aluminum foil, aluminum pans, and plastic sheeting. Non-sediment solid wastes will be segregated from sediment waste, disposed of as a solid waste in plastic trash bags, and put in dumpsters for disposal with municipal solid waste. Visible media (sediment) will be removed from PPE and disposable sampling equipment prior to disposal, to the extent practicable. Grossly contaminated non-sediment solid material that cannot be effectively decontaminated will be placed into 55-gallon drums, labeled, and stored temporarily, pending characterization and disposal.

5.2 Liquid Waste

Liquid waste will be generated during sediment/soil sample processing and decontamination activities. Excess water that may be collected at the time of water sampling will be returned to the waterbody. Similarly, rinse water (site water) utilized onboard sampling vessels will not be contained. Liquid waste will be collected in properly labeled 55-gallon (closed-top) drums pending characterization and disposal.

5.3 Drum Handling

The following procedures will be followed for storing solid and liquid waste in drums:

- A unique drum number (consisting of the program identification and the sequential number) will be assigned to each drum and the drum number will be clearly marked on the drum.
- A label indicating that the drum contains IDW pending characterization will be placed on each drum. Information on the label will include the drum number, type of material (sediment or waste water), start and end dates of generation, project number, and contact information.

- A log will be kept for each drum, listing the materials placed in that drum. All solid materials will be segregated based on the type of material (i.e., sediment, core liners, and PPE/plastic/miscellaneous) and, to the extent practicable, by where they were generated (e.g., location within the site or station number and process area).
- Drums will be kept closed at all times except when material is being added to them.
- Drums will be sealed (bungs or lid bands tightened) when not in active use.
- Drums will be stored in a secured location until proper disposal at an authorized facility can be coordinated.
- Prior to the disposal of IDW, the DNR will be informed of the intended disposal facility that will be receiving waste, the quantity of waste to be disposed of, and the entity responsible for transporting the waste.

6 Health and Safety

All site activities proposed under this FSP will follow the procedures outlined in the SSP. The SSP is included in Appendix C and was prepared in accordance with Occupational Safety and Health Administration requirements contained in 29 Code of Federal Regulations (CFR) 1910, including the final rule contained in 29 CFR 1910.120. All Anchor QEA employees and visitors will read and comply with the SSP and sign an acknowledgement form contained in the SSP. Subcontractors will develop and provide an SSP to cover their respective scopes of work during field activities.

Field team staff will complete a Job Safety Analysis (JSA) form when new tasks or different investigative techniques are proposed that are not addressed in the SSP. The JSAs will be reviewed and approved by the Field Lead, and completed forms will be reviewed with all field team staff performing the specific task prior to implementation.

The implementation of health and safety for the field investigation will be the shared responsibility of the Project Manager, the Field Lead, and field team staff and subcontractors implementing the field investigations. All field team staff, subcontractors, and site visitors have the authority to stop work if they see a potential or actual hazard that may threaten the safety of people or the environment. Upon stopping work, the designated Field Lead must be immediately notified and provided with information regarding the nature of the safety, health, or environmental concern. Once the potential or actual hazard has been eliminated, work can proceed.

7 Sample Documentation

This section defines the records that are critical to the sampling efforts of the project, identifies information to be documented, and describes the format and document control procedures to be used. Project information generated by Anchor QEA will be documented and provided to DNR. Information obtained during all field work will be recorded in the field database, logbook, or field forms, as appropriate, following procedures described in SOP 01 – Field Records (Appendix A).

Specification of the proper reporting format, compatible with data analysis and validation, will facilitate clear and direct communication of the investigations outlined in this FSP. Project data and information will be tracked and managed from its inception in the field to its final storage area.

The intent of sample documentation is to document field procedures and any measurements performed during the sampling effort. The Anchor QEA sampling team will maintain a field logbook (or tablet for electronic notes) to record sample collection and processing notes and to provide a daily record of significant events, observations, and measurements taken during the field investigation and any deviations from this FSP. All entries into the field logbook will be made with indelible ink. The field logbook (or tablet) is intended to provide sufficient data and observations to enable the field team to reconstruct events that occur during the project implementation.

The field logbook or tablet field notes will contain the following as a minimum:

- Sample collection team names
- Date and military time of collection
- Weather conditions, including temperature
- Site name
- Location of sampling point
- Sample identification number
- Type of sample
- Calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment
- Any field measurements taken
- Field observations, especially any notice of stained sediment, stressed or absent vegetation, and presence of invasive species
- References such as maps or photographs of the sampling site
- Any procedural steps taken that deviate from those presented in this FSP

Documents, records, photographs, and information relating to field activities will be maintained in the project file via electronic files and/or hard copy. The Anchor QEA Field Lead will review field documentation to verify the activities met the intent of this FSP. Field logbooks or tablets, field sheets, and photographs will be scanned/uploaded daily (if possible) and stored electronically.

Similarly, the laboratory project managers will review documentation of all comparable laboratory-related documentation to verify the activities meet the intent of the QAPP (Appendix B).

Other records of sample collection activities will include data collection logs, chain-of-custody records, custody seals, sample labels, telephone conversation records, airbills, and corrective action reports. Chain-of-custody records will be used to document the progression of field samples and quality control samples and are discussed further in the QAPP (Appendix B).

8 Quality Control

Data management and quality is an important component of the characterization activities and ultimately provides the basis of data usability. Quality and data management are the foundation for every step in the investigation process, from sample collection through processing and analysis. All field activities will be conducted in accordance with this FSP, including the procedures, details, and SOPs provided in the appendices, as well as the details provided in the QAPP (Appendix B). The QAPP presents the structure and protocols for data acquisition (QA/QC samples), assessment and oversight, and data validation (sample and laboratory) and usability evaluations. Field and laboratory quality control sample analysis frequency are listed in Table 6 and further described in the QAPP (Appendix B).

Following analytical data verification, data will be assessed and incorporated into the SIR. Data will be specifically reviewed (evaluated and interpreted) to determine if the DQOs identified herein were satisfied. All relevant records, correspondence, reports, logs, data, field reports, field logs, photographs, videos, subcontractor reports, analytical data, data reviews, and any other documentation will be reviewed and evaluated. The site characterization results will be used to identify areas, if any, that may require further investigation or remedial action.

The analytical testing program for the sediment samples from the SMC Investigation Area will be conducted according to the program outlined in the QAPP (Appendix B). PFAS samples will be collected during a separate field mobilization (see Section 4.3) using PFAS-free sampling protocols throughout sampling, sample handling, and sample management phases of the project, to ensure sample integrity. SMC Investigation Area sediment samples will be analyzed according to the EPA-approved SW-846 methods identified below, which are consistent with the EPA's Contract Laboratory Program methods. Upon sample submittal, Anchor QEA staff will review sample receipt confirmations from the laboratories to ensure samples are logged in correctly for analyses, coordinate with the laboratories for any issues with analyses or reporting, track data and review reports for completeness, and ensure data are reported correctly in the required formats with all mandatory information.

Data from the laboratories will be reported in the staged electronic data deliverable (SEDD) format, compatible with the Great Lakes Sediment Database and NOAA Query Manager, and compliant with the GLLA Data Reporting Standard, as needed. If the SEDD capability is not available, data will be provided in Anchor QEA's custom EQuIS format.

Data validation will be performed following the site investigation for all sample results according to EPA National Functional Guidelines for Organic and Inorganic Data Review (EPA 2017a, 2017b). Details of the data validation are described in the QAPP (Appendix B).

9 Reporting

The results of the field investigation activities will be presented in two separate documents. Results of the field investigation activities in the SMC Investigation Area will be documented in an SIR in accordance with Wisconsin Administrative Code Section NR 716.15. A PFAS Special Study Report will also be prepared documenting the PFAS sampling effort, including a comparison of detected PFAS concentrations to compiled screening levels established by other states, such as Michigan.

The SIR will be submitted at three stages: 50%, 90%, and 100%. The 50% SIR deliverable will be prepared after completion of field activities and analysis and will include documentation of field activities, a summary of number and location of samples, and preliminary analytical results (prior to validation). The preliminary results will be tabulated and screened against preferred screening ratios identified in Table 3, which are largely based on the *Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003*. Figures will also be developed to visualize where the PCB, metals, and PAH concentrations exceed the various sediment screening ratios.

Table 7
Sediment Screening Ratios

PCBs	Metals	PAHs
1 mg/kg	PEC	PEC
10 mg/kg	2x PEC	2x PEC
50 mg/kg	3x PEC	3x PEC

Notes:
mg/kg: milligrams per kilogram
PEC: probable effects concentration

The 90% SIR deliverable will be prepared 30 days after receipt of comments (or 30 days following submittal of the Data Usability Memorandum if later) and will include revision of the tables and figures with validated data. The 90% SIR will provide conclusions regarding the extent of concentrations exceeding screening levels and recommendations for next steps based on these results (e.g., no further action, remedial action options report). Finally, a Final (100%) SIR will be prepared and submitted to DNR and EPA within 30 days after receipt of comments on the 90% SIR deliverable.

A PFAS Special Study Report documenting the PFAS sampling effort will be prepared and will include data tables, maps, data interpretation, and a summary of findings. In the absence of cleanup goals

promulgated by DNR, PFAS concentrations will be compared to screening levels compiled from other entities, including the following:

- EPA health advisories (PFOS and PFOA)
- Department of Health Services recommended enforcement standards and preventative action limits for groundwater (PFOS and PFOA)
- Michigan health-based values recommended by their PFAS Science Advisory Workgroup (PFHxA, PFOA, PFNA, PFBS, PFHxS, PFOS, and GenX)
- Minnesota (PFBA, PFOS, PFBS, PFHxS, and PFOS)
- New Jersey (PFOA, PFNA, and PFOS)
- Texas (PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUnA, PFDoA, PFTrDA, PFTeDA, PFBS, PFHxS, PFOS, PFDS, and PFOSA)

Prior to data evaluation, Anchor QEA will provide DNR and EPA with an integrated list of preferred screening values that will be used to assess PFAS data. This approach will allow for selection of the most appropriate screening value for analytes with multiple screening values (i.e., PFOA and PFAS). An interpretation of the data, including a comparison of concentrations against sites reported in the literature, will also be provided. This comparison will provide further context for the measured values in the MKE AOC and assist in future management consideration of the MKE AOC sediments.

10 Schedule

The schedule to complete the data acquisition in 2019 will require very close coordination and collaboration by all parties involved. It is anticipated that field investigation will begin the week of November 4, 2019, and conclude November 15, 2019.

Prior to the start of the SMC Investigation field work, a kickoff meeting will be held with all project team members (as available). Field work will begin with the mobilization of the field crew (*Mudpuppy*, CEC, and Anchor QEA). Following the SMC investigation, UWM's *R/V Neeskay* and CEC will mobilize to conduct the MKE AOC PFAS Investigation. Phosphorus investigations will also occur during the MKE AOC PFAS investigation.

The following is the anticipated schedule for field work and reporting:

- November 4, 2019 – SMC investigation begins (estimate 5 days)
- November 11, 2019 – MKE AOC PFAS Investigation and phosphorus sampling begins (estimate 5 days)
- November 15, 2019 – Field sampling completed (weather pending)
- December 31, 2019 – Preliminary laboratory data received
- January 29, 2020 – Data Usability Memorandum submitted
- February 4 – 2020 – 50% SIR submitted (90% SIR submitted 30 days after receipt of comments)
- February 28, 2020 – Draft PFAS Special Study Report submitted (Final PFAS Special Study Report submitted 30 days after receipt of comments)

This schedule is subject to change based on weather delays, permits, and other factors that are out of the project personnel's control.

11 References

DNR (Wisconsin Department of Natural Resources), 1991. *Milwaukee Estuary Stage 1 Remedial Action Plan*. Contract No. PUBL-WR-276-91.

DNR 2017. *Draft Remedial Action Plan Update for the Milwaukee Estuary Area of Concern*. December 2017.

DNR 2019. *Professional Services Scope of Work for Characterization of sediments in the South Menomonee Canal and Milwaukee AOC PFAS Sampling*. September 2019.

CH2M, 2016a. *Final Site Characterization Report – Assessment of Contaminated Sediments in the Kinnickinnic River Mooring Basin in the Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin*. January 2016.

CH2M, 2016b. *Final Site Characterization Report – Menomonee River Sediment Investigation, Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin.* July 2016.

CH2M, 2019. *Focused Feasibility Study Report – Menomonee and Milwaukee Rivers Milwaukee Estuary Area of Concern*. Milwaukee, Wisconsin. Task Order No. 0029. Contract No. EP-R5-11-09.

EPA (U.S. Environmental Protection Agency), 2017a. *National Functional Guidelines for Organic Superfund Methods Data Review*. Office of Superfund Remediation and Technology Innovation (OSRTI). EPA-540-R-2017-002. January 2017.

EPA, 2017b. *National Functional Guidelines for Inorganic Superfund Methods Data Review*. Office of Superfund Remediation and Technology Innovation (OSRTI). EPA-540-R-2017-001. January 2017.

MDEQ (Michigan Department of Environmental Quality), 2018. *Michigan Department of Environmental Quality General PFAS Sampling Guidance*. Revised October 16, 2018.

RTI Laboratories, 2011. *Milwaukee Sediment Sampling and Analysis Report for USACE.* Task Order 0001. Contract No. W911XK-11-D-0005. August 2011.

USACE (U.S. Army Corps of Engineers), 2018. *Conditions of Channel Bathymetric Survey*. July 2018.

USACE, 2019. *Conditions of Channel Bathymetric Survey*. August 2019.

Tables

Table 4

South Menomonee Canal – Sediment Sampling Summary

Sampling Area and Reach	Location ID	Northing[1]	Easting[1]	Total No. of Cores Collected	Chemical Analysis							Geotechnical Analysis					
					Segregate Core						Undisturbed Core	Segregate Core				Field Testing	
					Total Polychlorinated Biphenyls Aroclor[3]	Total Organic Carbon	Polycyclic Aromatic Hydrocarbons (TPAH-18)[4]	Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn)	Total Solids	Total Phosphorus[2]	Phosphorus Testing[2]	Grain Size with Hydrometer	Specific Gravity	Atterberg Limits	Moisture Content	Bulk Density[5]	Strength Testing[6]
South Menomonee Canal	SMC-19-01	383444.5	2525819.8	2	X	X	X	X	X			X	X	X	X	X	X
	SMC-19-02	383374.8	2526038.4	1	X	X	X	X	X							X	X
	SMC-19-03	383177.4	2525778.7	1	X	X	X	X	X							X	X
	SMC-19-04	383150.8	2525884.9	1	X	X	X	X	X							X	X
	SMC-19-05	382932.9	2525828.9	1	X	X	X	X	X							X	X
	SMC-19-06	382696.3	2525787.9	1	X	X	X	X	X							X	X
	SMC-19-07	382604.2	2525885.4	1	X	X	X	X	X							X	X
	SMC-19-08	382473.5	2525780.7	1	X	X	X	X	X							X	X
	SMC-19-09	382386.4	2525588.0	1	X	X	X	X	X							X	X
	SMC-19-10	382290.4	2525643.1	2	X	X	X	X	X			X	X	X	X	X	X
	SMC-19-11	382287.5	2525440.7	1	X	X	X	X	X							X	X
	SMC-19-12	382270.8	2525209.5	1	X	X	X	X	X							X	X
	SMC-19-13	382159.2	2525250.1	4	X	X	X	X	X	X	X					X	X
	SMC-19-14	382148.6	2525045.3	1	X	X	X	X	X							X	X
	SMC-19-15	382053.5	2524826.2	1	X	X	X	X	X							X	X
	SMC-19-16	382000.6	2524890.7	1	X	X	X	X	X							X	X
	SMC-19-17	381915.4	2524696.7	1	X	X	X	X	X							X	X
	SMC-19-18	381838.4	2524502.5	1	X	X	X	X	X							X	X
	SMC-19-19	381752.6	2524516.5	1	X	X	X	X	X							X	X
	SMC-19-20	381746.3	2524310.4	1	X	X	X	X	X							X	X

Table 4

South Menomonee Canal – Sediment Sampling Summary

Sampling Area and Reach	Location ID	Northing[1]	Easting[1]	Total No. of Cores Collected	Chemical Analysis							Geotechnical Analysis					
					Segregate Core						Undisturbed Core	Segregate Core				Field Testing	
					Total Polychlorinated Biphenyls Aroclor[3]	Total Organic Carbon	Polycyclic Aromatic Hydrocarbons (TPAH-18)[4]	Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn)	Total Solids	Total Phosphorus[2]	Phosphorus Testing[2]	Grain Size with Hydrometer	Specific Gravity	Atterberg Limits	Moisture Content	Bulk Density[5]	Strength Testing[6]
South Menomonee Canal	SMC-19-21	381771.3	2524071.3	1	X	X	X	X	X							X	X
	SMC-19-22	381670.3	2524074.1	1	X	X	X	X	X							X	X
	SMC-19-23	381716.6	2523655.3	1	X	X	X	X	X							X	X
	SMC-19-24	381633.2	2523651.1	1	X	X	X	X	X							X	X
	SMC-19-25	381673.7	2523458.1	1	X	X	X	X	X							X	X
	SMC-19-26	381704.4	2523234.2	1	X	X	X	X	X							X	X
	SMC-19-27	381630.8	2523235.6	1	X	X	X	X	X							X	X
	SMC-19-28	381672.8	2523040.2	4	X	X	X	X	X	X	X					X	X
	SMC-19-29	381711.5	2522818.8	1	X	X	X	X	X							X	X
	SMC-19-30	381618.1	2522820.3	1	X	X	X	X	X							X	X
	SMC-19-31	381658.5	2522614.5	2	X	X	X	X	X			X	X	X	X	X	X
	SMC-19-32	381697.3	2522381.6	1	X	X	X	X	X							X	X
	SMC-19-33	381602.8371	2522381.6	1	X	X	X	X	X							X	X

Table 4

South Menomonee Canal – Sediment Sampling Summary

Sampling Area and Reach	Location ID	Northing[1]	Easting[1]	Total No. of Cores Collected	Chemical Analysis							Geotechnical Analysis					
					Segregate Core						Undisturbed Core	Segregate Core				Field Testing	
					Total Polychlorinated Biphenyls Aroclor[3]	Total Organic Carbon	Polycyclic Aromatic Hydrocarbons (TPAH-18)[4]	Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn)	Total Solids	Total Phosphorus[2]	Phosphorus Testing[2]	Grain Size with Hydrometer	Specific Gravity	Atterberg Limits	Moisture Content	Bulk Density[5]	Strength Testing[6]
Burnham Canal	SMC-19-34	381590.0	2524353.7	4	X	X	X	X	X	X	X					X	X
	SMC-19-35	381462.8	2524238.0	2	X	X	X	X	X			X	X	X	X	X	X

Notes:
1: Sample location coordinates are Wisconsin State Plane, South Zone, North American Datum of 1983 (NAD83), U.S. feet.
2: Two, 2-inch undisturbed cores will be collected from each location for phosphorus testing. One, 2-inch core will be collected from each location and segmented for phosphorus testing.
3: PCB Aroclors include: Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260, Aroclor 1262, and Aroclor 1268
4: TPAH-18 includes: 2-Methylnaphthalene, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(e)pyrene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene
5: Bulk density will be computed in the field based upon recovered sediment and inner core diameter and weight of wet sediment.
6: Strength properties of fine-grained sediments will be assessed using pocket penetrometer and torvane, where appropriate
As: arsenic
Cd: cadmium
Cr: chromium
Cu: copper
Hg: mercury
Ni: nickel
PAH: polycyclic aromatic hydrocarbon
Pb: lead
PCB: polychlorinated biphenyl
TPAH: total polycyclic aromatic hydrocarbons
Zn: zinc

Table 5

PFAS Special Study – Sediment and Surface Water Sampling Summary

Sampling Area and Reach	Location ID	Northing[1]	Easting[1]	Total of Cores Collected	Sediment					Surface Water	
					Segregate Core			Field Testing		Grab Sample	
					Perfluoroalkyl and Polyfluoroalkyl Substances[4]	Total Organic Carbon	Total Solids	Bulk Density[2]	Strength Testing[3]	Perfluoroalkyl and Polyfluoroalkyl Substances	Total Suspended Solids
Milwaukee River – Reach 2	MKE-19-04	384046.4	2527099.9	1	X	X	X	X	X	X	X
Milwaukee River – Reach 4	MKE-19-01	391660.005	2528873.483	1	X	X	X	X	X	X	X
	MKE-19-02	390370.1	2527720.9	1	X	X	X	X	X	X	X
	MKE-19-03	389715.5	2527342.1	1	X	X	X	X	X	X	X
Menomonee River – Reach 4	MKE-19-06	383048.4	2522429.2	1	X	X	X	X	X	X	X
Menomonee River – Reach 5	MKE-19-05	383288.9	2519879.4	1	X	X	X	X	X	X	X
South Menomonee Canal	MKE-19-07	382361.9	2525784.5	1	X	X	X	X	X	X	X
Kinnickinnic River – Reach 2	MKE-19-10	376321.2	2528821.6	1	X	X	X	X	X	X	X
Kinnickinnic River – SkipperBud's slip	MKE-19-09	375241.0	2528795.0	1	X	X	X	X	X	X	X
Kinnickinnic River – Reach 3	MKE-19-08	374421.3	2526856.1	1	X	X	X	X	X	X	X
Confluence of Milwaukee and Kinnickinnic Rivers, Inner and Outer Harbors	MKE-19-11	380515.817	2529010.7	1	X	X	X	X	X	X	X
Outer Harbor	MKE-19-12	381121.1	2531609.2	1	X	X	X	X	X	X	X
	MKE-19-13	375509.1	2533244.7	1	X	X	X	X	X	X	X
Lake Michigan	MKE-19-14	383699.3	2536463.5	1	X	X	X	X	X	X	X

Notes:

1: Sample location coordinates are Wisconsin State Plane, South Zone, North American Datum of 1983 (NAD83), U.S. feet.

2: Bulk density shall be computed in the field based upon recovered sediment and inner core diameter and weight of wet sediment.

3: Strength properties of fine-grained sediments shall be assessed using pocket penetrometer and torvane were appropriate.

4: PFAS – refer to Quality Assurance Project Plan (QAPP) for list of substances.

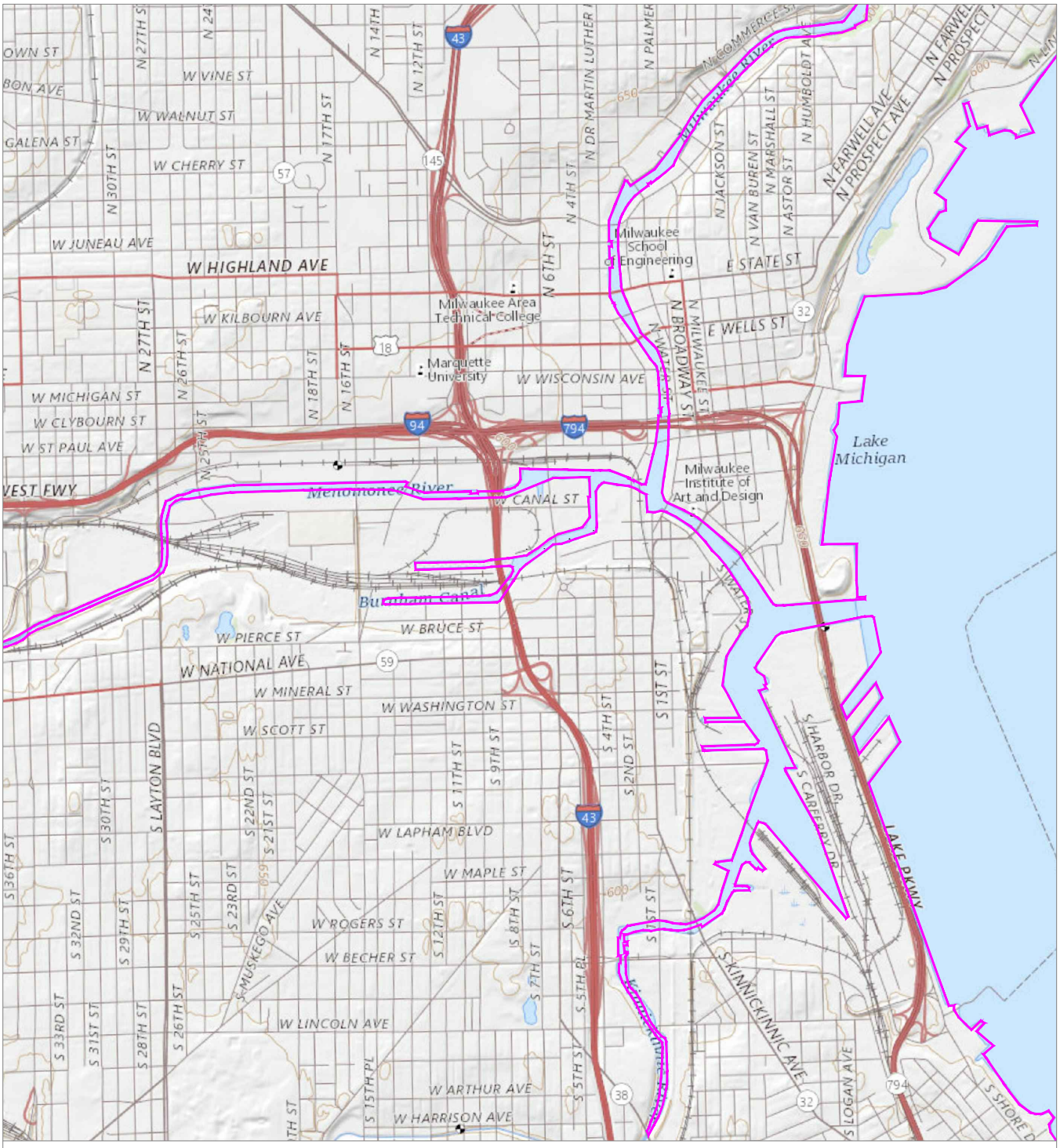
PFAS: perfluoroalkyl and polyfluoroalkyl substances

Table 6
Estimated Quantity of Samples and Quality Control Samples

Parameter	Estimated Samples[1]	Field QC Analysis				Laboratory QC Analysis[2]				Estimated Total
		Field Duplicates		Equipment Rinsate Blanks		Matrix Spike		Matrix Spike/ Laboratory Duplicate		
		Frequency	Number	Frequency	Number	Frequency	Number	Frequency	Number	
South Menomonee Canal – Sediment Sampling										
Sediment										
Metals (arsenic, cadmium, chromium, copper, lead, nickel, zinc)	210	1 per 20	11	1 per 20	11	1 per 20	11	1 per 20	11	254
Mercury, total	210	1 per 20	11	1 per 20	11	1 per 20	11	1 per 20	11	254
Polycyclic Aromatic Hydrocarbons (TPAH-18)	210	1 per 20	11	1 per 20	11	1 per 20	11	1 per 20	11	254
Total PCBs (Aroclor)	210	1 per 20	11	1 per 20	11	1 per 20	11	1 per 20	11	254
Total Organic Carbon	210	1 per 20	11	1 per 20	11	1 per 20	11	1 per 20	11	254
Specific Gravity	24	1 per 20	2	NA	NA	NA	NA	NA	NA	26
Moisture Content	24	1 per 20	2	NA	NA	NA	NA	NA	NA	26
Grain size with hydrometer	24	1 per 20	2	NA	NA	NA	NA	NA	NA	26
Atterberg Limits	24	1 per 20	2	NA	NA	NA	NA	NA	NA	26
Phosphorus Investigation										
Sediment										
Total Phosphorus	6	NA	NA	NA	NA	NA	NA	NA	NA	6
Surface Water										
Total Phosphorus	3	NA	NA	NA	NA	NA	NA	NA	NA	3
Orthophosphate	3	NA	NA	NA	NA	NA	NA	NA	NA	3
PFAS Special Study – Sediment and Surface Water Sampling Summary										
Sediment										
PFAS	56	1 per 20	3	1 per 20	3	1 per 20	3	1 per 20	3	68
Total Organic Carbon	56	1 per 20	3	1 per 20	3	1 per 20	3	1 per 20	3	68
Surface Water										
PFAS	14	1 per 20	2	1 per 20	2	1 per 20	2	1 per 20	2	22
Total Suspended Solids	14	1 per 20	2	NA	NA	NA	NA	NA	NA	16

Notes:
1 = Estimated samples assumes six samples are collected per core for the South Menomonee Canal - Sediment Sampling; two samples are collected per core for phosphorus investigation; and four samples are collected per core for the PFAS Special Study - Sediment Sampling. Additional sediment samples may be collected based on the field determinations.
2 = Field duplicates, MSs, MSDs, and equipment/field blanks will be performed at a frequency of 5% of the analytical program (1 per 20 samples).
3 = A field blank will be collected at the onset of the project.
NA = not applicable
PCB = polychlorinated biphenyl
PFAS = Perfluoroalkyl and Polyfluoroalkyl Substances
QC = quality control

Figures



SOURCE: USGS Topographic Map

HORIZONTAL DATUM: Wisconsin State Plane, South Zone, North American Datum of 1983 (NAD83), U.S. Feet

LEGEND:

Milwaukee River Estuary AOC

0 3000

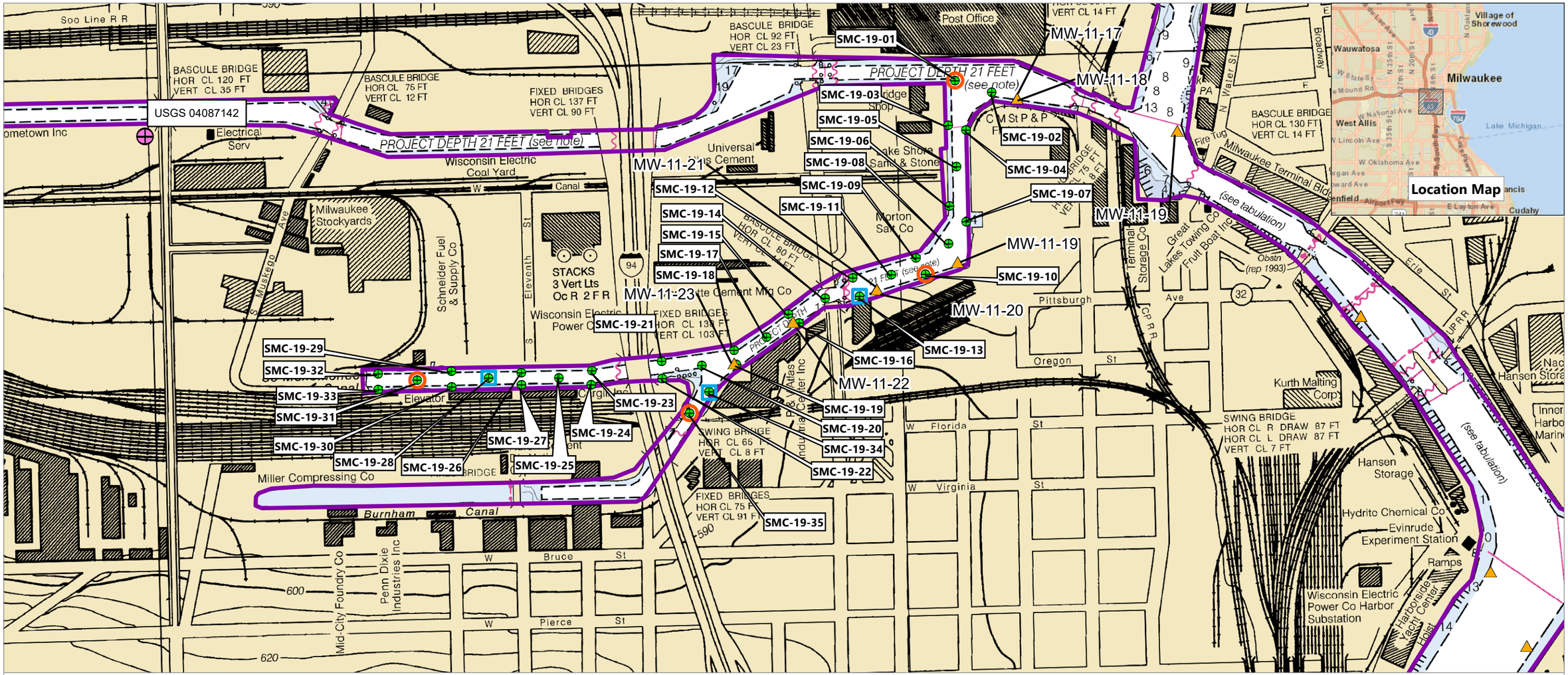
Feet

Publish Date: 2019/11/01 7:29 AM | User: bhurry
Filepath: K:\Projects\0000-Milwaukee\Milwaukee\Milwaukee AOC-RP-001 Location Figure.dwg Figure 1

ANCHOR QEA

Figure 1
Site Location Map

Milwaukee River Estuary Area of Concern
Milwaukee, Wisconsin



SOURCES:
ESRI, NOAA Nautical Charts
Map Service

LEGEND

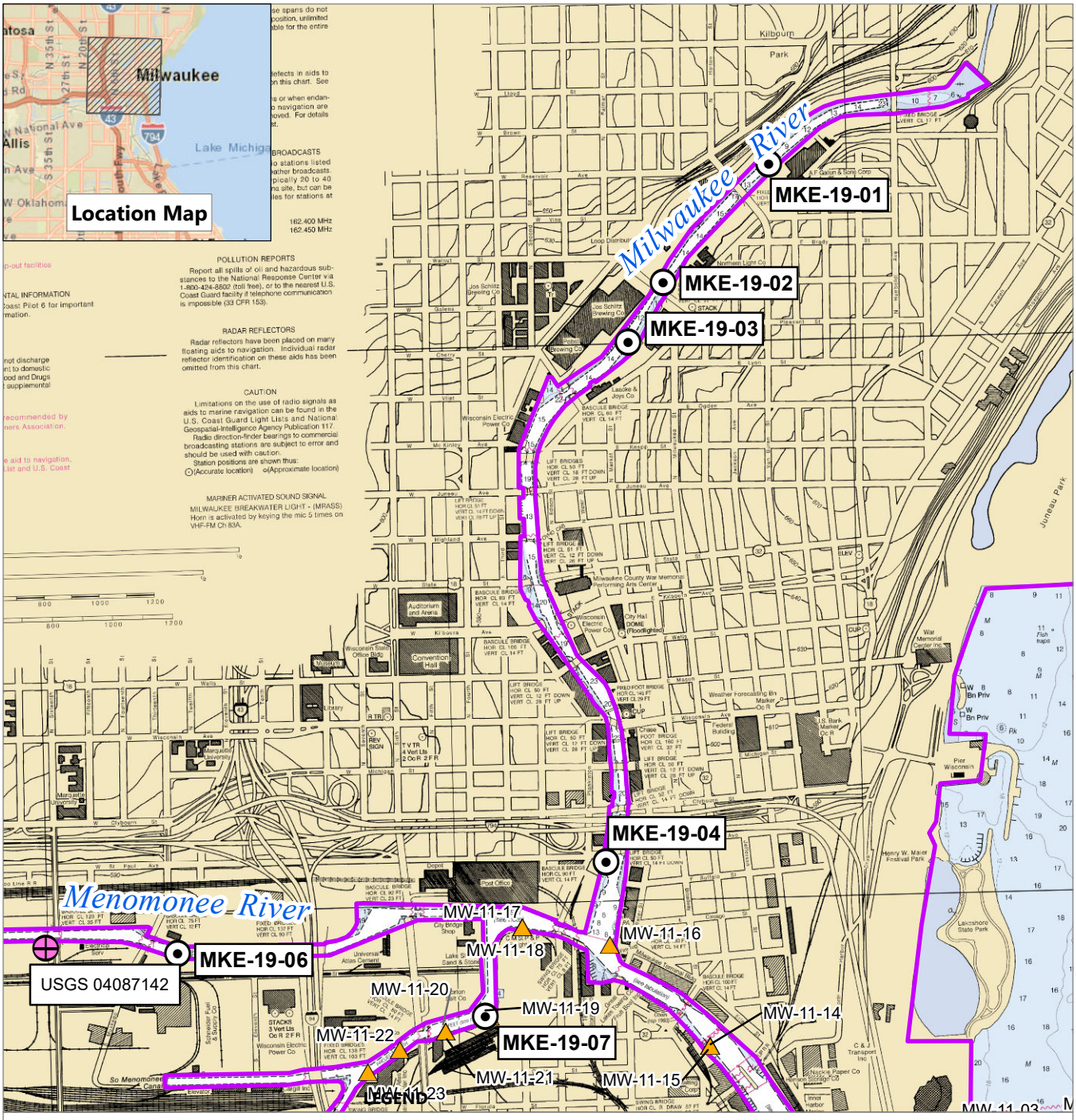
- Gauging Station
- Proposed SMC Sampling Locations
- 2011 USACE Sampling Locations
- Milwaukee River Estuary AOC
- Proposed Phosphorus Sampling Locations
- Proposed Geotechnical Sampling Locations

0 1,000
Feet

Publish Date: 2019/10/31, 10:07 AM | User: bhurry
Filepath: K:\Projects\0000-Milwaukee\Milwaukee\GIS\Milwaukee_Estuary - Figure 2 South Menomonee Canal 11x17 Landscape.mxd

ANCHOR QEA

Figure 2
South Menomonee Canal and Burnham Canal
Milwaukee River Estuary Area of Concern
Milwaukee, Wisconsin



SOURCES:
ESRI, NOAA Nautical Charts
Map Service

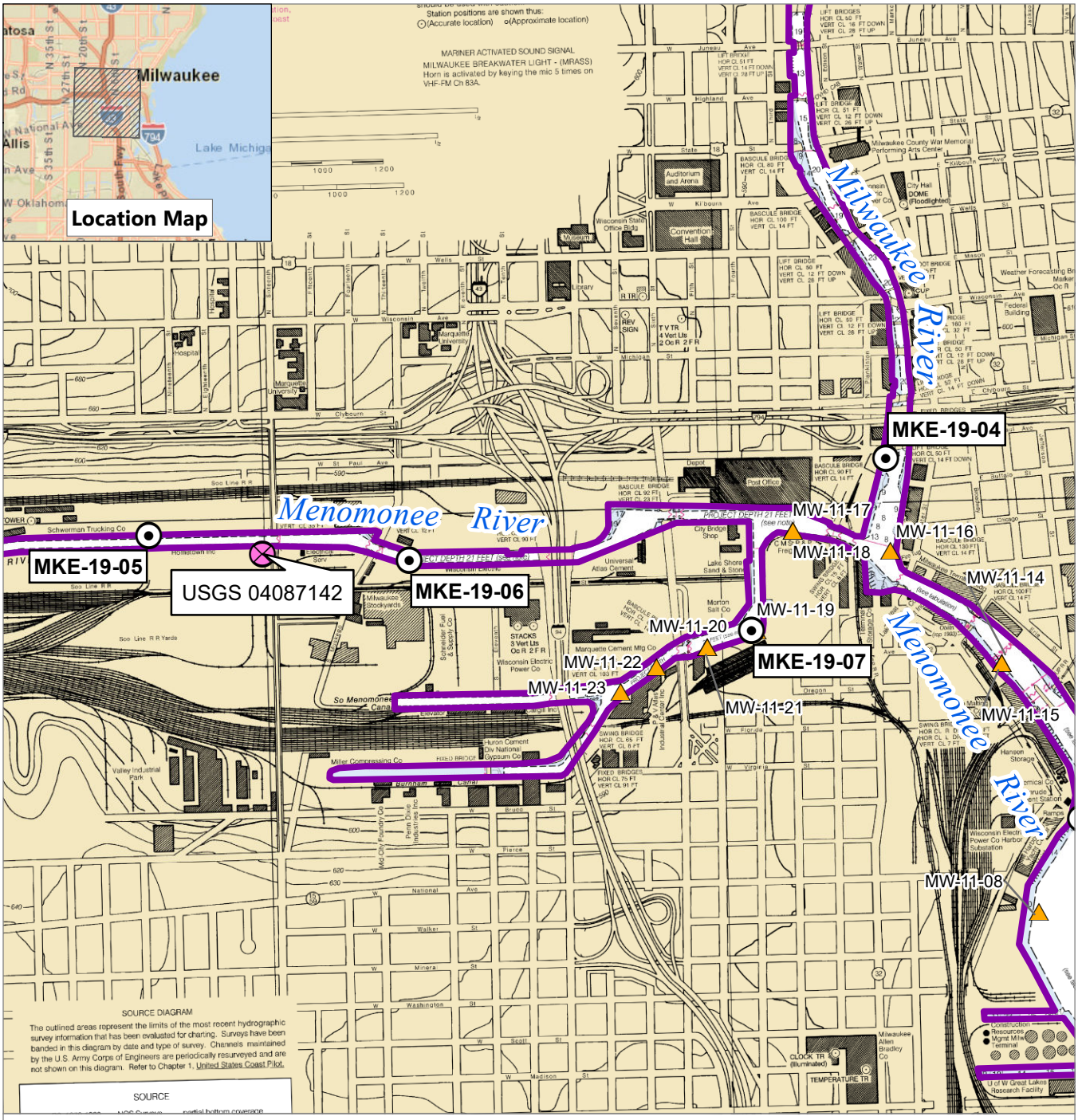
- Gauging Station
- Proposed PFAS Sampling Locations
- 2011 USACE Sampling Locations
- Milwaukee River Estuary AOC

0 1,000
Feet

Publish Date: 2019/10/31, 10:10 AM | User: bhurry
Filepath: K:\Projects\0000-Milwaukee\Milwaukee\GIS\Milwaukee_Estuary - Figure 3 Milwaukee River.mxd

ANCHOR QEA

Figure 3
PFAS Sampling - Milwaukee River
Milwaukee River Estuary Area of Concern
Milwaukee, Wisconsin



SOURCES:
ESRI, NOAA Nautical Charts
Map Service

LEGEND

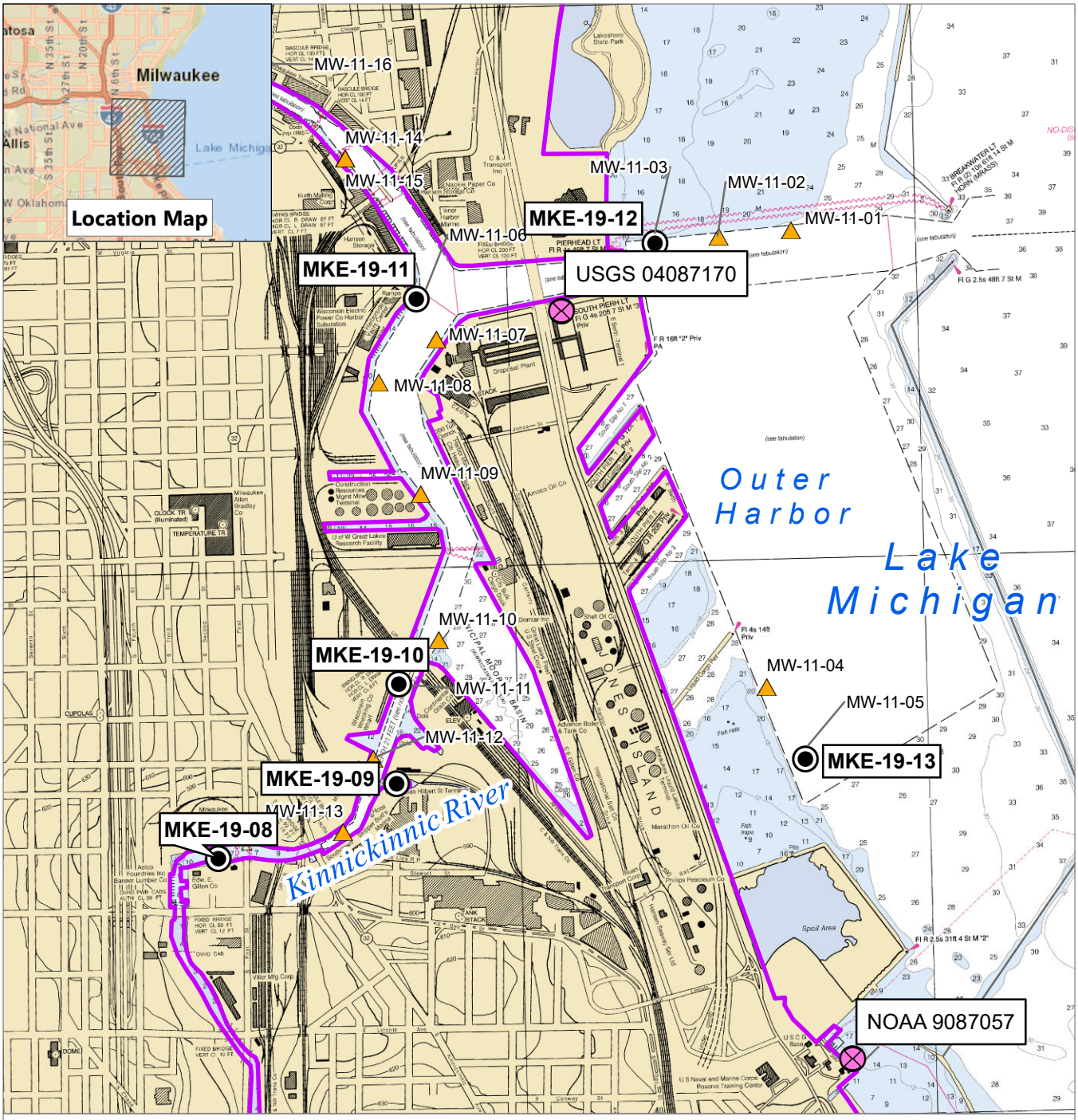
- Gauging Station
- Proposed PFAS Sampling Locations
- 2011 USACE Sampling Locations
- Milwaukee River Estuary AOC

0 1,000
Feet

Publish Date: 2019/10/31, 10:11 AM | User: bhurry
Filepath: K:\Projects\0000-Milwaukee\Milwaukee\GIS\Milwaukee_Estuary - Figure 4 Menomonee River.mxd

ANCHOR QEA

Figure 4
PFAS Sampling - Menomonee River
Milwaukee River Estuary Area of Concern
Milwaukee, Wisconsin



SOURCES:
ESRI, NOAA Nautical Charts
Map Service

LEGEND

- Gaging Station
- Proposed PFAS Sampling Locations
- 2011 USACE Sampling Locations
- Milwaukee River Estuary AOC

0 1,000
Feet

Publish Date: 2019/10/31, 10:12 AM | User: bhurry
Filepath: K:\Projects\0000-Milwaukee\Milwaukee\GIS\Milwaukee_Estuary - Figure 5 KK River and Outer Harbor.mxd

ANCHOR QEA

Figure 5
PFAS Sampling - Kinnickinnic River and Outer Harbor
Milwaukee River Estuary Area of Concern
Milwaukee, Wisconsin

Appendix A
Field Standard Operating Procedures

Standard Operating Procedure
SOP 01 – Field Records

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) addresses the sampling program requirements for the documentation of field activities during implementation of field tasks for the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. Field documentation will consist of bound field logbooks, sample collection forms, electronic field forms, photographs, and electronically recorded field measurements.

3 Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP:

- Daily logs
- Chain-of-custody forms
- Field forms and records
- Field Deviation Form
- Bound field logbook (no waterproof field books)
- Ballpoint pen
- Camera
- Electronic field application (if applicable)

4 Documentation Procedures

4.1 Field Forms

Field team members will keep a daily record of significant events, observations, and measurements on field forms. All field activities will be recorded on forms specific to the collection activity and will be maintained by the Field Lead. Field notes should be maintained for all field activities (e.g., the collection of samples or the gathering of environmental data). The on-site field representative will record on the daily log forms information pertinent to the investigation, including, at a minimum, the following:

- Project name
- Field personnel on site
- Visitors
- Health and safety discussions
- Sample station number
- Date and collection time of each sample
- Observations made during sample collection, including weather conditions, complications, vessel traffic, and other details associated with the sampling effort

- Sampling method and description of activities
- Any deviations from the Field Sampling Plan
- Conferences associated with field sampling activities

In addition to maintaining a daily log, sample collection forms or entries into the field database will be completed for each sample. The sample collection forms will include standard entries for station identifier, station coordinates, date and time of sample location, type of samples collected, type of analyses for each sample, and specific information pertaining to the matrix being collected. In general, sufficient information will be recorded during sampling so that reconstruction of the event can occur without relying on the memory of field personnel.

Field notes should be kept on paper (logbook), and all field documentation will be made using an indelible pen. Corrections will be made by drawing a single line through the error, writing in the correct information, then dating and initialing the change. Blank pages or lines in the field logbook will be lined-out, dated, and initialed at the end of each sampling day. The field forms will be scanned into the project file directory as convenient during the sampling event or upon completion of each sampling event.

4.2 Chain-of-Custody Forms

The documentation of chain-of-custody forms is described in SOP 06 – Sample Custody.

5 Sample Identification

The station and sample nomenclature are described below. Each station or location has been assigned a unique alpha-numeric identification beginning with three letters indicating the study area, followed by two numbers indicating the investigation year, followed by two digits indicating the station number.

Samples will be identified with a unique alpha-numeric system to facilitate sample tracking and data management. For sediment samples, the alpha-numeric system will begin with the station ID, followed by a hyphen, followed by four digits indicating the sampled depth interval in feet, followed by six digits (YYMMDD) following a hyphen indicating the date the sample was collected. The sampled depth interval may be more than four digits based on the actual depth sampled and should indicate the distance in feet, to the nearest tenth of a foot, from the top of the core. The top depth should be separated from the bottom depth with a hyphen. For example, the 1- to 2.5-foot depth interval would be presented as “01-02.5.”

For water samples, the alpha-numeric system will begin with the station ID, followed by six digits (YYMMDD) following a hyphen indicating the date the sample was collected.

An example sediment sample identification code is as follows:

SMC-19-01-01-02.5-20191105

This code signifies that a sediment sample was collected on November 5, 2019, from the South Menomonee Canal location SMC-19-01, from the 1- to 2.5-foot depth interval.

An example water sample identification code is as follows:

MKE-19-01-20191105

This code signifies that a water sample was collected on November 5, 2019, from the Milwaukee Area of Concern location MKE-19-01.

Field duplicate (FD), matrix spike (MS), and matrix spike duplicate (MSD) analyses will be noted on the chain-of-custody forms, and extra sample mass collected, as required. Field equipment rinsate blanks (RB) will use a coding system, with the prefix "RB," followed by the media type (SC=sediment core, SG=sediment grab, SW=surface water), followed by six digits (YYMMDD) following a hyphen indicating the date the sample was collected, followed by the sequential number of rinsate blanks performed. For example, the second rinsate blank collected on November 5, 2019, associated with sediment core collection, would be named RB-SC-20191105-02. Field duplicate samples will not be identified, and the laboratory will analyze them as "blind" quality control (QC) samples. Field duplicates will be given a unique sample identification starting with the prefix "FD," followed by the media type (SC=sediment core, SG=sediment grab, SW=surface water), followed by ten digits (YYMMDDHHMM) following a hyphen indicating the date and time the sample was collected. For example, a field duplicate of surface water collected on November 5, 2019, at 1:11 p.m. would be named FD-SW-201911051311.

6 Index of SOPs

SOP 01 – Field Records
SOP 02 – Navigation and Boat Positioning
SOP 03 – Sediment Sampling
SOP 04 – Sediment Core Processing
SOP 05 – Water Sampling
SOP 06 – Sample Custody
SOP 07 – Sample Handing, Packaging and Shipping
SOP 08 – Equipment Cleaning/Decontamination
SOP 09 – Investigation-Derived Waste Handling and Disposal

7 List of Attachments

Attachment 1 – Daily Log

Attachment 2 – Field Deviation Form

Attachments

Daily Log

Anchor QEA L.L.C.
290 Elwood Davis Road, Suite 340
Liverpool, NY 13088
Phone 315.453.9009 Fax 315.453.9010

PROJECT NAME: SMC and Milwaukee AOC PFAS Sampling **DATE:**

SITE ADDRESS: **PERSONNEL:**

WEATHER: **WIND FROM:**

N	NE	E	SE	S	SW	W	NW
SUNNY		CLOUDY		RAIN		?	

LIGHT	MEDIUM	HEAVY

TEMPERATURE: ° F . ° C
[Circle appropriate units]

TIME	COMMENTS
See Notes on bottom of page for detailed logging	
Equipment on site:	
Visual Survey: (overland flow, flow from outfalls, impacts,)	
Samples delivered to lab:	

Notes: Work performed, Phone calls made, Problems Issues/Resolutions, Visitors on site, Deviations from the Workplan
Safety infractions, Important comments/instructions to contractors

Signature: _____

290 Elwood Davis Road, Suite 340
Liverpool, NY 13088
Phone 315.453.9009
Fax 315.453.9010
www.anchorqea.com

1 Field Deviation Form

2 Form No._____

Deviation subject:_____

_____

2.1 Project name: SMC and Milwaukee AOC PFAS Sampling

2.2 Standard procedure for field collection:

2.3 Reason for deviation:

2.4 Description of deviation:

290 Elwood Davis Road, Suite 340
Liverpool, NY 13088
Phone 315.453.9009
Fax 315.453.9010
www.anchorqea.com

2.5 Special equipment, materials, or personnel required:

Initiator's name:	**Date**:
Project Manager:	**Date**:
QA Coordinator:	**Date**:

Standard Operating Procedure
SOP 02 – Navigation and Boat Positioning

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) describes the methods to be used for positioning boats for the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. Deviations from the procedures detailed in this SOP will be described on the Daily Log and in a Field Deviation Form (see SOP 01 – Field Records).

3 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors.

4 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]). Boat navigation and positioning will only be performed by field team staff or subcontractors experienced with boat operations and GPS operation.

5 Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Approved documents, including the SSP, Field Sampling Plan, and QAPP
- Daily Float Plan (Attachment 1) listing stations to be sampled, target station coordinates, access points along the site, and sample transfer and transport locations
- Ballpoint black ink pens
- Personal protective equipment as required by the SSP, including personal floatation devices
- Sampling vessel equipped with necessary GPS navigation and communication equipment
- Weighted tape measure (lead line) for water depth measurements
- Electronic depth finder for water depth measurements
- Boat spuds and an anchor system to stabilize boat on station
- Pre-determined sampling coordinates/waypoints and location figures

6 Horizontal Positioning Procedures

Horizontal positioning will be determined using a GPS based on target coordinates listed in the Field Sampling Plan. As described in the Field Sampling Plan, the sample locations may be modified based on field conditions. Measured geographic coordinates for station positions will be recorded using

GPS equipment with submeter accuracy. In addition, all sampling locations and survey information will be collected in the following coordinate systems:

- Horizontal datum: Wisconsin State Plane, South Zone, North American Datum of 1983 (NAD83), U.S. feet
- Vertical datum: International Great Lakes Datum 1985 (IGLD 85, feet)

The following procedures describe the steps used to establish a position at a location, as well as the steps to adjust the positioning for the collection of additional samples:

1. Sampling locations to be occupied will be selected by the Field Lead and communicated to field team staff each day. Coordinates for each sampling location will be entered as a waypoint into the GPS unit. The accuracy of each entry will be checked against the coordinates established in the Field Sampling Plan.
2. The GPS antennae will be maintained in a safe location that accurately represents the actual sample or measurement collection point (e.g., mounted to the top of the davit or A-frame used for raising or lowering the sampling equipment).
3. Using navigational data from the GPS, the boat operator will navigate to and approach the actual sampling/measurement station.
4. For sediment sampling, the boat will be secured within 10 feet of the sampling station by lowering anchors or spuds. For water sampling, the boat may not be anchored if sampling activities can be conducted safely as determined by the vessel operator.
5. Once the boat is on location, the coordinates from the GPS unit will be noted. With the boat on location, the coordinates will be stored electronically in the GPS unit and recorded on the appropriate field form.
6. For repeated attempts at a sampling location, the boat will be moved within the radius of 10 or fewer feet parallel to the shoreline or 10 or fewer feet perpendicular to the shoreline surrounding the target coordinates. The boat will be repositioned by adjusting an anchor line or spuds until the new position for the sampling device has been established. The new position will be recorded on the appropriate field form or in the field database.

7 Vertical Elevation Measurement Procedures

1. At each sampling station where elevation data are required, the water depth (from the top of the water level surface to the top of sediment surface) will be determined using a weighted line or survey rod.
2. The date and time of the measurement will be recorded on the appropriate data form.

3. Water surface elevations will be determined based on published data from the following gauging stations:
   a. National Oceanic and Atmospheric Administration Station 9087057 in Milwaukee
   b. U.S. Geological Survey Station 04087142 (Menomonee River)
   c.U.S. Geological Survey Station 04087170 (Milwaukee River)

   The water surface elevation from the station closest to the measurement will be used.

4. Vertical elevation of each measurement station will be converted to the vertical datum (International Great Lakes Datum 1985 [IGLD85]) after the field sampling event.

8 Quality Assurance/Quality Control

GPS system performance checks using built-in accuracy measurements and ground truths will be performed daily to confirm GPS accuracy. Minimum performance standards for horizontal accuracy will be +/- 3.28 feet or 1 meter horizontal. GPS users will complete and conform to the attached Location Data Checklist and Metadata Recording Form (Attachment 2) (U.S. Environmental Protection Agency, Great Lakes National Program Office). The following procedures describe the steps used to verify GPS accuracy and will be recorded on Attachment 2.

1. Prior to utilizing the GPS for the sampling event, measure and record horizontal coordinates at two control points
2. Prior to utilizing the GPS for the sampling event, measure and record elevation at two vertical control points.
3. Calculate displacement between known positions/elevation of control points and observed GPS position/elevation.
4. Establish three reference points. Record horizontal coordinates, elevation, and physical description for each reference point.

It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP.

9 List of Attachments

Attachment 1 – Daily Float Plan
Attachment 2 – Location Data Checklist and Metadata Recording Form

Attachments

ANCHOR QEA

DAILY FLOAT PLAN

Today's Date: _____

Vessel Name: _____

Operator: _____

Departure Time: _____ **Expected Time of Return:** _____

Cell Phone Number(s) _____

Office Contact Person Notified of Departure and Return: _____

Destination and Itinerary:

_____

_____

_____

Names of Personnel on Board:

_____

_____

_____

If expected time of return is exceeded by 1 hour, the following steps will be taken:

1. Office Contact Person will attempt to contact crew members.
2. Office Contact Person will notify Field Manager, if not the same person.

If Office Contact Person is not able to establish contact with crew the following steps will be taken in a logical order:

3. Field Manager will contact Health and Safety Officer.
4. Field Manager will contact Project Manager.
5. Local hospitals and emergency centers will be contacted.
6. Local search and rescue will be notified.

This document accompanies *GLNPO's Great Lakes Legacy Act Data Reporting Standard* , Version 1.0, March 2010, which provides detailed data reporting guidance for project data including required electronic data deliverables (EDD). In addition to the EDD and project field forms, project participants are required to complete this checklist at the end of each sampling event. Copies of completed forms should be submitted to the GLNPO Project Lead.

Contact Information

Contact Name: _____ Phone Number: _____

Affiliation: _____ E-mail Address: _____

Study Information

Project Title: _____

Site Name: _____

Sampling Start Date: _____ Sampling Stop Date: _____

Preparation Activities (please confirm each activity in the boxes to the right)

1. Sampling staff are trained in GPS Field Data Collection and have familiarized themselves with the GPS unit used for this project (certified training recommended). ☐

2. Determined window of satellite availability. http://www.trimble.com/planningsoftware_ts.asp ☐

3. Established at least two control points for both vertical and horizontal accuracy. ☐
   For assistance locating control points visit http://www.ngs.noaa.gov/cgi-bin/datasheet.prl or http://www.geocaching.com/mark/. This may not be feasible if the GPS unit is mounted to a vessel. *

4. Located 3 reference points. * ☐

Data Collection Activities (please confirm each activity in the boxes to the right)

1. GPS unit was configured to collect data only when the following requirements were met:
   a. A minimum of four satellites ☐
   b. Position dilution of precision (PDOP)<=6 ☐
   c. Satellite elevation >=15° above the horizon ☐
   d. A minimum signal-to-noise ratio (refer to GPS user manual for recommendation) ☐

2. Collected point data based on the nearest base station's logging interval. ☐

3. Collected point data for a period of at least 1 minute per location. ☐

4. Reported locational data in WGS 84 or NAD 83 (please specify_____). ☐

Please provide an explanation if a box was not checked for any of the responses above and specify deviations (include sample IDs if applicable):

_____

_____

_____

*Collect these points on at least the first day of sampling. Collecting on each sampling day is recommended. Record on page 2.

GPS Unit Specifications

GPS Brand and model number: _____

Model accuracy: _____

Data Processing

Which of the following best describes any data correction that may have been performed:

☐ real-time correction - specify type _____ ☐ post processed differential correction - provide base station id and location _____

☐ no correction ☐ other, please specify _____

Quality Information

Describe any difficulties in collecting locational data: _____

_____

List final post-processed accuracy of the data: _____

Data Collector:

Confirm required information has been provided.

_____ _____

Signature Date

GLNPO Project Lead:

Confirm required information has been provided.

_____ _____

Signature Date

Collect these data on at least the first day of sampling. Collecting on each sampling day is recommended.

Project Title: _____

Date: _____

Horizontal Control Point 1

Benchmark ID: _____ Time: _____

Established Latitude: _____ Measured Latitude: _____

Established Longitude: _____ Measured Longitude: _____

Displacement (include UOM): _____

Horizontal Control Point 2

Benchmark ID: _____ Time: _____

Established Latitude: _____ Measured Latitude: _____

Established Longitude: _____ Measured Longitude: _____

Displacement (include UOM): _____

Vertical Control Point 1

Benchmark ID: _____ Time: _____

Established Elevation: _____ Measured Elevation: _____

Displacement (include UOM): _____

Vertical Control Point 2

Benchmark ID: _____ Time: _____

Established Elevation: _____ Measured Elevation: _____

Displacement (include UOM): _____

Reference Point 1

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Reference Point 2

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Reference Point 3

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Standard Operating Procedure
SOP 03 – Sediment Sampling

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) is applicable to the collection of sediment samples for the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. Sediment for chemistry and geotechnical testing will be collected using vibracoring techniques from the R/V *Mudpuppy II* (Mudpuppy). Sediment samples for PFAS testing will be collected using either a piston sampler or direct-push methods by Coleman Engineering Company (CEC). For PFAS sediment samples to be collected from the R/V Neeskay, a grab sampler will be used to collect surface sediments. Core and surface sediment processing procedures are described in SOP 04 – Sediment Core Processing.

Procedures for sediment sampling outlined in this SOP are expected to be followed. Deviations from the procedures detailed in this SOP will be described on the Daily Log and in a Field Deviation Form (see SOP 01 – Field Records).

3 Contamination and Interferences

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits. PFAS are used in a wide variety of products; therefore, to prevent cross-contamination, field personnel should be familiar with and follow the Michigan Department of Environmental Quality (MDEQ) General PFAS Sampling Guidance (MDEQ 2018). In addition to following proper decontamination procedures (SOP 08 – Equipment Cleaning/Decontamination), the following measures should be utilized by sampling personnel before and during sample collection:

- Sampling equipment must be free of Teflon and Teflon-containing substances
- Wash hands prior to sampling
- Avoid sunscreen or insect repellants or only use allowable brands
- No fast food containers
- No Styrofoam cups
- Samples and any sampling equipment should not contact carpeted surfaces
- No new clothing should be worn, and clothing should have been washed at least six times prior to use without fabric softeners or fabric protectors
- Tyvek, Gore-Tex, and other water-repellent clothing should not be worn
- No PFAS-treated adhesive tape or paper products
- No PFAS-treated paper towel
- No pipe thread seal tape
- Avoid contact with water-repellent substances on boats or in vehicles
- Post-it notes (or similar) should not be used in relation to the sampling

4 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors. Utility clearance will be performed prior to any intrusive work.

5 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]). All field personnel are required to take a 40-hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response training course and annual refresher courses, as well as participate in a medical monitoring program, prior to engaging in core collection activities. Additionally, field personnel will be under the direct supervision of qualified professionals who are experienced in performing the tasks required for sample collection.

6 Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Sampling vessel equipped with necessary GPS navigation and communication equipment
- Approved documents including Field Sampling Plan, SSP, and QAPP
- Appropriate personal protective equipment and clothing as defined in the SSP
- Sample coordinates
- Vibracore sampler
- Direct-push equipment and sampler
- Piston sampler
- Grab sampler
- Core tubes and caps (polycarbonate tubes for PFAS sampling)
- Tubing cutters
- Sediment grab sampler (Eckman dredge, ponar, etc.)
- Core collection field forms or field database
- Duct tape or stretch tape (use PFAS-free tape for PFAS sampling)
- Aluminum foil (aluminum foil shall not be used for PFAS sampling)
- Disposable aluminum pans (shall not be used for PFAS sampling)
- Decontamination materials as described in SOP 08 – Equipment Cleaning/Decontamination

- Appropriate non-waterproof personal protective equipment and clothing as defined in the SSP
- Lead line
- Tape measure

7 Sampling Procedure Using Vibracore Sampler

Sediment core samples will be collected by the U.S. Environmental Protection Agency from the Mudpuppy using a vibracore sampler. Navigation and boat positioning procedures are described in SOP 02 – Navigation and Boat Positioning and will be followed to the extent practicable based on the on-board equipment and procedures of the Mudpuppy. The SOPs for the Mudpuppy are included in Attachment 1. Vibracore sampling will be performed using the following procedures:

1. Confirm utility locate has been performed and that any existing utilities have been clearly marked or confirmation that no existence of utilities is present. Utilities will be cleared before sampling is commenced. This may be accomplished through notifying Diggers Hotline (800-242-8511).
2. The vessel will be navigated to the proposed sample location (see SOP 02 – Navigation and Boat Positioning). The water depth will be measured using a weighted tape or survey rod. The date, time, and water depth (to the nearest 0.1 foot) will be recorded.
3. Sampling equipment and core tubes will be decontaminated prior to sampling and between locations (see SOP 08 – Equipment Cleaning/Decontamination). Site water will be utilized to decontaminate sampling equipment that is lowered through the water column during sampling.
4. Sediment core sample will be collected based on the Mudpuppy's SOPs (Attachment 1) targeting native material. Depending on the substrate encountered and depth to native material, sediment cores up to 20 feet in length may be required.
5. The retrieved sediment core shall be evaluated for acceptance based on the following criteria:
    a. Overlying water is present and the surface is intact.
    b. The core tube appears intact without obstruction or blocking.
    c. Recovery is greater than 70% of drive length.
    d. The core includes visible presence of native material in the bottom of the core.

    If sediment core acceptance criteria are not achieved, the core is rejected. Up to three attempts will be made to achieve acceptance criteria. Subsequent attempts will be made within 10 feet of the previous attempt. The retrieved core from each attempt will be retained. After three attempts, the core with the highest recovery percentage will be retained and sampled. The contents of rejected cores will be discarded into the waterbody over the side of the sampling vessel.
6. The accepted core tube will be labeled with the sample station number, sample date and time, and an arrow pointing to the top of the core.

7. The appearance and length of the core sample will be evaluated by examination through the clear-plastic core liner. Any stratigraphic intervals or other salient features will be noted in the field database or on the Sediment Core Collection Log sheet (Attachment 2) including the total length of the native material.
8. The cores will then be cut into appropriate lengths (5 feet or less in length) for transport to the core processing area for processing.
9. Accepted cores will be transported to shore for processing.
10. Sediment cores will be processed in accordance with SOP 4 – Sediment Core Processing.

8 Sampling Procedure Using a Piston-Core/Direct-Push Sampler

Sediment core samples will be collected by piston-core/direct-push sampler as the primary sampling method for PFAS testing and for collecting undisturbed cores for phosphorus analysis. CEC will collect sediment core samples using either a Direct Push MC-5 sampler or a piston sampler. Sampling method (piston or direct-push) will be selected in the field based on conditions to meet the acceptance criteria. The SOP for CEC is included in Attachment 3.

Sediment core collection for PFAS testing will be performed using the following procedures:

1. Confirm utility locate has been performed and that any existing utilities have been clearly marked or confirmation that no existence of utilities is present. Utilities will be cleared before sampling is commenced. This may be accomplished through notifying Diggers Hotline (800-242-8511).
2. Screen field equipment, sample vessel, and personal items for potential sources of PFAS cross-contamination prior to sampling (see MDEQ General PFAS Sampling Guidance). Remove or replace equipment that could result in PFAS cross-contamination.
3. The vessel will be navigated to the proposed sample location (see SOP 02 – Navigation and Boat Positioning).
4. A water sample will be collected prior to sediment sampling (see SOP 05 – Water Sampling).
5. The vessel will be secured on the proposed sample location using spuds or anchors after the water sample has been collected.
6. The water depth will be measured using a weighted tape or survey rod. The date, time, and water depth (to the nearest 0.1 foot) will be recorded.
7. Sampling equipment and core tubes will be decontaminated prior to sampling and between locations (see SOP 08 – Equipment Cleaning/Decontamination). Site water will be utilized to decontaminate sampling equipment that is lowered through the water column during sampling.
8. Sediment core sample will be collected following procedures outlined in the CEC Sediment Sampling SOP (Attachment 3). Sampler will be driven to a depth of 4 feet below the existing

mudline for sediment cores to be collected for PFAS analysis. Sampler will be driven 2 to 3 feet below the existing mudline targeting 30 inches of recovered sediment within the core for phosphorous analysis.

9. The retrieved core will be secured in an upright position for measurements. Any disturbed sediment will be allowed to settle completely within the core tube, and the recovered sediment length will be measured.
10. For cores collected for PFAS analysis, the water above the sediment will be drained by drilling a hole in the core tube just above the sediment surface. The excess tube will be cut off above the sediment surface, and immediately after that, the end will be capped and the caps secured on the top and bottom with duct tape.
11. For cores collected for phosphorus analysis, the core will be cut to a 3-foot length, leaving a minimum of 12 to 15 inches of headspace above the sediment surface. Excess water overlying the sediment will not be drained. Ends of the core will be capped and caps secured with stretch tape or duct tape.
12. The retrieved core will be evaluated for acceptance based on the following criteria:
    a. Overlying water is present and the surface is intact.
    b. The core tube appears intact without obstruction or blocking.
    c. Recovery is greater than 70% of drive length.

    If sediment core acceptance criteria are not achieved, the core is rejected. Up to three attempts will be made to achieve acceptance criteria. Subsequent attempts will be made within 10 feet of previous attempt. The retrieved core from each attempt will be retained. After three attempts, the core with the highest recovery percentage will be retained and sampled. The contents of rejected cores will be discarded into the waterbody over the side of the sampling vessel.
13. The accepted core tube will be labeled with the sample station number, sample date and time, and an arrow pointing to the top of the core.
14. The appearance and length of the core sample will be evaluated by examination through the clear-plastic core liner. Any stratigraphic intervals or other salient features will be noted in the field database or on the Sediment Core Collection Log sheet (Attachment 2) including the total length of the native material.
15. The cores will be sealed tightly and kept upright to prevent leakage or disturbance during transport to the processing area.
16. The sediment core will be processed in accordance with SOP 4 – Sediment Core Processing.

9 Sediment Core Collection Log

Field conditions and drive notes for sediment coring (vibracore sampler, piston sampler, or direct-push sampler) will be recorded in the field database or on a Sediment Core Collection Log (an example is provided in Attachment 2). The logs will include the following information:

- The sample station identification
- Water depth and time of measurement
- Geographic position of the actual coring location as determined by GPS
- Date and time of collection of each sediment core sample
- Names of field personnel collecting and handling the samples
- Observations made during sample collection, including weather conditions, complications, and other details associated with the sampling effort
- Length of drive penetration and recovery measurements
- Qualitative notation of apparent resistance of sediment column to coring (how the core drove)

10 Surface Sampling Procedure Using Grab Sampler

For the three PFAS sampling locations in the Outer Harbor area, a grab sampler (Ekman dredge or equivalent) may be used to collect a representative surface sediment sample.

Surface sediment collection will be performed using the following procedures:

1. Confirm utility locate has been performed and that any existing utilities have been clearly marked or confirmation that no existence of utilities is present. Utilities will be cleared before sampling is commenced. This may be accomplished through notifying Diggers Hotline (800-242-8511).
2. Screen field equipment, sample vessel, and personal items for potential sources of PFAS cross-contamination prior to sampling (see MDEQ General PFAS Sampling Guidance). Remove or replace equipment that could result in PFAS cross-contamination.
3. The vessel will be navigated to the proposed sample location (see SOP 02 – Navigation and Boat Positioning).
4. A water sample will be collected prior to sediment sampling (see SOP 05 – Water Sampling).
5. The water depth will be measured using a weighted tape or survey rod. The date, time, and water depth (to the nearest 0.1 foot) will be recorded.
6. Prepare grab sampling device (Eckman dredge or equivalent) for deployment.
7. At sample location, open or set the dredge and drop vertically making sure the end of the rope is maintained securely above the water.

8. Once the dredge has been allowed to settle into the bottom sediments, a hard pull on the rope will close the dredge and contain the sediments inside the dredge.
9. Open the dredge to allow the sediments to empty into a sample processing container (e.g., new or decontaminated [SOP 08 – Equipment Cleaning/Decontamination]) low-density polyethylene [LDPE] or high-density polyethylene [HDPE] container). Process sediment sample in accordance with SOP 4 – Sediment Core Processing.

11 Quality Assurance/Quality Control

Entries in the field forms will be double-checked by the field team staff to verify that the information is correct. It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP.

12 List of Attachments

Attachment 1 – SOP-MP-103 (Operating Vibracoring System on Board the RV Mudpuppy II), MP-107 (Decontamination), MP-108 (Recording Field Information)

Attachment 2 – Sediment Core Collection Log

Attachment 3 – Coleman Engineering Sediment Sampling SOP

13 References

MDEQ (Michigan Department of Environmental Quality), 2018. *General PFAS Sampling Guidance*. Revised October 16, 2018.

Attachments

TABLE OF CONTENTS

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures in using the vibracoring system to obtain sediment cores on board the Research Vessel (R/V) *Mudpuppy II*.

2.0 APPLICABILITY/SCOPE

This SOP describes the equipment and supplies used for the Vibracoring system sample collection. The vibracoring system consists of the vibracore head, core tube, underwater electrical cable coming from the surface support platform to the vibracore head, and control box located between the underwater cable and the power source.

This SOP should be followed by all project participants supporting the collection of samples using the vibracoring system. Project participants should also refer to the project-specific quality assurance project plan (QAPP) and field sampling plan (FSP) for detailed sampling procedures and requirements. The information in this SOP is adapted from EPA SOP #2016, *Sediment Sampling* (U.S. EPA, 1994).

3.0 DEFINITIONS

FSP	Field Sampling Plan
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GPS	Global Positioning System
QAPP	Quality Assurance Project Plan
R/V	Research Vessel
SOP	Standard Operating Procedure

4.0 SUMMARY OF METHOD/PROCEDURE

The vibracore head has a core tube clamp and an internal vibrator motor. The vibracorer applies thousands of vibrations per minute to help penetrate the sediment. When the core tube is inserted in the core tube clamp, the vibracorer is lowered to 6" above the water body and then turned on. As soon as the core tube touches the sediment, the sediment and water interface to create a slurry due to the vibrations between the core tube and sediment. This eases the entry of the core tube into the sediment.

5.0 PERSONNEL QUALIFICATION/RESPONSIBILITIES

Training for using the vibracoring system to obtain sediment samples on board the R/V *Mudpuppy II* involves shadowing a trained sampler and taking samples under supervision of the trainer. Personnel have an opportunity to learn how to use many of the samplers during the sampling season. In addition, all project participants should attend a standard R/V *Mudpuppy II* introduction training.

6.0 EQUIPMENT AND SUPPLIES

This section provides physical details of the vibracorer and presents a description of the equipment and supplies commonly required for sample collection.

6.1 Detailed Equipment Description

The vibracorer for the R/V *Mudpuppy II*, a Rossfelder P3C Vibracore (P3C) (Figure 1), operates at the following specifications:

Weight of vibracore head:	150 lbs
Power setting:	Medium = 5.0 kW, 8.0 amps
Force:	Centrifugal force at 60 Hz, medium power setting, produces a force of 20 kilonewtons
Vibrations per minute:	3450 vibrations per minute at 60 Hz
Water depth capability:	125 feet (based on R/V *Mudpuppy II* winch capacity)
Core tube type:	4 inch diameter metal or polycarbonate tubes

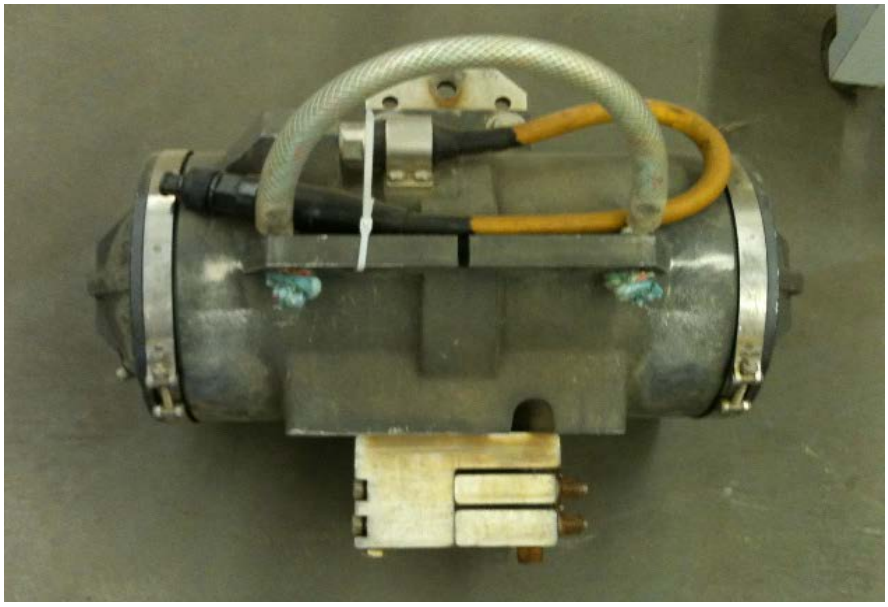


Figure 1. Vibracore sampler

6.2 Equipment List

The following equipment and supplies are required for the collection of a long core sediment sample at a typical sampling location, and are available on the R/V *Mudpuppy II* unless otherwise stated.

- Rossfelder P3C Vibracore
- Polycarbonate core tubes
- Underwater electrical cable
- Control box/power source
- Wrench
- Hydraulic articulating crane with winch
- Eggshell core catcher
- 20’ aluminum tube
- Stainless steel or aluminum rivets
- Stainless steel nose cone
- Chisel, Drill, Punch, Push rod
- Duct tape
- Cap
- Hand sledge, Hammer
- Polycarbonate liners
- Extractor flange
- Hand saw
- Rivet jig
- Riveter

7.0 REAGENTS AND STANDARDS

N/A

8.0 HEALTH AND SAFETY CONSIDERATIONS

At all times personnel should comply with the policies and procedures within the GLNPO *Safety, Health and Environmental Compliance Manual* (U.S. EPA, 2016*)* as this manual takes precedence over the SOP requirements. At a minimum, project participants must wear: a hard hat with face shield, safety glasses, a life jacket, steel-toed boots, and rubber gloves or leather gloves to operate the sampler. The power cable should not be bent, twisted, pinched or stepped on.

9.0 INTERFERENCES

Refer to the Rossfelder P3C Vibracore Manual.

10.0 PROCEDURE

10.1 Instrument or Method Calibration and Standardization

N/A

10.2 Sample Collection

The following sampling procedure is used to collect sediment samples up to 15 feet in length (disposable polycarbonate core tubes) using the vibracoring system on the R/V *Mudpuppy II*, after securing the vessel as instructed by the captain. Project participants should refer to the project-specific QAPP and FSP for any additional sample collection procedures.

1. Record sample location using global positioning system (GPS).
2. Measure and record water depth.
3. Install eggshell core catcher using 4 aluminum peel-back rivets (if not already done).
4. Using the winch, vertically lift the vibracore head so that the vibracore head is suspended just off of the bow of the sampling vessel.
5. Insert the core tube into the core tube clamp, making sure that the tube is contacting the top of the clamp..
6. Hold core tube in place while tightening the clamp around the core tube using a socket or a wrench.
7. With the winch, lower the entire assembly until the core nose is just above the sediment surface, as indicated by the markings on the power cable. Turn on the power to the vibracore head.

8. Slowly lower the vibracorer by keeping 6-10 inches slack of cable at a time. The power cable is marked in 1-ft increments. Monitor the core tube penetration by feeling for slack in the cable, watching the winch cable and listening to vibracorer. Keep track of penetration depth by counting the markings on the power cable.
9. Once the vibracorer ceases to penetrate the sediment :(i.e., the unit stops lowering, the cable remains slack or the vibracorer head starts to tip over) or the core tube has penetrated its entire length, turn off power to the vibracore head. **NOTE:** Care must be taken to ensure the vibracore head is not embedded in the sediment.
10. Using the winch, remove the core from the sediment surface.
11. Lift the entire assembly out of the water. Rise off core tube as it is being raised. Lower entire assembly until the sediment/water interface is about eye level..
12. Drill hole at sediment/water interface to decant water from tube.
13. Tie a clove hitch around the core tube.
14. Remove and lower the core tube onto the processing table. (This applies to 10' and shorter tubes. 15' and 20' tubes are laid on the deck on the port side of the boat.)
15. Measure the retrieved sediment, cut core tube to length, cap and tape ends of core tube.
16. Rinse the vibracorer off with site water, making sure to rinse the inside of the core clamp and check valve. Further decontamination should be performed in accordance with the site specific QAPP and FSP.

Steps to Obtain Sediment Cores of Twenty Feet in Length Using the Vibracorer

The following procedure is used to collect sediment samples 20 feet long using the vibracore system on the R/V Mudpuppy II. When sediment thickness is greater than 15 feet, cores up to 20 feet can be collected using outer-tube/liner/nosecone system. The change in methodology is necessary because at lengths over 15 feet, polycarbonate tubes (alone) do not transfer enough energy to the tip of the tube. What typically happens is that the core tube stops penetrating and the body of the core tube takes on a cyclonic movement that causes increased mixing of the core contents. Using an aluminum outer tube coupled with a thin wall polycarbonate liner, sufficient energy is transferred to the tip to collect 20 foot cores.

1. Use the rivet jig to mark rivet hole locations at one end of the aluminum outer tube.
2. Drill 3/16" holes where marked.
3. Slide a thin wall polycarbonate liner into the aluminum tube, leaving 6 inches of liner exposed at the end of the aluminum tube where the rivet holes are located.

4. Slide a stainless steel nose cone (with stainless core catcher attached) into the core liner until it bottoms out.
5. Slide the nose cone and liner (together) into the aluminum tube until it bottoms out and rotate the nose cone until the rivet holes line up.
6. Rivet the nose cone to the aluminum tube using 3/16" stainless steel rivets.
7. Making sure the liner stays completely seated on the nose cone, cut off the extra liner from the top of the tube assembly with a hand saw.
8. Continue taking the core as with a disposable polycarbonate tube.
9. After removing the core tube from the vibracorer head, lay the core tube down on the port side of the vessel, slowly decanting the water out the top of the tube.
10. Drill out the center of each rivet using a 3/16" drill bit.
11. Using a hammer and chisel, knock the heads off of the rivets and push the body of the rivet through the outer tube using a punch.
12. Keeping them together, slide the liner and nose cone out of the aluminum tube. If the liner does not easily slide out of the outer tube, the extractor flange and hand sledge can be used to drive them out from the top of the core.
13. Once the liner has slid out about a foot, the nose cone can be removed and the bottom of the core liner capped.
14. Slide the outer tube all the way off of the liner towards the top of the tube.
15. Wash sediment off the outside of the liner.
16. Measure the retrieved sediment, cut core tube to length, cap and tape ends of core tube.
17. Rinse the nose cone and outer core tube (inside and out) with site water.

10.3 Sample Handling and Preservation

Project participants should refer to the project-specific QAPP and FSP for details on specific sample handling and preservation procedures.

10.4 Sample Preparation and Analysis

N/A

10.5 Computer Hardware and Software to be Used

Project participants should refer to the project-specific QAPP and FSP for any computer hardware and software needed.

10.6 Troubleshooting

Refer to the Rossfelder P3C Vibracore Manual.

10.7 Data Acquisition, Calculations, and Data Reduction

Project participant should refer to the project-specific QAPP and FSP for any data acquisition, calculations or data reduction procedures.

10.8 Data Review and Acceptance

N/A

11.0 WASTE MANAGEMENT

Excess samples should be disposed of overboard. For further details, refer to the project specific QAPP and FSP.

12.0 DATA AND RECORDS MANAGEMENT

All Great Lakes Legacy Act (GLLA) projects must follow GLNPO's *GLLA Data Reporting Standard* (U.S. EPA, 2010). Other sediment projects should refer to reporting requirements outlined in their project-specific QAPP.

13.0 QUALITY CONTROL & QUALITY ASSURANCE

For specific quality control and quality assurance procedures, project participants should refer to the project-specific QAPP and FSP. At a minimum:

- If the first attempt at sample collection is not successful and discarded, project participants should adjust sample location so that the next attempt does not collect discarded material. Alternatively, the contents of the core can be discarded along the sides of the vessel to avoid contaminating subsequent attempts if moving sample location is not an option.
- All data must be documented according to the project-specific QAPP and FSP specifications.
- All instrumentation must be calibrated (when applicable), operated, and maintained in accordance with instructions as supplied by the manufacturer unless otherwise specified.
- All project participants must follow the sample handling, labeling, preservation and shipping procedures described in the project-specific QAPP and FSP.
- The sampler must be emptied and cleaned in between sample collection according to the procedures in this SOP and in the project-specific QAPP and FSP.

14.0 REFERENCES

Rossfelder P3C Vibracore Manual, Oct 1999.

U.S. EPA. November 1994. *Sediment Sampling,* SOP#2016, Rev. 0.0. Office of Solid Waste and Emergency Response, Environmental Response Team. http://www.dem.ri.gov/pubs/sops/wmsr2016.pdf

U.S. EPA. May 2016. *Safety, Health and Environmental Compliance Manual.* Great Lakes National Program Office.

U.S. EPA. March 2010. *Great Lakes Legacy Act Data Reporting Standard,* Version 1.0. Great Lakes National Program Office.

15.0 ATTACHMENTS

N/A

SUMMARY OF CHANGES FOR

***R/V MUDPUPPY II* - QMP-SOP'S**

(WITH REQUIRED SIGNATURES*)

VIBRACORE				**SOP # 103**
Rev #	**Date**	**Preparer** **PRINT / SIGN**	**Approver (COR)** **PRINT / SIGN**	**Approver (RRS I Section Chief)** **PRINT / SIGN**
2	April 2018	Harry Rogers 	Mary Beth Giancarlo 	Scott Cieniawski 

* Pls attach a PDF signature next to your name and return to the Originator for publication. For this to work going forward, the document must be kept in PDF Format

SOP-MP 107 Standard Operating Procedure for the Decontamination of the Research Vessel Mudpuppy II Between Sediment Surveys to Prevent Transport of Contaminants, Invasive Species, and Waterborne Pathogens.

Rev. 2 4-18

TABLE OF CONTENTS

1.0 PURPOSE

In an effort to prevent the transport of contaminants, invasive plant and animal species, and/or waterborne pathogens between various water bodies, the U.S. EPA Great Lakes National Program Office (GLNPO) has adopted standard operating procedures (SOPs) for decontamination of the Research Vessel (R/V) *Mudpuppy II* and sampling equipment between sediment surveys.

2.0 APPLICABILITY/SCOPE

U.S. EPA's sediment sampling vessel, the R/V *Mudpuppy II*, is utilized by U.S. EPA and its Great Lakes partners to sample sediments at numerous rivers and harbors, and some inland lakes, within the Great Lakes watershed. Rarely the use of the R/V *Mudpuppy II* is requested outside the Great Lakes basin. This SOP applies only to the R/V *Mudpuppy II* and the equipment that are normally operated on the vessel. This SOP does not apply to other research vessels or equipment that is brought on by other partners.

3.0 DEFINITIONS

AIS	Aquatic Invasive Species.
Decontamination	The process of removing chemical contaminants and killing attached AIS.

4.0 SUMMARY OF METHOD/PROCEDURE

This SOP describes the procedures that the R/V *Mudpuppy II* crew will follow to decontaminate the R/V *Mudpuppy II* and associated sampling equipment after a sediment sampling event is completed and before launching into a different water body. The

Standard procedure for preventing transport of AIS by boat is "clean, drain, dry". This includes cleaning the vessel of all visible plant, sediment and animal materials, draining all bilges and tanks and allowing the boat to air dry for a minimum of 5 days before placing it into another water body. If the boat cannot be dried for the full time, if AIS is identified, or if the vessel has water in it that cannot be proven to be free of AIS, disinfection should take place. Since the R/V Mudpuppy II may need to be used for emergencies with little notice, the vessel will be decontaminated each time it comes out of the water, unless the vessel will be put back into the same water body in short order and is not transported away from that water body.

Federal, State and local laws restrict the transport of aquatic invasive species, sediment and water. For this reason, some of the procedures listed below are required to be completed prior to leaving the launch site. If a decontamination site is locally available, immediate decontamination should be performed. Otherwise, decontamination will be performed when returning to the vessel's home port.

5.0 PERSONNEL QUALIFICATION/RESPONSIBILITIES

The R/V *Mudpuppy II* crew (i.e. Captain and Marine Technician) must read, be familiar with, and comply with the requirements of this SOP. Specialized training is not required for decontamination of the vessel and/or equipment; however, new staff will be supervised by experienced staff.

6.0 EQUIPMENT AND SUPPLIES

The following supplies are necessary for decontaminating the R/V *Mudpuppy II* between sediment surveys:

- Potable water source and hose
- Wash water storage tank
- Hot water pressure washer
- Low pressure attachment for pressure washer
- Undercarriage attachment for pressure washer
- Non-alkaline/phosphate free soap
- Stiff bristled brush (long handle)
- Soft bristled brush (long handle)
- Soft bristled hand brush
- Low pressure diffuser for pressure washer
- Outboard flushing ears
- Wet/dry vacuum
- Containment pad and berm
- 12 volt transfer pump

- 55 gallon drum
- 5 gallon bucket
- 12 volt battery
- Confined space ventilator fan
- Cloth rags or heavy duty paper towels
- Infrared thermometer

7.0 REAGENTS AND STANDARDS

N/A

8.0 HEALTH AND SAFETY CONSIDERATIONS

At a minimum, wear steel-toed boots, safety goggles, and heat resistant rubber gloves or leather gloves while decontaminating the R/V *Mudpuppy II*.

9.0 INTERFERENCES

N/A

10.0 PROCEDURE

Prior to loading boat on trailer, scrub visible sediment from deck using stiff bristle brush. Scrub visible sediment from hull of boat using soft bristle brush. Rinse with site water. This will most likely take place at the location of the final sampling station as part of the station decontamination.

1. Prior to leaving launch site, remove all visible vegetation from boat and trailer.
2. Prior to leaving launch site, raise bow of boat and discharge bilge water via bilge pump (do this far enough away from the ramp so that bilge water will not run into surface water).
3. Prior to leaving launch site, vacuum out remaining bilge water (dump vacuum away from surface water, preferably on gravel or grass).
4. Prior to leaving launch site, vacuum water out of deck tie-down pockets (dump vacuum away from surface water, preferably on gravel or grass).
5. Prior to leaving launch site, release wash-down pump pressure by opening sprayers.
6. Prior to leaving launch site, open generator, air conditioner, and wash-down pump sea-cocks.
7. Prior to leaving the launch site, clean out sea strainers and vacuum out water. Dispose of material from strainers in trash receptacle.
8. Prior to leaving launch site, remove filter nets on tray table and dispose of material in trash receptacle.
9. Fill power washer water storage tank with potable water. Add water to tank when the level is reduced to 50%. If municipal water supply is capable of providing a

minimum flow of 5 gallons per minute, the water supply can be attached directly to the power washer.

10. Establish a containment area around boat for purposes of decontamination. Pump wash water from containment area to storage tank for later use, or to municipal WTP if permitted to do so. This will usually occur at the home facility. In the event of decontamination at another facility, follow procedures in place at that location.
11. Pay out anchor lines, scrub anchors and chains with hand brush and soap. Rinse with 140 degree low pressure water. Make sure the tubing on the anchor is void of sediment, cleaning out with high pressure spray if necessary.
12. Fill drum with 140 degree water and place anchor and anchor line in drum. Allow to sit in drum for a minimum of 2 minutes.
13. As the anchor lines are soaking, clean the anchor rests and anchor lockers of any residual plant material and sediment. Scrub area with phosphate free/non-alkaline soap and hand brush, rinse rests and lockers down for a minimum of 10 seconds with 140 degree low pressure water (be careful not to soak the 12 volt switches inside of the anchor lockers).
14. Spray the anchor lines with high pressure 140 degree water as they are brought back into the anchor lockers. Use of a commercially available rope cleaner with 140 degree wash water is an acceptable alternative.
15. Scrub bulkheads and decks that are accessible only when on the boat. Start with the pilot house roof and work down using phosphate free/non-alkaline soap and a stiff bristle brush for decks and a soft bristle brush for bulkheads. Rinse bulkheads with 140 degree low pressure spray and decks with 140 degree high pressure spray.
16. Remove the bilge hatch covers and wipe off the seals and mating surfaces. Rinse with 140 degree low pressure spray for at least 10 seconds. Dispose of rags in solid waste receptacle.
17. Remove intake strainers and rinse with 140 degree low pressure water for at least 10 seconds. Replace strainers.
18. Attach low pressure hose to wash down pump valves and run them with 120 degree water for a minimum of 2 minutes. Cool the pumps down by running with cold water for 30 seconds.
19. If air conditioner valve was opened at any time while in the water, attach low pressure hose to air conditioner valve and run with 120 degree water for a minimum of 2 minutes. Cool the air conditioner down by running with cold water for 30 seconds
20. Attach low pressure hose to generator valve and run with 120 degree water for a minimum of 2 minutes. While the generator is running, pay out all the winch line into a bucket of 120 degree water and let sit for a minimum of 2 minutes. Cool generator down by running with cold water for 30 seconds.
21. Remove oil absorbent pads from bilge and discard.
22. Using low pressure 120 degree water, rinse the bilges for at least 2 minutes. Pump out rinse water with bilge pump and vacuum out the remaining water.

23. Attach flushing ears to each outboard and run for a minimum of 2 minutes using low pressure 120 degree water. Cool outboards down by running with cold water for 30 seconds.
24. Scrub the outside of the hull and outboards with non-alkaline/phosphate free soap using a soft bristle brush. Rinse with 140 degree low pressure spray for at least 10 seconds.
25. Using 140 degree high pressure water, spray all areas of the vessel below the water line to remove any attached organisms. Use an undercarriage attachment to spray down the bottom of the vessel.
26. Rinse all surfaces of the trailer with 140 degree low pressure spray for a minimum of 10 seconds. Follow up with 140 degree high pressure spray to remove any attached organisms. Use undercarriage attachment for hard to reach areas.
27. Store vessel with bilge hatches open to allow them to dry, if time allows. Use of forced ventilation will speed up dry time if needed. Replace oil absorbent pads (with new) when dry.
28. Clean all sampling equipment with non-alkaline/phosphate free soap and hand brush. Rinse with 140 degree low pressure spray for at least 10 seconds.
29. Fill out decontamination record and keep on board in case of inspection.

11.0 WASTE MANAGEMENT

All sediment, plant and animal material removed from vessel must be disposed of in trash receptacle, do not place back into water. Used oil absorbent pads that do not contain free liquid may be disposed of with solid waste. Oil pads that contain free liquid must be disposed of in accordance with federal, state and local laws.

12.0 DATA AND RECORDS MANAGEMENT

Decontamination/disinfection check lists shall be kept for 3 years at the home port office.

13.0 QUALITY CONTROL & QUALITY ASSURANCE

Use infrared thermometer to routinely check water temperature.

14.0 REFERENCES

Michigan Department of Natural Resources. December 9, 2014. *Invasive Species Decontamination for Field Operations in Michigan.*

Minnesota Department of Natural Resources. June, 2013. *Aquatic Invasive Species (AIS) Decontamination Handbook for Lake Service Providers.*

National Oceanic and Atmospheric Administration. *Preventing Invasive Species: Cleaning Watercraft and Equipment*

15.0 ATTACHMENTS

R/V Mudpuppy II Decontamination Record.

R/V MUDPUPPY II DECONTAMINATION RECORD

Last waterbody visited: _____ Date pulled out: _____

Prior to leaving launch ramp:

Visible AIS when pulled out? Yes/No

Visible sediment removed from boat? Yes/No

All vegetation removed from boat and trailer? Yes/No

Bilge water removed from boat? Yes/No

Water removed from deck pockets? Yes/No

Wash down pumps drained? Yes/No

Sea-cocks open for transport? Yes/No

Strainers cleaned and drained? Yes/No

Tray table nets removed and debris discarded in trash? Yes/No

At decontamination site:

Location of decontamination? _____

Date of decontamination? _____

Decontamination of vessel with non-alkaline/phosphate free soap performed? Yes/No

Anchor lines soaked in 140 degree water for at least 2 minutes? Yes/No

Anchor lockers cleaned out and flushed with 140 degree water? Yes/No

Anchor lines pressure washed prior to stowing in lockers? Yes/No

Decks and interior bulkheads rinsed with 140 degree water for at least 10 seconds? Yes/No

Deck power washed with 140 degree high pressure water? Yes/No

Hatch seals and surfaces cleaned and rinsed with 140 degree water? Yes/No

Intake strainers rinsed with 140 degree water for at least 10 seconds? Yes/No

Wash down pumps run with 120 degree water for at least 2 minutes? Yes/No

Air conditioner flushed with 120 degree water for at least 2 minutes? Yes/No

Generator run with 120 degree water for at least 2 minutes? Yes/No

Winch cable soaked in 120 degree water for at least 2 minutes? Yes/No

R/V MUDPUPPY II DECONTAMINATION RECORD

Oil absorbent pads removed from bilge and discarded? Yes/No

Bilges rinsed with 120 degree water for at least 2 minutes and pumped out? Yes/No

Outboard engines run on flushing ears with 120 degree water for at least 2 minutes? Yes/No

Exterior of vessel rinsed with 140 degree low pressure water for at least 10 seconds? Yes/No

Exterior of vessel sprayed with 140 degree high pressure water? Yes/No

Bottom of vessel sprayed with 140 degree high pressure water and undercarriage attachment? Yes/No

All surfaces of trailer rinsed with 140 degree low pressure water for at least 10 seconds? Yes/No

All surfaces of trailer sprayed with 140 degree high pressure water? Yes/ No

Vessel stored with hatches open for a minimum of 5 days? Yes/No Passive dry time: _____

Bilge areas force ventilated with fan? Yes/No Ventilated dry time: _____

Bilges dry at time of mobilization for next survey? Yes/No Date of mobilization: _____

New oil absorbent pads placed in bilge? Yes/No

Sampling equipment decontaminated with non-alkaline/phosphate free soap? Yes/No

Sampling equipment rinsed with 140 degree low pressure water for at least 10 seconds? Yes/No

Comments:_____
_____
_____
_____
_____
_____
_____

Signature: _____ Date: _____

SUMMARY OF CHANGES FOR

***R/V MUDPUPPY II* - QMP-SOP'S**

(WITH REQUIRED SIGNATURES*)

CLEANING MPII BETWEEN SEDIMENT SURVEYS				**SOP # 107**
Rev #	**Date**	**Preparer** **PRINT / SIGN**	**Approver (COR)** **PRINT / SIGN**	**Approver (RRS I Section Chief)** **PRINT / SIGN**
2	April 2018	Harry Rogers 	Mary Beth Giancarlo 	Scott Cieniawski 

* Pls attach a PDF signature next to your name and return to the Originator for publication. For this to work going forward, the document must be kept in PDF Format

TABLE OF CONTENTS

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures to collect and record field information on board the Research Vessel (R/V) *Mudpuppy II* and associated recording equipment to minimize equipment and user error.

2.0 APPLICABILITY/SCOPE

U.S. EPA's sediment sampling vessel, the R/V *Mudpuppy II*, is utilized by U.S. EPA and Great Lakes partners to sample sediments in rivers, harbors and inland lakes within the Great Lakes watershed. In an effort to prevent unnecessary error in the use of geographical positioning system (GPS) equipment and recording of sample information, Cetacean Marine has developed this SOP for recording field information onboard the R/V *Mudpuppy II*. This SOP should be followed by all project participants supporting the collection of samples on the R/V *Mudpuppy II*. Project participants should refer to the project-specific quality assurance project plan (QAPP) and field sampling plan (FSP) for detailed sampling procedures and requirements.

3.0 DEFINITIONS

DRS	Data Reporting Standard
FSP	Field Sampling Plan
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GPS	Global Positioning System
QAPP	Quality Assurance Project Plan

R/V	Research Vessel
SOP	Standard Operating Procedure

4.0 SUMMARY OF METHOD/PROCEEDURE

In order to reduce the possibility of error in collecting field information while sampling on the R/V *Mudpuppy II*, a system of redundancy and procedural guidelines has been established. Field data are hand written in the vessel's log and on field data sheets. In addition, a digital copy of position data is recorded on the vessel's computer. The digital position data file also includes field data that are input by the user at the time of sample collection. This method provides 3 source documents should a discrepancy arise.

5.0 PERSONNEL QUALIFICATION/RESPONSIBILITIES

The Vessel operation contractor should be trained on the use of the navigation system, including the GPS unit and associated hardware. EPA Chief Scientists should attend a standard R/V *Mudpuppy II* introduction training (i.e. attend an annual shakedown or shadow and experienced employee), which includes the use of the data dictionary function in Terra Sync.

6.0 EQUIPMENT AND SUPPLIES

The R/V *Mudpuppy II* uses a Trimble Pro XRS GPS, coupled to a laptop computer running Trimble Terra Sync (V5.41) software to collect position data and GPS Pathfinder Office (V5.6) to post process position data. The vessel also has a dedicated log book. Field data reporting forms are generated for the survey based on information needed.

7.0 REAGENTS AND STANDARDS

N/A

8.0 HEALTH AND SAFETY CONSIDERATIONS

N/A

9.0 INTERFERENCES

Poor satellite geometry due to angle of elevation or physical obstructions (buildings, trees, bridges) can have a significant adverse effect on the accuracy of the position recorded.

10.0 PROCEDURE

At the beginning of each Great Lakes Legacy Act (GLLA) sampling event, the *Mudpuppy II* crew will make the following observations using the vessel's GPS unit:

1. Measure and record latitude and longitude at 2 horizontal control points and record on GPS daily check sheet.

2. Measure and record elevation at 2 vertical control points and record on GPS daily check sheet.
3. Calculate displacement between known position/elevation of control points with observed position/elevation and record on GPS daily check sheet.
4. Establish 3 reference points. Record latitude, longitude, elevation and physical description for each reference point on GPS daily check sheet.

The following site information should be collected and recorded by the Captain in the ship's log each day of sampling:

a. Time departing dock (ship time, military)
b. Start time (ship time, military)
c. End time (ship time, military)
d. Date (mm/dd/yyyy)
e. Cruise from
f. Cruise to
g. Weather (e.g., clear, overcast, rain, snow, hazy, fog, partly cloudy, mostly cloudy) and sea conditions (e.g., windspeed, wave height, other observations)
h. GPS reference station readings (It is recommended that reference station GPS readings are taken each day. Sample locations may not allow for visiting all reference station locations on any given day).

The following site information should be collected and recorded at each sampling station:

1. Vessel's Log Book(filled out by Captain):
    a. Station ID
    b. Anchored/Tied off/Drifting
    c. Time arrived at station (shiptime, military)
    d. Coordinates using primary GPS (degrees, decimal minutes)
    e. Water depth (feet and inches.
    f. Probe depth (feet)
    g. Core tube length/Ponar (feet)
    h. Depth of core penetration (feet)
    i. Length of recovered core (inches)
    j. Comments (e.g., bottom type, reason for moving station, problems encountered, GPS issues)

2. Field Information Form (filled out by EPA, contractor or State personnel):

   Note: Refer to site specific QAPP and FSP for details about required information to be recorded for each sample and example field information form. Great Lakes Legacy Act surveys are to record minimum field data elements as specified in the Great Lakes Legacy Act (GLLA) Data Reporting Standard (DRS). Examples of information to be recorded on the field information form include:

   a. Station ID
   b. GPS coordinates
   c. Type of sample (routine, duplicate, equipment blank)
   d. Sample ID
   e. Date of sample
   f. Time of sample
   g. Sample technique (core, ponar, box core)
   h. Water depth
   i. Probe depth
   j. Depth of penetration
   k. Sample coordinates
   l. Core tube length
   m. Refusal?
   n. Length of recovered core
   o. Percent recovery
   p. Sheen/odor observations.
   q. Sediment color/consistency
   r. Field crew names (first and last name, affiliation)
   s. Other locational information observations.
   t. Sub-sample parameters/collection depths

3. Data dictionaries (filled out by Captain, EPA, contractor or State personnel):

   Each sample location (feature) collected using Terra Sync will have a number of optional data fields that can be added to the electronic record of sample position. Each type (grab, vibracore, probe etc.) of feature will have different data fields. Data fields may replicate data recorded in the Ship's log or field data sheets.

11.0 WASTE MANAGEMENT

N/A

12.0 DATA AND RECORDS MANAGEMENT

Ship logs will be retained indefinitely at R/V *Mudpuppy II* warehouse in Bay City, MI. The entire log book or a particular survey can be scanned and e-mailed upon request at any time. Project files (which include position and data dictionary fields) from Terra Sync and Pathfinder Office will be kept on the *Mudpuppy II* computer and backed up to an external hard drive. Project files may be downloaded and transferred via e-mail or USB flash drive to EPA upon request. EPA will store the project files as part of the electronic project record according to the appropriate EPA retention schedule.

The Support contractor will typically scan any loose data sheets and attach them to the final data summary report submitted to EPA. The electronic record will be stored and maintained according to their contract requirements.

13.0 QUALITY CONTROL & QUALITY ASSURANCE

The GLLA DRS's Locational Data Checklist and Metadata Recording Form must be used for GLLA projects. This form specifies the following data collection requirements:

1. Settings:
   a. Minimum of four satellites
   b. Positional dilution of precision (PDOP) ≤ 6
   c. Satellite elevation ≥ 15 degrees above the horizon
   d. A minimum signal-to-noise ratio based on the model recommendations
2. Record:
   a. Datum
   b. Any variations from standard settings (see note below)
   c. Any environmental anomalies (tall buildings, bridges) affecting accuracy
   d. GPS unit specifications
   e. Data correction method used
   f. Final post-processed accuracy of data

The Captain will attempt to sample an impacted station at a different time, but if the interference is unavoidable, the sampling crew will make note of the issue in the hard copy and electronic records

14.0 REFERENCES

U.S. EPA. March 2010. *Great Lakes Legacy Act Data Reporting Standard*, Version 1.0. Great Lakes National Program Office.

15.0 ATTACHMENTS

Great Lakes Legacy Act Data Reporting Standard Locational Data Checklist and Metadata Recording Form.

Great Lakes Legacy Act Data Reporting Standard GPS Daily Check.

U.S. EPA Great Lakes National Program Office
Locational Data Checklist and Metadata Recording Form

This document accompanies *GLNPO's Great Lakes Legacy Act Data Reporting Standard*, Version 1.0, March 2010, which provides detailed data reporting guidance for project data including required electronic data deliverables (EDD). In addition to the EDD and project field forms, project participants are required to complete this checklist at the end of each sampling event. Copies of completed forms should be submitted to the GLNPO Project Lead.

Contact Information

Contact Name: _____ Phone Number: _____

Affiliation: _____ E-mail Address: _____

Study Information

Project Title: _____

Site Name: _____

Sampling Start Date: _____ Sampling Stop Date: _____

Preparation Activities (please confirm each activity in the boxes to the right)

1. Sampling staff are trained in GPS Field Data Collection and have familiarized themselves with the GPS unit used for this project (certified training recommended). ☐

2. Determined window of satellite availability. http://www.trimble.com/planningsoftware_ts.asp ☐

3. Established at least two control points for both vertical and horizontal accuracy. ☐
   For assistance locating control points visit http://www.ngs.noaa.gov/cgi-bin/datasheet.prl or http://www.geocaching.com/mark/. This may not be feasible if the GPS unit is mounted to a vessel. *

4. Located 3 reference points. * ☐

Data Collection Activities (please confirm each activity in the boxes to the right)

1. GPS unit was configured to collect data only when the following requirements were met:
   a. A minimum of four satellites ☐
   b. Position dilution of precision (PDOP)<=6 ☐
   c. Satellite elevation >=15° above the horizon ☐
   d. A minimum signal-to-noise ratio (refer to GPS user manual for recommendation) ☐

2. Collected point data based on the nearest base station's logging interval. ☐

3. Collected point data for a period of at least 1 minute per location. ☐

4. Reported locational data in WGS 84 or NAD 83 (please specify_____). ☐

Please provide an explanation if a box was not checked for any of the responses above and specify deviations (include sample IDs if applicable):

_____

_____

_____

*Collect these points on at least the first day of sampling. Collecting on each sampling day is recommended. Record on page 2.

GPS Unit Specifications

GPS Brand and model number: _____

Model accuracy: _____

Data Processing

Which of the following best describes any data correction that may have been performed:

☐ real-time correction - specify type _____ ☐ post processed differential correction - provide base station id and location _____

☐ no correction ☐ other, please specify _____

Quality Information

Describe any difficulties in collecting locational data: _____

_____

List final post-processed accuracy of the data: _____

Data Collector:

Confirm required information has been provided.

_____ _____

Signature Date

GLNPO Project Lead:

Confirm required information has been provided.

_____ _____

Signature Date

U.S. EPA Great Lakes National Program Office
GPS Daily Check

Collect these data on at least the first day of sampling. Collecting on each sampling day is recommended.

Project Title: _____

Date: _____

Horizontal Control Point 1

Benchmark ID: _____ Time: _____

Established Latitude: _____ Measured Latitude: _____

Established Longitude: _____ Measured Longitude: _____

Displacement (include UOM): _____

Horizontal Control Point 2

Benchmark ID: _____ Time: _____

Established Latitude: _____ Measured Latitude: _____

Established Longitude: _____ Measured Longitude: _____

Displacement (include UOM): _____

Vertical Control Point 1

Benchmark ID: _____ Time: _____

Established Elevation: _____ Measured Elevation: _____

Displacement (include UOM): _____

Vertical Control Point 2

Benchmark ID: _____ Time: _____

Established Elevation: _____ Measured Elevation: _____

Displacement (include UOM): _____

Reference Point 1

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Reference Point 2

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

Reference Point 3

Time: _____

Physical/Locational description: _____

Measured Latitude: _____ Measured Longitude: _____

SUMMARY OF CHANGES FOR

***R/V MUDPUPPY II* - QMP-SOP'S**

(WITH REQUIRED SIGNATURES*)

RECORDING FIELD INFORMATION				**SOP # 108**
Rev #	**Date**	**Preparer** **PRINT / SIGN**	**Approver (COR)** **PRINT / SIGN**	**Approver (RRS I Section Chief)** **PRINT / SIGN**
1	April 2018	Harry Rogers 	Mary Beth Giancarlo 	Scott Cieniawski 

* Pls attach a PDF signature next to your name and return to the Originator for publication. For this to work going forward, the document must be kept in PDF Format

Sediment Core Collection Log

Job: SMC and Milwaukee AOC PFAS Sampling	**Station ID:**
Job No:	**Attempt No.**
Field Staff:	**Date:**
Contractor:	**Logged By:**
Vertical Datum:	**Horizontal Datum:**

Field Collection Coordinates:

Lat/Northing:	Long/Easting:

A. Water Depth	**B. Lake Level Measurements**	**C. Mudline Elevation**
DTM Depth Sounder:	Time:	
DTM Lead Line:	Height:	

Core Collection Recovery Details:

Core Accepted: Yes / No

Core Tube Length:

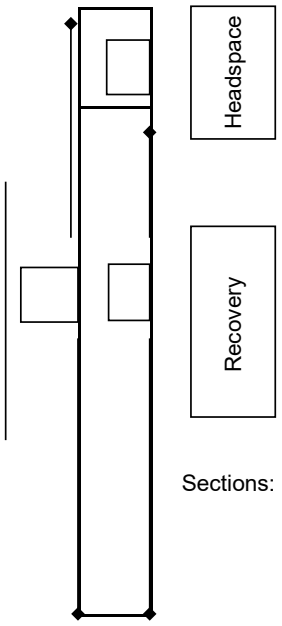
Drive Penetration:

Headspace Measurement:

Recovery Measurement:

Recovery Percentage:

Total Length of Core To Process:



Drive Notes:

Core Field Observations and Description:

Sediment type, moisture, color, minor modifier, MAJOR modifier, other constituents, odor, sheen, layering, anoxic layer, debris, plant matter, shells, biota

Notes:

COLEMAN ENGINEERING COMPANY
CIVIL ENGINEERING • ENVIRONMENTAL ENGINEERING • GEOTECHNICAL ENGINEERING • SURVEYING
635 CIRCLE DRIVE • IRON MOUNTAIN, MI 49801 • PHONE: 906-774-3440

STANDARD OPERATING PROCEDURE
SEDIMENT SAMPLING

This Standard Operating Procedure (SOP) is applicable to the collection of representative sediment samples. Analysis of sediment may be biological, chemical, or physical in nature and may be used to determine the following:

- toxicity;
- biological availability and effects of contaminants;
- benthic biota;
- extent and magnitude of contamination;
- contaminant migration pathways and source;
- fate of contaminants;
- grain size distribution;
- deposition environment;
- sediment type;

For the purpose of this procedure, sediment is the mineral and/or organic material situated beneath an aqueous layer. The aqueous layer may be either static, as in lakes, ponds, and impoundments or flowing, as in rivers and streams. The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water.

These are standard (i.e. typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

SPECIFIC SITE/PROJECT REQUIREMENTS

Specific site requirements may limit the re-use of samplers and rely solely on dedicated single use samplers. In this instance, the dedicated sampler will be new and contained in protective covering. The protective covering will be removed just prior to sampling.

Certain site specific precautions may be necessary to prevent cross contamination between sampling tools, personal protective equipment (PPE) and ambient environmental conditions. In this case, the target contaminant will be identified and the potential ambient conditions anticipated for the sampling activities will be evaluated and potential sources that could contribute to cross contamination of the samples eliminated or controlled.

This SOP considers the target contaminant Per- and PolyFluoroAlkyl Substances (PFAS). PFAS are present in many common items such as insect repellent, sunscreen, clothing treatments and food packaging/containers. This SOP has been prepared considering PFAS reduction measures as recommended by Michigan Department of Environmental Quality (MDEQ) PFAS Sampling Guidance document.

EQUIPMENT

The equipment and supplies required for field work depend on the project specifications. The following is a general list of equipment and supplies. A detailed list of equipment and supplies should be prepared based on the project planning documents. In general, the use of dedicated or disposal equipment is preferred but equipment may be re-used after thorough decontamination between sample locations.

- MC-5 Macrocore samplers
- 3-inch diameter piston sampler (polycarbonate) with non-PFAS end caps
- Stainless-steel spoons, trowels, or scoops
- Liners and/or catchers for core samplers
- Tube cutter(s), stainless steel knives(s)
- Ancillary equipment and supplies (e.g., meter stick or tape measure, disposable nitrile gloves)
- Lake water for decontamination
- Decontamination equipment and supplies (Non-phosphate detergent, plastic bristle brushes, etc.)
- Sample containers, preservatives, and shipping equipment and supplies
- Waste handling supplies

EQUIPMENT PREPARATION

Prior to mobilizing to the site prepare the equipment specific to the project requirements. Preparation will include:

- Routine maintenance of mechanical components
- Decontamination of all equipment to contact sampling operation
- Remove potential sources of cross contamination
- Preparing anticipated sampling equipment and support tooling
- Preparing and having sufficient sampling tubes/caps

PROCEDURE

Piston Sampler-

- Purge the sampling area of potentially PFAS containing material.

- Pre-clean the sampling equipment.
- Measure the depth of water to the mudline using a weighted tape or telescoping level rod with a “foot”. Record to nearest 0.1 feet.
- Probe the sediment to determine the depth of soft sediment. Record to nearest 0.1 feet.
- Before deploying the sampler, visually inspect the sediment retainer (vacuum piston) to verify the seal should be sufficient to prevent loss of core sediment.
- Slowly lower the corer to the bottom. The corer should enter the bottom vertically.
- Upon reaching the mudline, secure the piston cable to allow the piston to remain stationary as the sampling tube is advanced thereby creating a suction type action on the soft sediment.
- Advance the sampling tube to the desired depth either manually or using hydraulic slide feed.
- Retrieve the sampling tube to the surface manually or using the hydraulic slide feed.
- Bring the corer out of the water and place onto sampling platform.
- Observe and record the length of recovery of the sediment. If insufficient, make additional attempts to secure required minimum recovery. Adjust piston if needed.
- Sediment cores should be capped and stored upright if not processed immediately.
- After allowing the surface sediment to settle, decant the surface water from the top of the core tube.
- Evaluate compaction (core length versus depth of penetration [based on sediment traces on the outside of the core tube]).

Direct Push MC-5 Sampler-

- Purge the sampling area of potentially PFAS containing material.
- Pre-clean the sampling equipment.
- Measure the depth of water to the mudline using a weighted tape or telescoping level rod with a “foot”. Record to nearest 0.1 feet.
- Probe the sediment to determine the depth of soft sediment. Record to nearest 0.1 feet.
- Before deploying the sampler, visually inspect the sediment retainer to prevent loss of core sediment.
- If using discrete sampling method, confirm the discrete point is seated into the tip to prevent collecting sediment above the desired depth. Ensure the point and locking rod is secured into the sampler.
- Slowly lower the corer to the bottom. The corer should enter the bottom vertically.
- If using the discrete sampling method, remove the locking rod to allow the point to be pushed up as sediment is sampled.
- Advance the sampler using the hydraulic hammer and feed slide to the desired depth.
- Retrieve the sampling tube to the surface manually or using the hydraulic slide feed.
- Bring the corer out of the water and place onto sampling platform.
- Remove the inner sampling tube from the corer.
- Observe and record the length of recovery of the sediment. If insufficient, make additional attempts to secure required minimum recovery.

- Sediment cores should be capped and stored upright if not processed immediately.
- After allowing the surface sediment to settle, decant the surface water from the top of the core tube.
- Evaluate compaction (core length versus depth of penetration [based on sediment traces on the outside of the core tube]).

Standard Operating Procedure
SOP 04 – Sediment Core Processing

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) is applicable to the processing of sediment samples to characterize sediments as part of the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. Sediment collection is described in SOP 03 – Sediment Sampling.

Procedures for sediment core processing outlined in this SOP are expected to be followed. Deviations from the procedures detailed in this SOP will be described on the Daily Log and in a Field Deviation Form (see SOP 01 – Field Records).

3 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors.

4 Contamination and Interferences

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits. PFAS are used in a wide variety of products; therefore, to prevent cross-contamination, field personnel should be familiar with and follow the Michigan Department of Environmental Quality (MDEQ) General PFAS Sampling Guidance (MDEQ 2018). In addition to following proper decontamination procedures (SOP 08 – Equipment Cleaning/Decontamination), the following measures should be utilized by sampling personnel before and during sample collection:

- Sampling equipment must be free of Teflon and Teflon-containing substances
- Wash hands prior to sampling
- Avoid sunscreen or insect repellants or only use allowable brands
- No fast food containers
- No Styrofoam cups
- Samples and any sampling equipment should not contact carpeted surfaces
- No new clothing should be worn, and clothing should have been washed at least six times prior to use without fabric softeners or fabric protectors
- Tyvek, Gore-Tex, and other water-repellent clothing should not be worn
- No PFAS-treated adhesive tape or paper products
- No PFAS-treated paper towel
- No pipe thread seal tape

- Avoid contact with water-repellent substances on boats or in vehicles
- Post-it notes (or similar) should not be used in relation to the sampling

5 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan (FSP), and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]). All field personnel are required to take a 40-hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response training course and annual refresher courses, as well as participate in a medical monitoring program, prior to engaging in core processing activities. Additionally, field personnel will be under the direct supervision of qualified professionals who are experienced in performing the tasks required for sample processing.

6 Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Approved documents including SSP, FSP, and QAPP
- Appropriate personal protective equipment and clothing as defined in the SSP
- Decontamination equipment described in SOP 08 – Equipment Cleaning/Decontamination
- Powderless nitrile gloves (specific to PFAS sample processing)
- Stainless-steel or disposable aluminum pans (aluminum is prohibited for PFAS sample processing)
- Low-density polyethylene (LDPE) or high-density polyethylene (HDPE) bins
- Stainless-steel or disposable plastic utensils (only stainless-steel utensils may be used for PFAS sample processing)
- Physical Description of Sediment and Soil Key (see example provided in Attachment 1) and Sediment and Soil Core Processing Log forms (see example provided in Attachment 2)
- Tape measure
- Ballpoint pens or fine or ultra-fine point Sharpie markers
- Camera
- White board and pens
- Paper towels
- Duct tape
- Scale
- Aluminum foil (aluminum is prohibited for PFAS sample processing)
- Core-cutting equipment

- Coolers with ice
- Sample containers and labels
- LDPE clear-plastic, resealable zippered bags (Ziploc or equivalent)
- Computer with field application
- Thin HDPE sheeting
- Foldable tables
- U.S. Department of Transportation (USDOT)-approved, 55-gallon, open-topped drums with lid for collection of solids
- USDOT-approved, 55-gallon, closed-top drums for collection of liquids

7 Core Processing Procedures

1. Sediment cores, once collected, will be stored upright to preserve core sediment integrity and stored out of direct sunlight until processing. Sediment cores will be stored on ice consistent with SOP 07 – Sample Handling, Packaging, and Shipping.
2. Sediment core processing will be conducted at the designated processing area after being transported from the collection boat or field sampling crew location. PFAS sample processing will not be performed concurrently with other sediment processing events to minimize cross-contamination potential. Prior to performing PFAS processing, the processing area, personal items, materials, and equipment will be screened for potential sources of PFAS cross-contamination (see MDEQ General PFAS Sampling Guidance). Prohibited items shall be removed from the processing area.
3. Core processing consists of removing the sediment from the core or cutting the core open to access the materials.
4. All working surfaces and instruments will be thoroughly cleaned, decontaminated, and covered with plastic or aluminum foil to minimize outside contamination between sampling events. Aluminum foil will **not** be used for processing of PFAS samples.
5. Disposable gloves will be discarded after processing at each station and replaced prior to handling decontaminated instruments or work surfaces.
6. The length and weight of the core will be measured to calculate wet bulk density as indicated in the FSP. Measurements will be recorded in the field logbook or field database. Prior to sample collection, the unit weight of the empty core tubes and core caps will be determined. The wet bulk density will be calculated by dividing the mass of sediment by the volume of sediment. Bulk density will be recorded in pounds per cubic foot.
7. Prior to processing, the core caps will be removed, and each section of the core will be cut longitudinally using a circular saw or a cutting tool; care will be taken not to penetrate the sediment while cutting.

8. Two longitudinal cuts will be made along the sides of the core so that the core can be opened to expose the sediment.
9. The core will be split with decontaminated stainless-steel or new disposable plastic utensils to expose the center of the two halves for sampling. Only stainless-steel utensils will be used for PFAS sample processing.
10. Prior to sampling, color photographs will be taken of the total core length.
11. A description of the core sample will be recorded on the Sediment and Soil Core Processing Log form (see example provided in Attachment 2) and field database for the following parameters, as appropriate:
    a. Date and time of sample collection
    b. Sample recovery (depth in feet of penetration compared to recovery)
    c. Physical soil description along the entire length of the core (including lengths of each material type) in accordance with ASTM International (ASTM) procedures (ASTM D2488 – Standard Practice for Description and Identification of Soils [Visual-Manual Procedure] and ASTM D2487 – Standard Classification of Soils for Engineering Purposes [Unified Soil Classification System]) will be recorded including soil type, moisture content, density/consistency of soil, color, and visual evidence of impacts (e.g., hydrocarbon-like sheens)
    d. Odors (e.g., hydrogen sulfide or petroleum)
    e. Visual stratification, structure, and texture, including measurement with tape measure as to where within the core they occur
    f. Vegetation and debris, including measurement with tape measure as to where within the core they occur
    g. Photoionization detector readings, including measurement with tape measure as to where within the core they occur
    h. Biological activity (e.g., detritus, shells, tubes, bioturbation, and live or dead organisms), including measurement with tape measure as to where within the core they occur
    i. Presence of sheen, including measurement with tape measure as to where within the core they occur
    j. Any other distinguishing characteristics or features
12. As indicated in the FSP, strength parameters will be assessed using pocket penetrometer and a torvane where fine-grained sediments (e.g., silts and clays) are observed within the core. Observed values of the compressive strength (pocket penetrometer) and shear strength (torvane) will be recorded. A minimum of one set of strength tests will be performed on a representative portion of sediment from a given depth interval.
13. Sample material from a specific sample interval will be removed from the core using either decontaminated spoons or spatulas or new disposable plastic utensils (only stainless-steel

utensils will be used for PFAS sample processing), while taking care not to remove material that has come into contact with the sides of the core tube. Sample material from the specific sample interval will be placed into either a decontaminated stainless-steel or new disposable aluminum tray or bowl for homogenization. Aluminum trays or bowls will **not** be used for PFAS sample processing. The material will be homogenized until a uniform color and consistency is achieved.

14. Following homogenization, the sample will be placed in appropriate laboratory-supplied jars. The sediment samples for PFAS testing will be placed in a laboratory-provided container free of PFAS.
15. Core intervals to be removed for analyses are described in the FSP and will be determined based on recovered measurements.
16. Immediately after filling the sample container with sediment, place the screw cap on the sample container and tighten.
17. Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
18. Samples containers shall be kept on wet ice until they are packaged in accordance with SOP 07 – Sample Handling, Packaging, and Shipping.

8 Sediment Grab Sample Processing Procedures

Sediment grab processing is typically conducted aboard the sampling vessel. It is important to place the grab on a stable surface and avoid disturbing the grab prior to surface water removal. All working surfaces and instruments will be thoroughly cleaned, decontaminated to minimize outside contamination between sampling events. Disposable powderless nitrile gloves will be discarded after processing each station and replaced prior to handling decontaminated instruments or work surfaces.

The steps for processing the samples are as follows:

1. Following grab retrieval, place the grab on a stable surface. Remove any overlying water using a PFAS-free syphon hose or turkey baster.
2. After noting their presence, remove any large objects or debris from the sediment surface.
3. Prior to sampling, color photographs will be taken and a sediment description of each grab will be recorded on processing log form (Attachment 2). Record the description of the grab sample on the log form for the following parameters as appropriate and present:
    a. Sample recovery (depth in inches or centimeters of recovery in the grab sampler). This can be done using a ruler and measuring the depth of sediment in the grab at the center of the grab.
    b. Physical soil description of the grab in accordance with the Unified Soil Classification System (includes soil type, density/consistency of soil, moisture, and color)
    c. Odor (e.g., hydrogen sulfide, petroleum)

d. Note any vegetation or debris
e. Biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
f. Presence and depth of the redox potential discontinuity layer
g. Presence of oil sheen
h. Any other distinguishing characteristics or features

4. Using a clean spoon, place sample material from the desired grab depth (typically 0 to 10 centimeters) into a decontaminated stainless-steel bowl or HDPE bucket. To avoid cross-contamination, take care to remove only sediment that has not come into contact with the sides or bottom of the grab. When sufficient material has been removed, the sample will be homogenized until a uniform color and consistency is achieved.
5. Following homogenization, the sample will be placed in a pre-labeled, appropriate, laboratory-supplied container free of PFAS. Laboratory-provided containers will only be opened immediately prior to filling with sediment to minimize cross-contamination potential.
6. Immediately after filling the sample container with sediment, place the screw cap on the sample container and tighten.
7. Thoroughly check all sample containers for proper identification, analysis type, and lid tightness.
8. Samples containers shall be kept on wet ice until they are packaged in accordance with SOP 07 – Sample Handling, Packaging, and Shipping.

9 Quality Assurance/Quality Control

Entries in the field forms or field database will be double-checked by the field team staff to verify that the information is correct. It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP.

Field precision will be assessed through the collection and analysis of field duplicates and matrix spike/matrix spike duplicate (MS/MSD) sample aliquots. Field duplicates and MS/MSDs will be collected at a rate of 5%, or one per 20 samples collected. Each field duplicate sample will be collected for the suite of chemical analyses designated for the original sample.

10 List of Attachments

Attachment 1 – Physical Description of Sediment and Soil Key
Attachment 2 – Sediment and Soil Core Processing Log

11 References

MDEQ (Michigan Department of Environmental Quality), 2018. *General PFAS Sampling Guidance*. Revised October 16, 2018.

Attachments

ANCHOR QEA

Physical Description of Sediment/Soil Key

Visual sediment/soil descriptions consist of the following:

Moisture content, density/consistency, color, minor constituent, MAJOR CONSTITUENT/GROUP NAME; structure descriptions (as needed); amount and shape of minor constituents (e.g., organics and anthropogenics); biota; odor; sheen

Recovered and in situ depths

Recovered = measured in the lab, actual sediment depth from core tube

Sediment/Soil Description Terminology		
1. Moisture Content		
Dry	Little perceptible moisture (upland only)	
Damp	Some perceptible moisture, probably below optimum (clays, core intervals at depth)	
Moist	Probably near-optimum moisture content, no visible water (most sediment)	
Wet	Visible free water, probably above optimum	
2. Density (Core Drive Penetration and Finger Pressure)		
SAND or GRAVEL		
Density	**Visual**	**Notes**
Very loose	Freefall	May occur at the top of a core or grab
Loose	Easy penetration	
Medium dense	Moderate penetration	Typically down core due to compaction or compression
Dense	Hard penetration	Bottom of a core, typical to glacial deposits
Very dense	Refusal	
SILT or CLAY		
Consistency	**Visual**	**Notes**
Very soft	Freefall	Soupy, not cohesive
Soft	Easy penetration	Easily penetrated, just starting to be cohesive
Medium stiff	Moderate penetration	Cohesive, molded by finger pressure
Stiff	Hard penetration	Can indent and mold by stiff finger pressure
Very stiff/hard	Refusal	Modeling clay (rolls to a ball)
3. Color and Shading		
Example Colors		**Shades**
Black		Light
Browns (olive, yellow, red)		Dark
Grays (gray, olive, brown)		Very dark
Mottling: Streaks or spots of a minor color within the larger color unit		
4. Minor and MAJOR Group Name		
Gravel		Silt
Sand		Clay
* MAJOR is written in all CAPITAL LETTERS		
* Description of minor constituent precedes MAJOR constituent, except for trace		
Minor Constituents		**Percent**
Trace (clay, silt, sand, gravel)*		0 to 5
Slightly (clayey, silty, sandy, gravelly)		5-15
Clayey, silty, sandy, gravelly		15 to 30
Very (clayey, silty, sandy, gravelly)		30 to 50
GROUP NAME		Greater than 50
* For trace minor constituents, place after MAJOR constituent		

Sediment Description Terminology	
Descriptors	
Sand and Gravel	Rounding
	Sorting
	Grain color

5. Other Minor Constituents: % by volume (e.g., organics and anthropogenics)*	
Other Minor Constituents*	**Percent**
Trace	0 to 5
Occasional	5 to 10
Moderate	10 to 30
Substantial	30 to 50
*Separate major from other minor constituents with a period	

6. Biota
Beggiatoa - white/colorless, filamentous proteobacteria
Marsh grass, shells, worms, etc.

7. Odor Descriptions	
Amount	**Odor Types**
Trace	Petroleum-like
Slight	H_2S-like (Hydrogen sulfide-like)
Moderate	Septic-like
Strong	Solvent-like
	Metallic-like

8. Sheen (No odor or sheen observed unless noted)	
Amount	**Percent**
None, trace	Less than 2
Slight	2 to 15
Moderate	15 to 40
Moderate to heavy	40 to 70
Heavy	Greater than 70

Visual Description Terminology	
Rainbow	Multicolored
Metallic	Metallic gray-colored
Florets, streaks	Semi-circular and flat (two dimensional [2-D]) (florets = individual; streaks = lines)
Blebs	Semi-circular and spherical (3-D)

9. Product	
Oil stained	Visible brown or black stains on soil (fine-grained soil)
Oil coated	Visible brown or black coating on soil (coarse-grained soil)
Oil wetted	Visible brown or black oil wetting on soil. Oil appears as a liquid and is not held by soil grains (pools)

Nonaqueous phase liquid (NAPL): NAPL is generally classified as light NAPL (LNAPL) if the density is less than that of water (i.e., will float on water) and dense NAPL (DNAPL) if the density is greater than that of water (i.e., will sink in water).

Sediment Description Terminology	
10. Structure and Other Sediment Descriptions	
Hummocky	Cohesive soil that can be broken down into smaller lumps
Gummy	Cohesive, pliable soil with high percentage of clay
Bed	Greater than or equal to 0.5 inch thick
Thin bed	Less than 0.5 inch thick
Pockets	Semi-circular to circular inclusion/deposit
Laminated beds	Thin beds (less than 0.5 inch thick) lying between or alternating within a greater unit
Stratified beds	Beds (greater than 0.5 inch thick) lying between or alternating within a greater unit
Organic matter	Mass of leaves, twigs, wood, etc.
Anthropogenic material	Material originated from industrial activity such as coal fragments, slag, etc.
Aggregates	Industrial waste products
Anthropogenic debris	Debris originated from human activity such as trash, plastic, etc.
Decomposed	Visible sign of decomposition or discoloration
Fresh	No visible sign of decomposition or discoloration
Winnowed	Loss of material that occurred during coring, creating a washed-out void space
Contacts: For Core Processing Only	
@	Compositional change or presence of minor constituent
----------	Major unit change/non-discrete, gradational contact (dashed line)
————	Major unit change/visually discrete, abrupt contact (solid line)
----------	Native major unit change/non-discrete, gradational contact (dash-dot line)
----------	Native major unit change/visually discrete, abrupt contact (dash-dot-dot line)
---------	Minor unit change (competency, color), not used in final core logs, used in field processing logs (half dashed line)

Notes:

*Classification of sediment on core logs is based on visual field observations, which include density/consistency, grain size, and plasticity estimates, and should not be construed to imply field nor laboratory testing unless presented herein.
Visual-manual classification method American Society for Testing and Materials (ASTM) D-2488 for the description and identification of soils was used as an identification guide.
"Grades to" indicates that all characteristics not called out stay the same as the unit above.
@ symbol indicates one single piece of the material (when not acompanied with a "grades to" or contact)
Chemistry: Cores analyzed for chemistry or select chemistry lists
Geotechnical: Cores analyzed for geotechnical analysis list
Geochronology: Cores analyzed for geochronology list
Station IDs: Multiple cores were taken at each subsurface sediment station to collect adequate volume for analysis. Co-located cores were labeled with sequential letters (A-E) within the station identification (ID) to differentiate each accepted attempt. Cores from each station were chosen for an analysis type (e.g., chemistry, geochronology, and archive) based on collection factors such as penetration, recovery, and observation of native material.
Acronyms/terms used in core logs:
NAD83 = North American Datum of 1983, Wisconsin State Plane, South Zone
NAVD88 = North American Vertical Datum of 1988
PID = Photo-ionization detector, measures volatile organic compounds (VOCs)
SC = sediment collection

Sediment/Soil Core Processing Log

SMC and Milwaukee AOC

Job: PFAS Sampling	Station ID:
Job No.	Date/Time:
No. of Sections:	Core Logged By:
Drive Length:	Attempt #:
Recovery:	Type of Core | Direct Push | Vibracore | Diver Core
% Recovery:	Diameter of Core (inches)
Notes:	Core Quality | Good Fair | Poor | Disturbed

Recovered Length (cm)	Size % Gravel	Size % Sand	Size % Fines	**Classification and Remarks** (Density, Moisture, Color, Minor Constituent, MAJOR Constituent, with Additional Constituents, Sheen, Odor)	Recovered Length (cm)	PID	Sample	Summary Sketch

Standard Operating Procedure
SOP 05 – Water Sampling

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) is applicable to the collection of surface water samples for the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. These activities will include conducting water quality field measurements using a multi-parameter probe and collecting surface water samples for subsequent laboratory analysis for selected chemical parameters.

Deviations from the procedures detailed in this SOP will be described on the Daily Log and in a Field Deviation Form (see SOP 01 – Field Records).

3 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors. Utility clearance will be performed prior to any intrusive work.

4 Contamination and Interferences

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits. PFAS are used in a wide variety of products; therefore, to prevent cross-contamination, field personnel should be familiar with and follow the Michigan Department of Environmental Quality (MDEQ) General PFAS Sampling Guidance (MDEQ 2018). In addition to following proper decontamination procedures (SOP 08 – Equipment Cleaning/Decontamination), the following measures should be utilized by sampling personnel before and during sample collection:

- Sampling equipment must be free of Teflon and Teflon-containing substances
- Wash hands prior to sampling
- Avoid sunscreen or insect repellants or only use allowable brands
- No fast food containers
- No Styrofoam cups
- Samples and any sampling equipment should not contact carpeted surfaces
- No new clothing should be worn, and clothing should have been washed at least six times prior to use without fabric softeners or fabric protectors
- Tyvek, Gore-Tex, and other water-repellent clothing should not be worn
- No PFAS-treated adhesive tape or paper products
- No PFAS-treated paper towel
- No pipe thread seal tape

- Avoid contact with water-repellent substances on boats or in vehicles
- Post-it notes (or similar) should not be used in relation to the sampling

5 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]). All field personnel are required to take a 40-hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response training course and annual refresher courses, as well as participate in a medical monitoring program, prior to engaging in water sample collection activities. Additionally, field personnel will be under the direct supervision of qualified professionals who are experienced in performing the tasks required for sample collection.

6 Equipment and Supplies

The following equipment list contains materials that may be needed to carry out the procedures documented in this SOP. Because multiple procedures may be included in this SOP, not all of which are necessarily conducted when using this SOP, not all materials on the equipment list may be required for a specific activity.

- Approved documents, including the Field Sampling Plan, SSP, QAPP, and SOPs
- Personal protective equipment, as required by the SSP
- Sampling vessel equipped with necessary GPS navigation and communication equipment
- Decontamination equipment described in SOP 08 – Equipment Cleaning/Decontamination
- PFAS-free Kemmerer sampler
- Electronic depth finder
- Laboratory-provided sample containers
- Disposable powderless nitrile gloves
- Laptop computer
- Field database
- Multi-parameter water quality instrument capable of in situ monitoring of depth, pH, dissolved oxygen, temperature, and turbidity (YSI 6920 or equivalent)
- Cooler with wet ice
- Resealable food storage bags
- Trash bags

7 Surface Water Collection Procedures

Water samples will be collected for this investigation for phosphorous analysis and for PFAS testing. It is expected that water samples will be collected from Coleman Engineering Company's sampling vessel and the University of Wisconsin Milwaukee R/V Neeskay. The vessel request use form for the R/V Neeskay is included in Attachment 1. All probes for the multi-parameter water quality instrument will be calibrated prior to use per manufacturer recommendations. The procedures described in the instrument owner's manual will be adhered to when performing calibrations for temperature, pH, specific conductance, dissolved oxygen, and turbidity.

Surface water sampling will be performed using the following procedures:

1. Screen field equipment, sample vessel, and personal items for potential sources of PFAS cross-contamination prior to sampling (see MDEQ [2018] General PFAS Sampling Guidance). Remove or replace equipment that could result in PFAS cross-contamination.
2. The sampling vessel will navigate to the proposed sample location (see SOP 02 – Navigation and Boat Positioning).
3. If conditions allow, the vessel operator will maintain the vessel within 10 feet of the proposed location using engine power to stay on location. If needed, the vessel may anchor or spud to stay on location. Care should be taken to minimize disturbance of bottom sediments.
4. Measure and record the water depth using an electronic depth finder.
5. Obtain water quality data by lowering a YSI 6920 series (or equivalent) sonde to two-thirds of the water column depth of the sample location. Maintain the sonde at depth for a minimum of 3 minutes in order for all of the sensors to reach equilibrium and obtain accurate results. Record data in the field database and field notebook.
6. If anchoring or spuds are used to hold the vessel on location, monitor turbidity using the water quality meter. Water sampling may proceed only after turbidity levels have returned to ambient conditions. Ambient turbidity conditions should be determined prior to disturbance of bottom sediments.
7. Grab samples will be taken with the Kemmerer sampler at two-thirds the water depth of each sample location.
    a. The Kemmerer sampler will be decontaminated prior to use and between sampling locations in accordance with procedures outline in SOP 08 – Equipment Cleaning/Decontamination.
    b. The Kemmerer sampler will be lowered to the desired sampling depth, deploying the messenger to trigger sample collection, and then filling the containers.
    c. Retrieve the sampler and dispense collected water into laboratory-supplied containers. Remove sample container lids immediately prior to filling and replace lids immediately after the sample container is filled.

d. When practical, the project identification, sample matrix, laboratory designation/analyses requested, field sample identification code, and preservation will be typed or printed onto labels before sampling in accordance with SOP 06 – Sample Custody.

8. Sample containers shall be kept on wet ice until they are packaged in accordance with SOP 07 – Sample Handling, Packaging, and Shipping.

8 Quality Assurance/Quality Control

Entries in the field forms will be double-checked by the field team staff to verify that the information is correct. It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP.

Equipment rinsate blanks will be collected by filling the Kemmerer sampler with PFAS-free water and filling the appropriate laboratory containers.

9 References

MDEQ (Michigan Department of Environmental Quality), 2018. *General PFAS Sampling Guidance*. Revised October 16, 2018.

10 List of Attachments

Attachment 1 – R/V Neeskay Vessel Use Form

Attachment

UWM- School of Freshwater Sciences-Great Lakes WATER Institute

REQUEST FOR VESSEL USE: Enter request for only one cruise. Use separate forms for each cruise.

This form can be downloaded and completed electronically (Acrobat Reader).
Submit via email.

PRINT

Very short description (Title) of the requested cruise:

Surface Water and Sediment PFAS Sampling

Funding Source (Needed to reserve the Neeskay). Be specific:

EPA Grant GL-00E02392

General area of operation (geographic description, latitude and longitude, or distance from Milwaukee):

Milwaukee Outer Harbor and Lake Michigan, as shown on a provided map, not far from Port Milwaukee.

Brief description of the cruise (how many stations visited, type of sampling conducted, equipment needed, etc.):

Three stations visited, two in the outer harbor, one in Lake Michigan to conduct surface water and sediment sampling for per- and polyfluoroalkyl substances. Anchor QEA, a contractor to DNR, will be the personnel conducting the sampling.

- Please discuss the use of an ROV or SCUBA divers directly with the vessel crew and/or SFS staff. There are additional fees for these services.
- Day cruises of more than 7 hours should start no later than 8 am. Discuss later departure times with the vessel crew. Billing begins at the scheduled start time.
- The length of a cruise includes unloading activities that require the vessel crew's assistance

Number of people in scientific crew: 3

Buoy deployment requires permit BEFORE cruise

Cruise Dates or Time Frame		Start Time	Length of Days (Hr):	Port of Operation		If the cruise is canceled due to weather or other conditions, does the cruise need to be rescheduled? Suggested rescheduled date(s)		
Preferred:	Alternate:			Milw	Other Port:			
11/11/2019	11/12/2019	8:00	7	✔		YES	✔	A crew will be conducting sampling the week of the 4th. and target the best weather day during the first week in November to perform the sampling.
						NO		

List any significant cruise needs (extra time to load, major equipment to load/prepare, hazardous chemicals, special electrical power needs, etc.)

Sediment sampling equipment needed, box corer or ponar. Surface water sampling equipment will provided by Anchor. Sampling equipment will need to be decontaminated with PFAS free water prior to using.

Investigator requesting Neeskay:			Contact Information	
Name:	Scott Inman		Telephone (Voice):	608-273-5613
Title:	Contaminated Sediment Engineer		Cell Phone:	608-576-4912
Affiliation/Institution:	Wisconsin Department of Natural Resources		Fax Number:	
Address:	3911 Fish Hatchery Road		Email address:	Scott.Inman@wisconsin.gov
			Zip/Postal Code:	53719
City:	Fitchburg	State/Prov: WI		

Submit your completed form to: Robert Paddock, UWM-School of Freshwater Sciences, 600 E. Greenfield Ave., Milwaukee, WI 53204-2944 Voice 414-382-1745; e-mail: rpaddock@uwm.edu

Confirmation of requested dates will be made via email.

Additional information will be needed well in advance of the cruise. Please submit a cruise plan and confirm your intent to conduct the cruise within the following time frames:	
6 weeks in advance	Nonstandard sampling techniques or work outside of Lake Michigan
4 weeks in advance	Additional crew deployment or from a port other than Milwaukee
1 week in advance	Operating out of Milwaukee for more than 1 day or more than 8 hours
3 days in advance	Operating out of Milwaukee: 8 hours or less

Information about the Neeskay and her operating schedule are posted at
http://uwm.edu/freshwater/facilities/fleet/

Standard Operating Procedure
SOP 06 – Sample Custody

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) addresses the sampling program requirements for maintaining custody of samples throughout the sample collection and shipping process as part of the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. The objective of chain-of-custody (COC) procedures is to provide sufficient evidence of sample integrity to satisfy data defensibility requirements.

Procedures for sample custody outlined in this SOP are expected to be followed. Deviations from the procedures detailed in the SOP will be described on the Daily Log and on a Field Deviation Form (see SOP 01 – Field Records).

3 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors.

4 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]). Specialized training is not required for COC procedures; however, field staff will be supervised by experienced staff when first performing COC procedures.

5 Equipment and Materials

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Approved documents including the SSP, Field Sampling Plan, and QAPP
- Bound field logbooks
- Ballpoint black ink pens
- Custody tape or seals
- Sample labels
- COC forms (see example in Attachment 1)
- Re-sealable, zippered clear-plastic bags for COCs
- Clear-plastic sealing tape

6 Chain-of-Custody Procedures

As few people as possible should handle the samples. Each sample generated in the field will be assigned a unique identification (refer to SOP 1 – Field Records for the sample identification protocol). A label will be attached to each sampling container used for shipment to the laboratory. Labels will be applied to the container, not the lid, whenever possible. The lid will also be labeled with the sample identification written in indelible black ink as a backup for the container label.

When practical, the project identification, sample matrix, laboratory designation/analyses requested, field sample identification code, and preservation will be typed or printed onto the label before sampling. Completion of the sample labels (including the field team staff's initials and the date and time of sample collection) will occur prior to filling the sample bottles. Labels will be completed in indelible black ink. Individual sample bottles will be properly labeled and securely sealed before being placed in the container for shipment to the laboratory (see SOP 07 – Sample Handling, Packaging, and Shipping).

Samples are considered to be in one's possession if the samples are: 1) in the custodian's possession or view; 2) in a secured location (under lock) with restricted access; or 3) in a container that is secured with an official seal(s) such that the sample cannot be reached without breaking the seal(s). Field COC procedures shall be followed from the time a sample is collected until it is relinquished to the analytical laboratory (either in person or to a shipper). The principal document used to track possession and transfer of samples is the COC form. A COC form shall be filled out in duplicate and initiated when the first sample is collected and updated continuously through the sampling event. A new COC form shall be prepared for each day of field sampling. Information to be entered on the COC form includes the following:

- Project identification (project and task number)
- Sample identification
- Time and date of sampling
- Sample matrix (e.g., sediment, water, and air)
- Number of containers for each sample
- Analyses requested
- Preservative, if applicable
- Grab or composite sample designation, if applicable
- Signatures of field team staff/sample custodian
- Field team staff's remarks
- Destination (e.g., laboratory name and location)
- Page number (e.g., 1 of 2, 2 of 2)
- Air bill or other shipping number, if applicable
- Any special instructions

All data entries will be made using an indelible ink pen. Corrections will be made by drawing a single line through the error, writing in the correct information, and then dating and initialing the change. Blank lines and spaces on the COC form will be lined-out, dated, and initialed by the individual maintaining custody. A COC form will accompany each cooler of samples to the analytical laboratories. Each person who has custody of the samples will sign the COC form and ensure that the samples are not left unattended unless properly secured. One copy of the COC form should be placed in a bag and attached to the inside of each sample cooler. In the event that sediment subsamples are being sent to different laboratories, separate COC forms should be prepared for each laboratory and each sample cooler. A custody seal should be placed on the sample cooler when it is not in the custody of a member of the sampling team.

When samples are relinquished, either to the laboratory or for shipment, the COC form must be completed by the sample deliverer (except in the case of a commercial carrier such as FedEx). It should include the printed and signed name of the deliverer, the organization that person represents, date and time of sample relinquishment, and method of shipment, if appropriate. A completed copy of the laboratory-verified COC form will be distributed via email or fax to the Project Chemist within 24 hours of sample receipt at the laboratory. The original will be retained by the laboratory.

7 Quality Assurance/Quality Control

Completed COC forms will be reviewed by the individuals preparing the samples for shipment for completeness, accuracy, and legibility. Specifically, the sample labels and COC record will be compared to ensure agreement between the samples and the COC and to verify the number of sample containers.

It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP.

8 List of Attachments

Attachment 1 – Chain-of-Custody Form

Attachment

ANCHOR QEA

ENVIRONMENTAL SAMPLE CHAIN OF CUSTODY

COC ID:

Sample Custodian:

Client: **Project:** **Lab:**

COC Sample Number	Field Sample ID	Matrix	Collected		# Containers	Analytical Program	Lab QC*
			Date	Time			☐

Comment:

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature	Signature	Signature	Signature	Signature
Print Name	Print Name	Print Name	Print Name	Print Name	Print Name
Company	Company	Company	Company	Company	Company
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

Date Printed: 10/21/2019

* Lab QC Requested for sample when box checked

Standard Operating Procedure
SOP 07 – Sample Handling, Packaging, and Shipping

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) describes procedures for packaging and shipping samples collected as part of the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. Sample packaging and shipping generally involves the placement of individual sample containers into a cooler with packing material and coolant in a manner that isolates the samples to prevent breakage, maintains required temperature, and limits the potential for damage to sample containers when the cooler is transported.

Procedures for sample packaging and shipping outlined in this SOP are expected to be followed. Deviations from the procedures detailed in the SOP will be described on the Daily Log and recorded on a Field Deviation Form (see SOP 01 – Field Records).

3 Contamination and Interferences

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits. PFAS are used in a wide variety of products; therefore, to prevent cross-contamination, field personnel should be familiar with and follow the Michigan Department of Environmental Quality (MDEQ) General PFAS Sampling Guidance (MDEQ 2018). In addition to following proper decontamination procedures (see SOP 08 – Equipment Cleaning/Decontamination), the following measures should be utilized by sampling personnel before and during sample collection:

- Sampling equipment must be free of Teflon and Teflon-containing substances
- Wash hands prior to sampling
- Avoid sunscreen or insect repellants or only use allowable brands
- No fast food containers
- No Styrofoam cups
- Samples and any sampling equipment should not contact carpeted surfaces
- No new clothing should be worn, and clothing should have been washed at least six times prior to use without fabric softeners or fabric protectors
- Tyvek, Gore-Tex, and other water-repellent clothing should not be worn
- No PFAS-treated adhesive tape or paper products
- No PFAS-treated paper towel
- No pipe thread seal tape
- Avoid contact with water-repellent substances on boats or in vehicles
- Post-it notes (or similar) should not be used in relation to the sampling

4 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors.

5 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP, Quality Assurance Project Plan [QAPP]). Additionally, field personnel will be under the direct supervision of qualified professionals who are experienced in performing the tasks required for sample handling, packaging, and shipping.

6 Equipment and Materials

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Approved documents including SSP, Field Sampling Plan, and QAPP
- Ballpoint black ink pens
- Personal protective equipment as required by the SSP
- Inert packing material (e.g., cardboard and bubble wrap)
- Pre-preserved sample containers as specified in the QAPP
- Sample labels
- Insulated coolers
- Custody seals
- Shipping tape
- Re-sealable, zippered, clear-plastic bags
- Temperature blanks (if not provided by the laboratory)
- Wet ice
- Overnight courier airbills or shipping forms
- Clear-plastic sealing tape
- Stretch tape for sealing undisturbed core samples

7 Procedures

Observance of proper holding times and conditions during sample storage and shipment prior to laboratory analysis is critical to obtaining quality data from a sampling effort. Immediately after collection, samples should be stored in refrigerators (if available) or ice-filled, insulated coolers with sufficient ice to maintain an ambient temperature of approximately 4°C until received by the

analytical laboratory. Specific sample holding times and conditions for specific matrices and analyses are listed in the QAPP.

Individual sample containers (or groups of sample containers) should be stored in the coolers and packed in re-sealable, zippered, clear-plastic bags to prevent labels from smearing and falling off. Ice should be placed on top of samples inside the coolers.

For PFAS samples and water samples, wet ice will be double-bagged in low-density polyethylene (LDPE) resealable storage bags (i.e., plastic bags) that will not contact the sample media. Sample Shipping

All samples should be shipped or hand-delivered to the analytical laboratory as soon as possible after completion of sampling to minimize the number of people handling samples and protect sample quality and security. PFAS sediment and water samples should be shipped as soon as possible (e.g., overnight) to ensure the samples arrive within the analytical holding time specified by the laboratory. The following guidelines apply to sediment samples that will be shipped by courier to the laboratory:

1. Shipping containers should be in good shape and capable of withstanding rough treatment during shipping.
2. Samples should be packed tightly with dividers (e.g., bubble wrap and cardboard) separating all glass containers and empty space within shipping containers filled so the jars are held securely.
3. Sample coolers should be packed with ice to maintain an ambient sample temperature of approximately 4°C until delivery to the analytical laboratory. Wet ice (no synthetic ice) can be used, and should be packed in a manner that will preclude leaking inside the sample cooler. A temperature blank (supplied by the laboratory) can be placed in the sample cooler along with analytical samples.
4. All coolers must be leak-proof or lined with a leak-proof plastic liner. Leaking coolers will not be delivered by some couriers.
5. A chain-of-custody (COC) form for each shipping container should be filled out completely (see SOP 06 – Sample Custody).
6. The original COC form and analysis request should be protected from damage by sealing in a re-sealable, zippered, clear-plastic bag, and taped to the underside of the cover inside the shipping container.
7. A custody seal should be attached to the outside of the shipping container lid so that the shipping container cannot be opened without breaking the seal.
8. Shipping containers carrying glass sample containers should have a “this side up” label to ensure that jars are transported in an upright position, and a “fragile – glass” label should be attached to the top of the container to minimize agitation of the samples.

9. Shipping containers should be sent by a carrier that will provide a delivery receipt (such as FedEx) to confirm that the contract laboratory received the samples and to serve as a backup to the COC form.

Undisturbed cores to be analyzed for phosphorus will be hand-delivered to the project laboratory as soon as possible after completion of sampling. Hand-delivery will minimize the number of people handling samples and protect sample quality and security. The following guidelines apply to undisturbed sediment cores that will be transported to the testing laboratory:

1. Once the undisturbed core has been collected, it will be stored upright and secured to minimize disturbance of the sediment.
2. The undisturbed core will be sealed with caps on the ends of the collection tube. To allow for phosphorus analysis, 12 to 15 inches of headspace in the tube is required.
3. The ends of the collection tube will be capped and further secured in place using stretch tape (various types available).
4. The collection tube will be labeled with the station ID, sample date, and sample time, and marked to indicate the "top" of the undisturbed core.
5. During storage, transfer, and transport, the sample will remain upright and be secured so that the chance for unnecessary movement and disturbance of the core is minimized.

8 Quality Assurance/Quality Control

It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP.

9 References

MDEQ (Michigan Department of Environmental Quality), 2018. *General PFAS Sampling Guidance*. Revised October 16, 2018.

Standard Operating Procedure
SOP 08 – Equipment Cleaning/Decontamination

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) describes the decontamination of sampling equipment, instruments, and other materials used during implementation of field tasks for the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation. Decontamination is the process of neutralizing, washing, and rinsing field sampling equipment to clean field equipment and minimize the potential for sample cross-contamination.

Procedures for equipment decontamination outlined in this SOP are expected to be followed. Deviations from the procedures detailed in this SOP will be described on the Daily Log and on a Field Deviation Form (see SOP 01 – Field Records).

3 Health and Safety Warnings

Health and safety issues for work associated with this SOP, including physical and chemical hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors.

4 Contamination and Interferences

The probability of false positives is relatively high during PFAS sample collection due to the potential for many sources of cross-contamination, combined with low laboratory detection limits. PFAS are used in a wide variety of products; therefore, to prevent cross-contamination, field personnel should be familiar with and follow the Michigan Department of Environmental Quality (MDEQ) General PFAS Sampling Guidance (MDEQ 2018). In addition to following proper decontamination procedures (SOP 08 – Equipment Cleaning/Decontamination), the following measures should be utilized by sampling personnel before and during sample collection:

- Sampling equipment must be free of Teflon and Teflon-containing substances
- Wash hands prior to sampling
- Avoid sunscreen or insect repellants or only use allowable brands
- No fast food containers
- No Styrofoam cups
- Samples and any sampling equipment should not contact carpeted surfaces
- No new clothing should be worn, and clothing should have been washed at least six times prior to use without fabric softeners or fabric protectors
- Tyvek, Gore-Tex, and other water-repellent clothing should not be worn
- No PFAS-treated adhesive tape or paper products
- No PFAS-treated paper towel
- No pipe thread seal tape

- Avoid contact with water-repellent substances on boats or in vehicles
- Post-it notes (or similar) should not be used in relation to the sampling

5 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]) and the MDEQ General PFAS Sampling Guidance (MDEQ 2018). Specialized training is not required for decontamination of equipment; however, field staff will be supervised by experienced staff.

6 Equipment and Supplies

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Personal protective equipment, as required by the SSP
- Scrub brushes
- Plastic wash and rinse buckets or tubs
- Phosphate-free biodegradable detergent (e.g., Liquinox or Alconox)
- Deionized (DI) water (or distilled water)
- PFAS-free water
- Spray bottles
- Tapwater source (any treated municipal water supply)
- Investigation-derived waste (IDW) storage containers (refer to SOP 09 – Investigation-Derived Waste Handling and Disposal)

7 Procedures for Decontamination of Equipment

Sample containers, instruments, working surfaces, personal protective gear, and other items that may come into contact with sample media must meet high standards of cleanliness. All equipment and instruments that are in direct contact with the sample medium will be decontaminated prior to use in the field.

The following steps will be used to decontaminate supporting equipment such as boats, lines, and ropes that are not in direct contact with samples or sediment:

1. Equipment will be rinsed with ambient water onboard the boat.
2. Rinse water will not be contained.
3. Incidentally spilled sediment on the decks will be washed overboard if possible, otherwise spilled sediment will be contained and disposed of as IDW.

4. Ongoing decontamination of the boat decks will continue throughout the day to keep the decks clean.

The following steps will be used to decontaminate sediment sampling equipment that will be lowered through the water column, such as vibracore sampler, piston sampler, direct-push sampler and surface grab samplers:

1. Equipment will be pre-rinsed prior to use with ambient water onboard the boat. Ambient site water will be sourced from the specific sample location and will not be retained from location to location.
2. Visually inspect equipment. If residual sample media is observed, equipment will be rinsed and scrubbed off (use PVC brush). If needed, a solution of ambient water and detergent (Liquinox) may be used.
3. Repeat Step 2 as needed until residual sample media is removed from equipment.
4. Final rinse with ambient water onboard the boat.
5. The use of ambient site water or decontamination solution will be minimized to the extent practicable and will not be contained.

The following steps will be used to decontaminate in-water vessels to prevent the spread of invasive species consistent with Wisconsin general boating law (DNR 2002):

1. Drain water from live wells, bilges, and other containers before leaving launch area.
2. Remove plant parts and animals from vessel, trailer, and accessory equipment. Dispose of material in garbage.
3. Wash boat and trailer thoroughly with tap water. High temperature and pressure water are preferred. Wash can be performed at the boat ramp on site.

The following decontamination steps will be used to decontaminate sample processing equipment that comes into contact with sample media and is intended for reuse. To the extent practical, disposable equipment will be used to avoid the need for decontamination. These procedures do **not** apply for samples being analyzed for PFAS. The decontamination procedure is as follows:

1. Residual sample media on equipment will be rinsed, scrubbed off, and collected according to the procedures outlined in SOP 09 – Investigation-Derived Waste Handling and Disposal.
2. Pre-wash rinse with tap water.
3. Wash with solution of tap water and detergent (use scrub brush).
4. Rinse with tap water.
5. Rinse with DI water.
6. Use immediately or cover all decontaminated items with aluminum foil or plastic.

The following decontamination steps will be used to decontaminate sample equipment that comes into contact with sample media that will be analyzed for PFAS and is intended for reuse. To the extent practical, disposable equipment will be used. The decontamination procedure is as follows:

1. Pre-wash rinse with PFAS-free water.
2. Wash with a solution of PFAS-free water and detergent (use PVC brush). Liquinox, Alconox, and Citranox can be used.
3. Rinse with PFAS-free water and visually inspect equipment for residual media. Repeat Steps 2 and 3 as needed until clean.
4. Final rinse with PFAS-free water.
5. Use immediately.

Decontamination fluids generated during sample processing will be collected and placed in labeled, designated containers suitable for disposal in accordance with IDW procedures outlined in SOP 09 – Investigation-Derived Waste Handling and Disposal.

Sensitive field instruments, such as water quality meters, will be rinsed daily during field operations at the end of each workday, or as needed, with DI water at a minimum, or more rigorously according to the manufacturer's instruction.

8 Quality Assurance/Quality Control

It is the responsibility of the Field Lead to periodically check to ensure that the procedures are in conformance with those stated in this SOP. As described in the QAPP, equipment blanks will be collected periodically to validate the effectiveness of decontamination procedures.

9 References

DNR (Wisconsin Department of Natural Resources), 2002. *Hazardous hitchhikers. Battling aquatic invasive species.* August 2002.

MDEQ (Michigan Department of Environmental Quality), 2018. *General PFAS Sampling Guidance*. Revised October 16, 2018.

Standard Operating Procedure
SOP 09 – Investigation-Derived Waste Handling and Disposal

1 Standard Operating Procedure Acknowledgement Form

Project No. 191779-01.01 Project Name: SMC and MKE AOC PFAS Sampling

My signature below certifies that I have read and understand the procedures specified in this Standard Operating Procedure.

Date	Name (print)	Signature	Company

2 Scope and Application

This Standard Operating Procedure (SOP) describes the instructions for proper handling and disposal of investigation-derived waste (IDW; i.e., sediment, water, personal protective equipment [PPE], and other potentially contaminated materials) generated during field work for the South Menomonee Canal and Milwaukee Area of Concern perfluoroalkyl and polyfluoroalkyl substances (PFAS) sampling investigation.

Procedures for IDW handling and disposal outlined in this SOP are expected to be followed. Deviations from the procedures detailed in the SOP will be described on the Daily Log and on a Field Deviation Form (see SOP 01 – Field Records).

3 Health and Safety Warnings

Health and safety issues for the work associated with this SOP, including physical, chemical, and biological hazards, are addressed in the Site Safety Plan (SSP). The SSP will be followed during all activities conducted by all field personnel, including subcontractors.

4 Personnel Qualifications

Field personnel executing these procedures will have read, be familiar with, and comply with the requirements of this SOP, the Field Sampling Plan, and the corresponding documents (i.e., SSP and Quality Assurance Project Plan [QAPP]). Additionally, field personnel will be under the direct supervision of qualified professionals who are experienced in performing the tasks required for sample collection and processing.

5 Equipment and Materials

The following is a list of equipment that may be necessary to carry out the procedures contained in this SOP. Additional equipment may be required, pending field conditions.

- Approved documents including SSP, Field Sampling Plan, and QAPP
- PPE as required by the SSP
- U.S. Department of Transportation (USDOT)-approved, 55-gallon, open-topped drums or Baker tank with lid for collection of solids
- USDOT-approved, 55-gallon, closed-top drums for collection of liquids
- 30-gallon garbage bags
- 5- to 10-gallon buckets or carboys to be used as satellite waste-collection containers
- Chemical drums
- Pallets
- Drum pad

- Drum cart
- Bung tool to open closed-top drums
- Drum wrenches to tighten open-top drum lids
- Acid and solvent spill kits
- Labels and tags
- Duct tape
- IDW Drum Log forms (see Attachment 1)
- Drum marking crayons
- Waste manifest forms

6 Waste Disposal Procedures

Materials that are known or suspected to be contaminated with hazardous substances through the actions of sample collection or personnel and equipment decontamination are said to be IDW. These wastes are classified into the following two categories:

1. Solid materials consisting of sediments, used core tubes, used PPE, and other materials used in the handling, processing, and storage of sediment
2. Liquid wastes, such as waste decontamination water

Each type of material will be handled in a manner described in this SOP.

7 Solid Waste

Solid residual wastes generated during field activities will consist of two types of materials: sediment and non-sediment solids. Sediment wastes will include leftover sediment from core and grab samples not used for sample analyses. Sediment residuals will be placed in 55-gallon drums, labeled, and stored temporarily pending characterization and transfer to an approved disposal facility.

Non-sediment wastes include disposable items such as used core tubes and caps, aluminum foil, and PPE (e.g., gloves and plastic sheeting). Non-sediment and sediment wastes will be segregated and stored in separate containers pending disposal. Non-sediment solids will be decontaminated (SOP 08 – Equipment Cleaning/Decontamination) to the extent practical, with loose visible sediment being removed from non-sediment waste items prior to disposal. Non-sediment solid material will be placed in 30-gallon plastic bags and temporarily stored until disposed of with municipal solid waste. Grossly contaminated non-sediment solid material that cannot be effectively decontaminated will be placed into 55-gallon drums, labeled, and stored temporarily pending characterization and transfer to an approved disposal facility.

8 Liquid Waste

Liquid waste will be generated during sediment processing and decontamination activities. Liquid waste is expected to consist predominately of decontamination fluids. This will include rinse water and decontamination solutions of water and detergent. Liquid waste will be collected in 55-gallon, closed-top drums, labeled, and stored temporarily pending characterization and transfer to an approved disposal facility. Excess water from sediment sampling and decontamination liquids generated onboard sampling vessels will not be contained (SOP 8 – Equipment Cleaning/Decontamination).

9 Drum Handling

Placement of sediment/soil or liquid waste into sequentially numbered disposal drums will be documented on IDW Drum Logs (see example in Attachment 1) listing the sample ID from which waste material originated. Information recorded on the IDW Drum Logs will include the following:

- Sequential drum number
- Type of waste stored in drum (e.g., wet sediment or water)
- Accumulation start and end dates
- Waste manifest number and date
- Transport contractor name and date of pickup
- Laboratory ID number associated with drum characterization testing

10 Waste Manifest Forms

Waste manifest forms will be completed for pick-up of IDW designated for off-site disposal. The following information should be recorded on the manifests:

- Generator ID number
- Generator's name and mailing address
- Generator's phone
- Generator's site address
- Waste tracking number
- Designated disposal facility name and address
- Transporter's name and U.S. Environmental Protection Agency ID number
- Waste shipping name and description:
  - Description of waste
  - Number and type of containers and total quantity of waste
- Generator's/offeror's printed name and signature
- Transporter's printed name and signature
- Disposal facility owner's or operator's printed name and signature

Following delivery of drums to the waste disposal facility, a copy of the fully executed waste manifest will be delivered to the waste generator and retained in the project file.

11 Quality Assurance/Quality Control

It is the responsibility of the Field Lead to periodically check and ensure that IDW handling and disposal procedures are in conformance with those stated in this SOP.

12 List of Attachments

Attachment 1 – Investigation-Derived Waste Drum Log

Attachment

ANCHOR QEA

Drum Number:	Investigation-Derived Waste Medium:
Accumulation Start Date:	Manifest Number:
Accumulation End Date:	Manifest Date:
Transport Contractor:	Lab ID Number:
Transport Pick-up Date:	Haz Characterization Date:
Manifest Copy Received from Waste Facility: _____	Date:

Samples Placed in Drum	Date of Placement	Comment	Initials

Investigation-Derived Waste Medium:

Wet Sediment

Liquid Waste

Soiled Personal Protective Equipment

Appendix B
Quality Assurance Project Plan

Appendix C
Site Safety Plan